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Autonomous Driving: Are we ready to accept it?
A study about Information influences on technology acceptance

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Resumo

Nesta era de tecnologia em que nos encontramos os transportes são alvo de rápidos desenvolvimentos e corridas à inovação pelas marcas, com o foco de se tornarem pioneiros no lançamento de um carro autónomo. As datas previstas para lançamento ao público estão próximas, ainda que hoje apenas existam ainda protótipos em teste com nível de automação 4. Sendo este um tema recente, pouca informação existe tanto para os consumidores ou empresas, assim este estudo propõe-se a identificar a informação e tecnologia atuais que podem influenciar a opinião sobre estes carros. Foi selecionado o modelo *Innovation Adoption in Robotics* (IAR) como referencial teórico, uma vez que este estuda a intenção de adoção de veículos autónomos, para determinação das variáveis. Optou-se pela construção de um questionário, de forma a permitir recolher opiniões e medir quantitativamente outras variáveis relacionadas com a aceitação do carro. Este modelo é baseado no *Technology Acceptance Model* (TAM) desenvolvido por Davis (1989) e no *Diffusion of Innovations Model* (DIM) desenvolvido por Rogers' (1983).

Afere-se através do estudo que o tema é conhecido, embora de acordo com os inquiridos a informação sobre este é pouca, sendo evocado por estes a necessidade de obter maior progresso na tecnologia, de experimentar e de obter mais informação. Apenas mitigando as faltas referidas anteriormente, as incertezas quanto à fiabilidade do sistema e as vantagens que poderiam ser melhor esclarecidas.

Ausência de informação disponível atualmente sobre este tipo de tecnologia e as incertezas em relação ao preço, preparação dos países e da própria população, em conjunto com a impossibilidade de experienciar, o carro tornam a sua aceitação dificultada.

Palavras-Chave: Condução Autónoma, Automação, Aceitação dos Utilizadores

Abstract

In this era of technology we live in, transportation is the subject of rapid developments with brands racing, with a focus on becoming the pioneer in launching a stand-alone car. The planned dates for public release are close, however today there are only prototypes in test with level of automation 4. Being a recent subject, little information exists for both consumers or companies, so the study proposes to identify the information and technology that can influence opinion on these cars. The Innovation Adoption in Robotics (IAR) model was selected as the study's theorical reference to study the intention of adopting autonomous vehicles, to determine the variables and construct a questionnaire to collect opinions and quantify other variables related to car acceptance. This model is based on the Technology Acceptance Model (TAM), developed by Davis (1989) and the Diffusion of Innovations Model (DIM) developed by Rogers' (1983).

It is noted through the study that the subject is known the inquirers, although information about it is scarce, being evoked by them the need to obtain further progress in technology, to experiment and to obtain more information. Only by mitigating the abovementioned faults, uncertainties as to the reliability of the system and the advantages could be better clarified.

Absence of information currently available about this technology and uncertainties regarding price, preparation of countries' preparation and of the population itself, together with the impossibility of experiencing the car make these technology's acceptance difficult.

Keyword: Autonomous Driving, Automation, User Acceptance

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Glossary

Automation	Process in with human's actions and thinking are replaced by a system
Autonomous Vehicle and Autonomous Car	Used throughout the document as synonyms referring to Cars used on daily basis, which have the maximum automation level.
Vehicle Automation Levels	Autonomous Cars are classified into a scale of 4 levels, starting on 0 to 4, being 0 as no automation and 4 fully autonomous and no driver required (Kun, Boll, & Schmidt, 2016)

List of Abbreviations and Acronyms

AB	Absolute Frequency
ABS	Anti-lock Braking System
ACC	Adaptive Cruise Control
AICC	Autonomous Intelligent Cruise Control
AV	Autonomous Vehicle
DAS	Driver Assistance Systems
HCI	Human Computer Interaction
HF	Human factors
HTI	Human-Technology Interaction
ICC	Intelligent Cruise Control
LPG	Liquefied petroleum gas
M	Mean
NHTSA	The National Highway Traffic Safety Administration
OEM	Original Equipment Manufacturer
PCC	Pearson correlation coefficient
PSF	Performance-Shaping Factors
R	Relative Frequency
SD	Standard deviation
SUV	Sport Utility Vehicle
UCD	User- Centered Design
UI	User Interface

Chapter 1 - Introduction

1.1 Contextualization and relevance of the theme

The automotive industry has been evolving in three aspects, which will impact the future of society and industry, these are automation, safety and energy transformation. The automation concerning vehicles, has mainly born from the need to increase safety and driving experience, allied to the environmental concern that has been growing (Kun, Boll, & Schmidt, 2016; N. Sousa, Almeida, Coutinho-Rodrigues, & Natividade-Jesus, 2017). Thus, bearing in mind, this latest evolution in the automotive market, automation, is the focus of this study.

Automation aims to make automatic certain functions performed by humans, such as keeping speed at a certain level, Cruise Control[1] or Anti-lock Braking System (ABS). These systems arose for economic, comfort and safety reasons and in order to assist in the experience of Driving (Weisser, Schulenberg, Göllinger, & Schmidt, 2000).

With the progress of automation, Autonomous Cars arose, these are considered as having a high level of automation, not requiring human intervention (Kun et al., 2016).

Thus, Autonomous Cars are considered one of the greatest transformations in the automotive sector after the invention of the wheel and, also considered by many a disruptive innovation [2] or a revolution even, in the sense that it can bring great changes in the everyday life of society in the way it deals with transport (Anselmetti, 2016; Bay & Nysveen, 2016) and bring social, economic, environmental impacts and infrastructure and city planning and other transport-related sectors such as insurers, automobile companies, public transport, car rentals, travel sharing, and others. However, according to (N. Sousa, Almeida, Coutinho-Rodrigues, & Natividade-Jesus, 2017) these social transformations will be achieved gradually.

Autonomous vehicles may be cars, lorries, buses, boats, trains, airplanes, drones and with distinct functions, whether for regular use, agricultural, military, patient transport, ... However, the present study covers only the autonomous cars for regular use.

In 2015, Sullivan predicts that within 20 years we will present 80% acceptance of this type of transport, and Vitoria Transport Policy Institute foresees that between 2020 and 2030 autonomous driving cars will be available for sales at a high prices, providing independent mobility to non-drivers (Litman, 2017).

[1] Cruise Control
[2] An innovation that is distinct from everything in the market.

However, nowadays cars have Driver Assistance Systems (DAS), being an attempt to add value to the consumer (N. Sousa et al., 2017).

The scale of automation has change over the last years, according to The National Highway Traffic Safety Administration (NHTSA) in 2013 vehicles are categorized in 5 levels, from 0 to 4, see Table 1. The SAE International in 2016 defined a 6-level scale, from 0 to 5, which the 4th level of NHTSA has decomposed in High Automation and Full Automation, see Figure 1 and Table 2 (SAE Internacional, 2018).

Table 1 – Former Automation Levels. Font: NHTSA

Level	***Description***	***Example automation technologies***	***Typical or expected secondary tasks***
0	Car has no automation	None	Listening to the radio, conversation, limited control of in-car entertainment (adjusting volume, switching radio channel)
1	Driver can disengage from either pedals or steering wheel	(Adaptive) Cruise Control	Legally the same for levels 0. Practically, people might engage in secondary tasks such as use of mobile devices.
2	Driver can disengage both from pedals and steering wheel	Automated parking	Legally the same for levels 0 and 1. Practically, people might engage in secondary tasks more like those allowed under level 3.
3	Car takes over fully for periods of time, notifies the driver to reengage when needed.	Highway driving automation	Time-limited reading or watching movies, with minimal attention left for reengaging
4	Car is fully automated, and no driving is required	Google X self-driving car without pedal or steering wheel	Reading, sleeping

According to Bay and Nysveen and SAE International, cars with Driver Assistance Systems (DAS) are already classified as autonomous vehicles even though in low levels that require human intervention, from level 0 to 2. In the 3rd level of automation some human intervention is still required, in case of system request, however the car can monitor traffic and drive. When in the 4th level, the existence of pedals and steering is not necessary, once these are autonomous under some conditions, and having pedals, human driving is optional. The fully automated cars, 5th level which is the maximum level, do not have human intervention and are able to operate in any conditions. The Original Equipment Manufacturer (OEM) are trying to reach this level in a competition to be pioneers an innovators in this new concept of car (Bay & Nysveen, 2016; N. Sousa et al., 2017).

On the other hand, most automotive brands today hold specific lines for vehicle automation, with two divergent strategies:

- Incremental logic-Cars feature automatic part complemented by an optional manual part, such as the Tesla.
- Disruptive logic-cars only hold the automatic part, such as Google's Waymo (Litman, 2017).

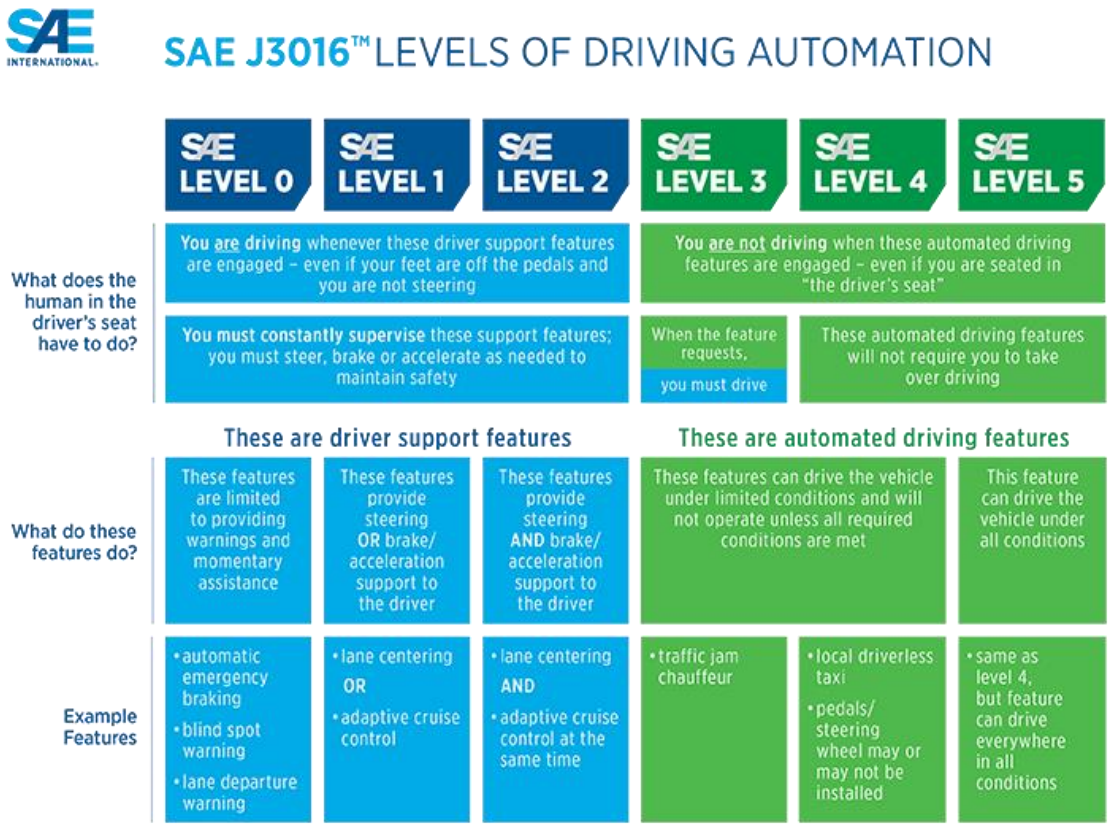

Figure 1- Levels of Automation. Font: SAE

The following table represents a summary of the image above.

Table 2 -Actual Automation Levels. Font: (SAE Internacional, 2018) *and* (Synopsys, 2019)

		Human monitors the driving environment	
0	No Automation	All driving tasks are performed by the human	
1	Driver Assistance	Car has a single automated driving mode, for example cruise control, but needs the human to perform all other tasks	Fiat 500
2	Partial Automation	Vehicle has one or more drive modes of both steering and acceleration/deceleration. The human driver is still necessary to monitor, and it can engage driving in any time.	Tesla Cadillac
		System monitors the driving environment	
3	Conditional Automation	Most of the tasks are engaged by the car under certain conditions., in which human driver is necessary if a request occurs	Audi A8L
4	High Automation	All the driving tasks are performed automatically, human intervention is optional	Waymo
5	Full Automation	All the driving tasks are performed automatically and there is no need for human intervention	

1.2 Questions and objectives of investigation

Despite the great transformations to the transport system that can occur with the implementation of the Autonomous Cars, few studies exist about them, namely about their maximum level, that is, studies about autonomous cars without human intervention in driving.

So, the brands are going through the challenge of trying to define the correct expectations of what autonomous cars are, so that they can be accepted and adopted by potential consumers (Lin 2016). This requires that brands have the capacity to overcome the new psychological challenges of potential customers, as well as the technological challenges (Anselmetti 2016). Since technology is only at its maximum potential when adjusted to the needs of consumers, this innovation must also be implemented considering social, technological, legal, ethical, social and data protection issues. To that end, it requires a multidisciplinary and cooperative intervention between industries and users (Lin 2016).

Some questions may arise due to the adoption of Autonomous Cars, such as:

Is the forecast real? Is society prepared to this change? Can we trust machines with our lives and let them make such decisions? Is the cost-benefit positive? Do consumers know the concept and accept it? Which psychological factors may influence the adoption of Autonomous Cars? Which technological components may affect the adoption of Autonomous cars? Potential consumers, are most prone to adopt and accept cars built with an incremental strategy or disruptive strategy? Do consumers see cars as secure and trustful? Which is the perception that consumers may have on Autonomous Cars? When acquiring an Autonomous Car, which are the key factors that may influence the decision? In an accident, evolving two autonomous cars, whose fault is it?

All of these questions need further investigation, since brands may not be aware of the consumer's opinions, perceptions that may be key to define and develop the new car models with a design focused in experiences during the trip (Bay & Nysveen, 2016).

There are not many answers to these questions, it is necessary to explore and comprehend the technology knowability, the user profiles and the perception concerning the Autonomous Cars.

Table 3 - Main question, research function and objectives.

Main Question	***Research Function***
How the information and technologies currently available influence opinion about AVs?	Understand which information's and technologies affect most and least the consumer's acceptance of Autonomous Cars.
Objectives	
1. Compare the ease and skills associated with the use of driving assistance systems with the AV driving system. 2. Gauge if the subject is unknown in the sample 3. Gauge the feeling associated with the idea of using an AV 4. Check the situations that may change the daily life and the benefit or not in using the AV.	

5. Compare whether the prices currently advertised by brands match the expectations of potential consumers.
6. Assess the level of risk associated with AV driving systems.
7. Determine which features are most and least relevant / appreciated by the sample (and verify if AVs can meet these).
8. Identify the opinion on current car driving (and compare it with the level of safety associated with the AV)

To accomplish the objectives in the proposed time the sample used in study is the students and teaching staff of ISCTE, since it covers young people who have just taken the driving license and adults who use cars for several years. However, they already have some education and formation, being absent from the sample people with less than secondary education. This theme is a global concern, having many companies from automobile to Artificial Intelligence technologies interested in this type of investigation and technologies. In addition, for the public is a way to obtain context and understand some parameters of autonomous driving.

1.3 Methodological approach

To initiate the proposed study an exploration concerning the Autonomous Driving has been done to better define questions and objectives. Secondly, a research on methodologies has accomplished to help assess the variables that may affect technology acceptance and adoption.

The chapter describes the methodological choices taken to execute the research, in sum the research consists on these phases:

1. General research on the topic and questions of the investigation;
2. Methodology research;
3. Literature review concerning autonomous cars and gathering secondary data, to respond the variables on methodology and profiles;
4. Definition of the inquiry and sample;
5. Definition of the Methodology to analyze data (Qualitative and Quantitative);
6. Delineation and gathering qualitative and quantitative data (Data combined techniques);
7. Analyze quantitative data with SPSS and qualitative data with QDA Miner;
8. Conclusions and future research.

After a brief research on the topic, the methodology research begins, having selected three as likely to implement, this are described in the following topics.

1.3.1 Technology Acceptance Model (TAM)

Technology Acceptance Model is one of the chosen methodological models, being the most used methodology for studying the acceptance of information systems in diverse types of technologies, in different situations, factors and samples. This methodology is based on personal variable, being measured by perceived ease of use and perceived usefulness. However according to an evaluation accomplished by Lee, Kozar and Larsen, since its creation this methodology has been:

- Evaluating acceptance behaviors with success;
- Considered a consistent, reliable and valid methodology;
- Evolved to circumvent the limitations, being added:
    - External variable of Perceived Ease of Use (PEOF) such as computer anxiety, efficiency, perception of external control, … and for the Perceived Usefulness (PU) like social influence and cognitive instruments.
    - Variables related to behavior such as system quality, training, compatibility, this are usually measured by frequency or time of use and actual number of usages, and diversity of usage (Lee et al., 2003).

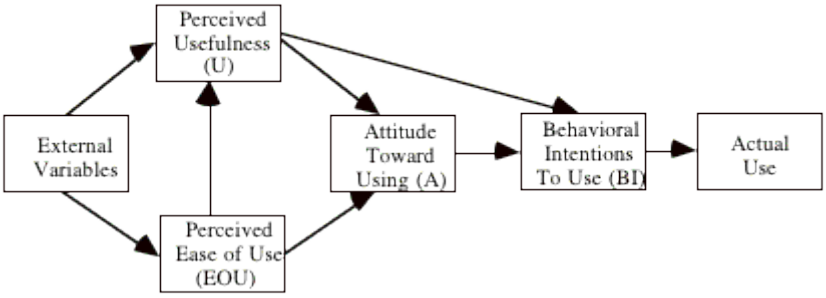

Figure 2 - Technology Acceptance Model, Davis et all, 1989 (Legris, Ingham, & Collerette, 2003)

1.3.2 Diffusion of Innovations Theory (DIT)

This theory bases on the statement that communication is the "process in which participants create and share information with one another to reach a mutual understanding" and assumes that sharing information in society can influence opinion and decision (Rogers, 1995).

Having these in mind, the DIT describes the decision process having 5 steps:

1º Knowledge: the existing information is few about the innovation and these are not curious about it;
2º Persuasion: search for information related to the innovation;
3º Decision: assess the benefits and drawbacks, to reach a decision, being the most difficult stage to acquire empirical knowledge.
   a. Reject;
   b. Accept;
4º Implementation: uses the innovation searching for added information and determines if it is worth it;
5º Confirmation: reach to a conclusion and decide about the innovation usage continuity.

However the decision can the either voluntary (Optional Decision), collective (Collective Decision) and obligatory (Authority Decision) (Rogers, 2003).

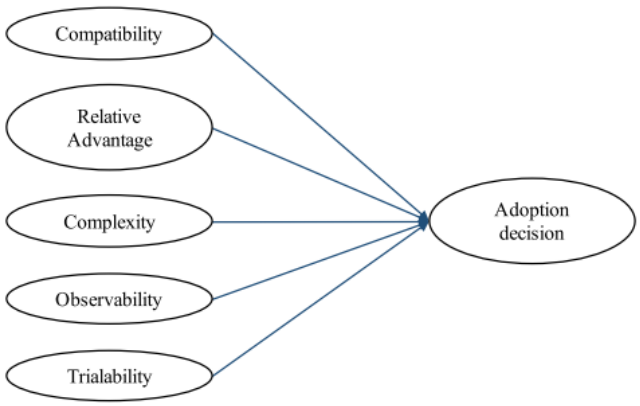

Figure 3 - Diffusion of Innovation Theory

1.3.3 Innovation Adoption in Robotics (IAR)

The model explained in this chapter studies consumer intention to adopt Autonomous Vehicles and is based on two previous models, the Technology Acceptance Model (TAM) Davis (1989) and the Diffusion of Innovations Model (DIM) Rogers' (1983).

Innovation Adoption in Robotics (IAR) is the chosen methodology to the study presented. This method studies the key personal characteristics considered relevant when using autonomous cars, contemplating new dimensions related to personal characteristics, such as the symbolic value and the sensations attributed to the technology, having a wider range of variables when compared to TAM or DIT (Bay & Nysveen, 2016). The IAR evolved from the previous models by:

- Deconstructing risk variable in subcategories such as reliability, data privacy, security attacks, malfunction and security or physical risks ...
- Deconstructing personal values variable;
- Designing the model focusing on behaviors, such as work, fun, sleeping ...
- Having various models of acquisition, such as car sharing, ridesharing, or acquisition.

So, the model contemplates new dimensions related to personal characteristics, such as the symbolic value and the sensations attributed to the technology, having a wider range of variables. In addition, the model focuses on the consumer adoption of Autonomous vehicles, having the same objective and theme of the present study. For that reason, the IAR is the chosen model (Bay & Nysveen, 2016).

Therefore, to reach the objectives proposed in the study (see 1.2) IAR is used and to accomplish the objectives proposed these tasks are needed:

- Research concerning consumers profiles for adopting technology;
- Selection of the model to help assess the factors that may undermine adoption;
- Literature review to evaluate the factors concerning the variables on the model chosen.

To obtain secondary data such as technological profiles, competencies, skills, and variables considered on adoption of technology a literature review has conducted having as basis the variables in IAR model. This search aim is to identify in each variable of the model the factors that may affect the use or adoption of AVs and verify the existence of differences in these factors regarding the user's profiles.

In some aspects there is absence of information concerning the AV's, one aspect which the answer is incomplete is the factors that affect the use and acceptance of the autonomous cars. In this scenario where literature regarding AV is insufficient, similar technologies where considered in the study, such as electric cars, DAS and even characteristics considered important in regular internal combustion cars with human as drivers. In these situations, it may be evaluated if the factors observed in similar vehicles also affects the AV acceptance.

The variables in IAR model help to execute the study by giving the metrics to evaluate factors that influence or undermine technology acceptance and in addition the perceptions of the population concerning AV.

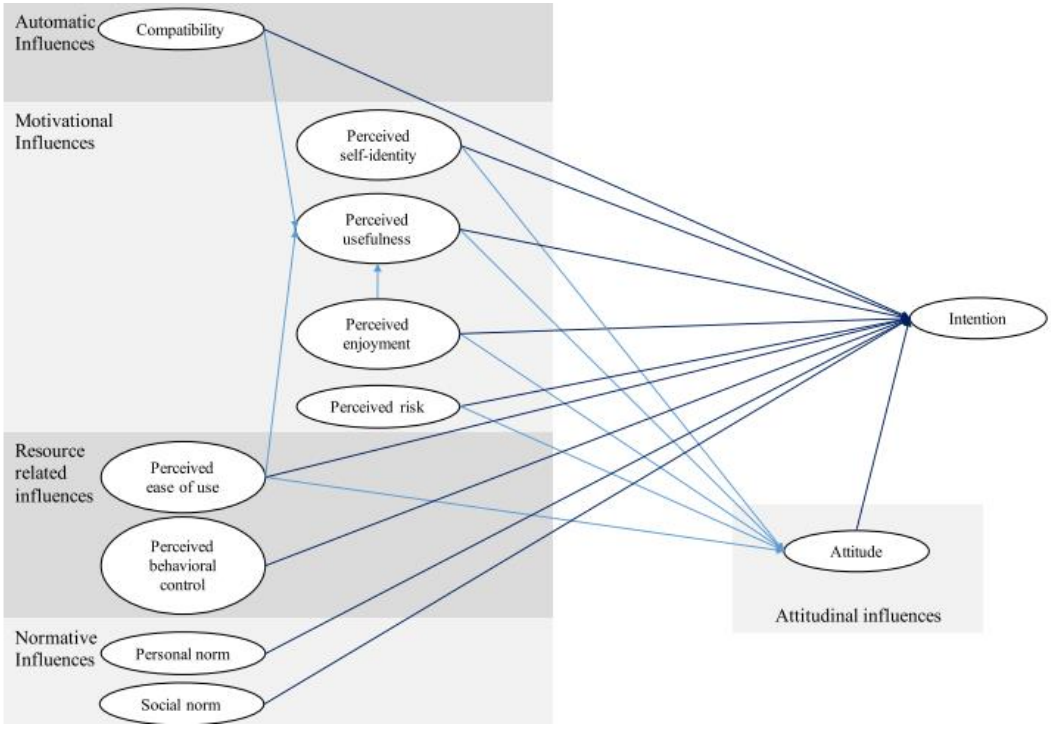

Figure 4 - Innovation Adoption in Robotics (Bay & Nysveen, 2016)

1.4 Structure and organization of the dissertation

In the first chapter, a brief explanation was given, detailing the reasons why the present research was proposed, and it is main objectives.

On the second chapter, the State of Art intends, aims to give a contextualization of the evolution about the topics addressed in the thesis. As such, it details about the key subjects related to the driverless cars, as these are the technologies used that make possible the interactions between human and car. In this chapter we also consideredall the questions concerning maintenance, safety, user profile ethical issues and others. These are described as follows:

- Autonomous Vehicles
  - Description
  - Characteristics
  - How it works
  - Impacts & Changes
  - Automation History
  - Autonomous Vehicles Today
  - Challenges & Problems
- Technology Adoption
  - Purchase Reasons

- Technology as Influencer in Adoption
- Societal Influences in Adoption
- Individual Personality and Competencies as Influencers in Adoption

Posteriorly, the third chapter will detail the methodology model used to achieve the aims of the research, and that made possible to create the research tools, i.e. the questionnaire that was used to gather all the data for this study.

On the final chapter the gathering of data and the method that was applied to analyze the acquired data are explained. After analysed, the gathered data will provide us with all the information this study needs to reach its conclusions, understand its limitations and plan for futures researches themes, and ence contribute further to society's understanding of this technology..

Chapter 2 - State of Art

2.1 Autonomous Vehicles

2.1.1 Description

Autonomous, Intelligent, Driverless, Robotic or Self-Driving Cars (Litman, 2017) are vehicles that allow themselves to drive self-sufficiently on the road (Baber, Kolodko, Noël, Parent, & Vlacic, 2005), imitating a human driver by making decisions. The car systems try to replicate the human decisions process (Lin, 2016) such as:

- Avoiding obstacles;
- Keeping distance from the vehicles in front;
- Follow cars laterally;
- Stop at red signs;
- Give passage to other vehicles;
- Avoid unpredictable situations for example a child running to the road (Franke et al., 1998)
- Communicate to other vehicles or entities on proximity to coordinate and cooperate (P. Sousa & Veríssimo, 2002)
- Automated parking (e.g.: Toyota Prius).

According to SAE International scale of automation (see Figure 1, Table 2 and Figure 5) Autonomous Cars are capacitated with the last level of automation (Kun et al., 2016; SAE Internacional, 2018).

From: BMW Partly Automated Driving (PAD)

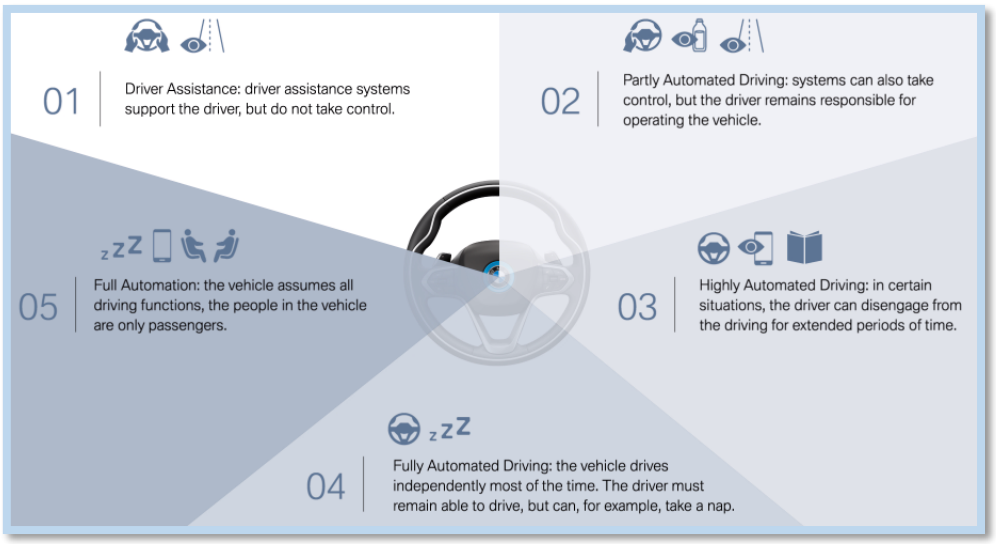

Figure 5 - Autonomous Driving Categories.

2.1.2 Characteristics

Autonomous Cars have distinctive characteristics that render obsolete the actual focus of creation or design, instead is focused on adding value to the consumer by enhancing the driving experience and safety. These two factors are the main reason to the existence of driving assistance systems (DAS) (Kun et al., 2016), affecting the first phase of the vehicle cycle of life, see Figure 6 (Mohd Jawi et al., 2013).

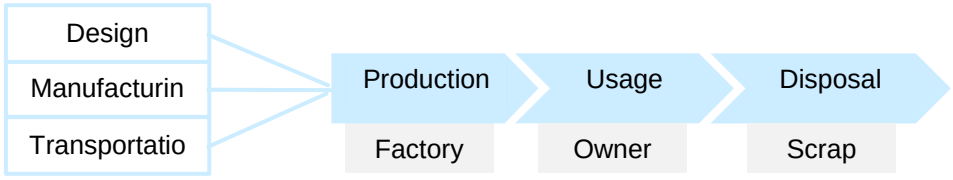

Figure 6 - Cycle of Automotive Industry

According to several authors, this new concept of cars that drive by themselves the focus needs to change to create an experience during the time of travel (Bay & Nysveen, 2016). These cars will have distinct characteristics such as:

- Electric powered vehicles (Kun et al., 2016);
- Media Center (Video, Music, Internet, Video Games, Social Networks);
- Voice recognition;
- Gestural recognition;
- Artificial Intelligence Systems, to imitate human decision process;
- Lidar radar;

Some of these features are already available in the subsequent prototypes of partially and full automated cars that we can find on test nowadays:

- Mercedes-Benz F 015 Luxury (Mercedes-Benz, 2018b);
- BMW Partly Automated Driving (PAD) (BMW, n.d., 2016);
- Tesla;
- Apple eletric car (Project Titan);
- Volvo Drive Me;
- Audi Self-Driving A7;
- Rinspeed SNAP from Rinspeed and Samsung subsidiary HARMAN International;
- Nissan ProPILOT;
- Waymo from Google;

From: Mercedes-Benz (Mercedes-Benz, 2018a, 2018b)

Figure 8 - Mercedes-Benz F015Luxury experiences, gestural and voice recognition, interiors and exterior.

From: BWM News (BMW, 2016)

Figure 7 – BMW Partly Automated Driving (PAD).

2.1.3 How it works

According to Lin (Lin, 2016) Autonomous Cars try to replicate human behavior and decision when driving, so it needs to perform tasks and make decisions. It is then crucial to better understand how this is done and deepen these topics:

a) System Major Tasks

To be able to drive autonomously on city traffic, these cars need to perform certain actions, that mimic the decisions made today by human drivers. As such, the Autonomous Vehicle system should execute the major tasks listed below:

- Assess the distance, speed and acceleration on lateral and longitudinal directions of the car ahead (leader);
- Detect lane course, regardless of the poor condition of the road;
- Detect and recognize traffic signs and lights, even at night, where the environment becomes very bright and difficult to read.
- Identify and recognize static objects, people, animals, bikes, and others, view Figure 9 . System structure to pedestrian recognition;
- Perceive and manage obstacles that reduce available space. (Franke et al., 1998).

From: *Vlacic, Parent, and Harashima 2001*

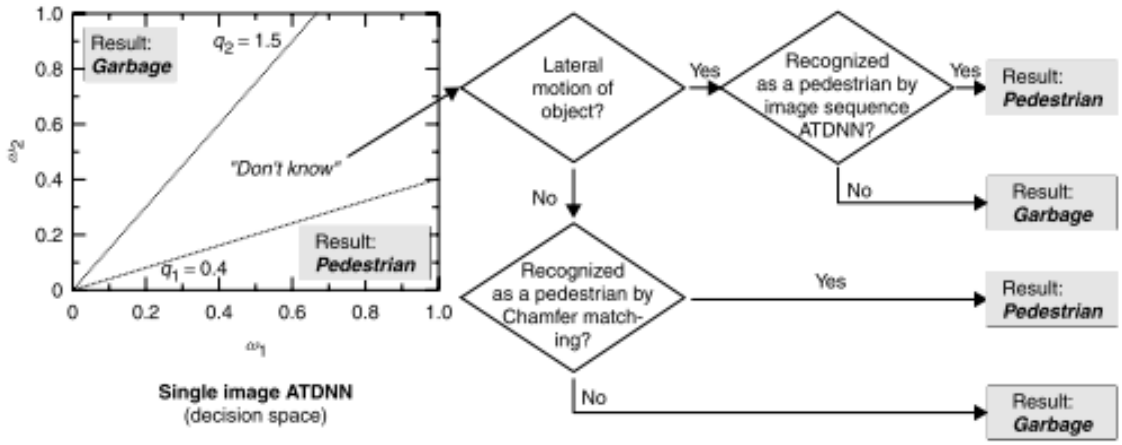

Figure 9 . System structure to pedestrian recognition

b) System Decision Models (Artificial Intelligence and Ethics)

It is a pre-requisite that autonomous vehicles must perform responsibly on roads, that requires a system able to replicate human thinking and actions. Even though, this reasoning process can be either logical or not, requiring a sense of ethics is imperative. This feat is however of the most complex nature, involving not only logic but complex reasoning, which is notoriously difficult to achieve for a system. Ethics is a requirement due to various situations that can occur that do not have a probable correct answer to the problem, being so the answer can vary according to one's beliefs and culture (see Table 4).

Table 4 - Ethics applied to Autonomous vehicles systems facing no provable correct action scenarios.

Situation	Possibilities	Hypothesis
Car is going at high velocity and encounters a scenario which it must choose between hitting an elderly or a child.	1º Swerve right: elderly 2º Swerve left: child 3º Do not swerve: both	1º Strike the elderly could be less evil since it lived and the child is innocent. 2º Aims to protect car occupants it should hit the lightest object, that would be the child.
Ethic problem	Both decisions are unethical once it discriminates by age, and in United States and Germany the equal protection of all persons is on constitution.	
Car is going at high velocity and encounters a scenario which it must choose between hitting two distinct vehicles.	1º Swerve right: vehicle 1 2º Swerve left: vehicle 2 3º Do not swerve: both	1º Aim to protect pedestrians and other drivers, it should hit the heaviest object, or if the car is able to identify models it should hit safer vehicles over not known cars. 2º Aims to protect car occupants it should hit the lightest object, that would

		be the lightest vehicle, such as a motorcycle.
Ethic problem	The second hypothesis may be better both ethically and legally by minimizing lawsuits and injuries. This choice would make parents need a Sport Utility Vehicle (SUV) to transport their children most safely. In addition, that could cause a decline in sales for brands known to be safer.	
Car is going at high velocity and encounters a scenario which it must choose between hitting a motorcyclist with helmet or one without helmet.	1º Swerve right: with helmet 2º Swerve left: no helmet 3º Do not swerve: both	1º To reduce harm the car should hit the motorcyclist with helmet. 2º Hit the irresponsible motorcyclist without helmet. (goes beyond harm)
Ethic problem	The first hypothesis would be preferable however the responsible motorcyclist that wear helmet are being discriminated against the irresponsible ones. This would encourage some motorcyclist not hearing helmet.	
Appearance of an object in front of the car. Is it an animal, person or other?	1º Give control human 2º Brake 3º Swerve 4º Brake and swerve 5º Continue	1º and 2º May not be the safest 3º and 4º Swerve to right may cause driving of road and hit and object (Portugal, United States and others). Swerve left may be on opposite lane facing a head-on collision. 5º If a squirrel, continue could be safer.
Ethic problem	Other factors should be considered to decision such as type of road, condition of car tires and brakes, occupants are belted, transporting dangerous cargo, proximity to a hospital, damage to houses, building and others. If animals, a cat or a dog should be avoided by some.	
A car encounters a scenario which it must choose between brake and hit a school bus risking lives or drive off a cliff.	1º Brake 2º Swerve 3º Off cliff 4º Continue	1º and 2º May not be the safest 3º Assuming there is no super happy or super depressive persons and there is no person more important than other, they would all be equal. The decision would be to sacrifice the car occupant rather than more persons. 4º If it as a dear instead of the bus, the decision would be to stay on road despite having an accident, because dear life is less than a human life.
Ethic problem	Driving off the cliff can be an issue due to lack of freedom of choice and transparency, once the machine would make the decision without consent or foreknowledge of the possibility. Even if the person would have chosen to drive of a cliff.	

A car is driven by a human can intentionally or not run over five pedestrians and the system detects a possible accident and takes control of the car swerving to the only direction possible and founds a pedestrian who is killed.	1º Human maintains control 2º Car assumes control	1º If the human maintains control he may not be accountable for the loss of the five pedestrians. 2º If the car assumes control and kills one pedestrian the driver may be responsible, by the Original Equipment Manufacturer (OEM).
Ethic problem	Responsibility and transparency problems.	

According to the (Bundesministerium für Bildung und Forschung, Federal Ministry of Education and Research (BMBF), & Demographic Change Division; Human-Machine-Interaction, 2016) developing future cars that include these innovations will require their developers to consider both safety and ethical matters. And when facing a no probable correct action or "no win" scenarios, some ethical issues must be considered (Lin, 2016). Some problems that may arise are:

- Discriminations by age, ethnic, religion, gender, disability, origin, sexual orientation, gender identity or expression.
- Lake of transparency;
- Inability to choose;

Besides ethical problems there are:

- Legislations limitations and differences;
- Technology errors;
- Poor maintenance;
- Inappropriate servicing;
- Security vulnerabilities, such as hacking;
- Legal and moral responsibilities;
- Third-party advertisers that influence the system.

Moreover, in a more distance future:

- How will the driverless car affect city revenue? Once fines are applied to human drivers.
- How society will manage organ transplants? Once many come from car-accidents.
- How to legalize autonomous models when older car exists and may be less safe?
- Drunk-driving;
- Liability of the manufacturers;

One suggestion may be not to confront driverless cars with ethical issues by stopping or giving back control to the human when such situations occur. However, these may not always be enough, even today on daily basis scenarios braking may be an unsafe action. In addition, the most advanced systems are unable to detect small objects, which can cause car failures or deviations from the path. The alternative is the human to assume control, still not enough on some situation, since studies suggest

that to regain awareness depending on the activity that has being done, may require up to 40 seconds, and the typical time on an accident is 1-2 seconds.

Crash-avoidance is insufficient, there are inevitable accidents on those occasions crash-optimization is needed to choose the action that may reduce the severity or do less harm. Despite that, reducing harm may not be always the choice, if the design process had in mind ethical implications by ensuring that those values are represented correctly or transparently, it could turn the system more acceptable for society.

Some other issues about transparency could occur, in “no-win” scenarios, to minimize this problem industry should set expectations with society by explaining that self-injurie could be justified by an overall good (Lin, 2016).

Currently driver-monitoring systems are being tested, such as eye blinking, lane keeping, steering monitoring and collision warning, especially applying to professional drivers. These types of systems may have benefits in when combined with maps and accurate location, warning the driver if unsafe situations are about to occur. Another use of this systems can be to detect drowsiness levels (Vlacic et al., 2001).

2.1.4 Impacts & Changes

Autonomous Vehicles may alter the transportation system as we know it, being considered by Morgan and Daniels, (2001), Bay and Nysveen (2016), Litman (2017) and Anselmetti (2016) as an disruptive innovation or even a revolution.

These changes have direct impact on employment[3], industry, ecology, and society behaviors. With those, some challenges arise, considering the psychological and physical aspects, so that the technology may be accepted on markets (Anselmetti 2016).

In Europe, the strategic measures for transports includes:

- Competitiveness and innovation: material efficiency; engines, design, use of clean energies, better safety in information and communication systems;
- Efficiency and sustainability: cleaner energies with less environmental impact;
- Harmonization: individual legislation that foments coherence between countries;
- Security: lower traffic accidents recurring for example to DAS, which are based in automation processes;

One of the main European strategic goals is the reduction of environmental impact (Schreurs & Steuwer, 2015), with transports currently emitting 14% of greenhouse effect gases. Considering as example, the electrical cars developed with the aim to reduce those prints and pairing that feature with Autonomous Driving technology, is considered by most brands as an environmentally friendly technology with big

[3] It is foreseen-that robotics may eliminate about 5.1 million of jobs in the world (Anselmetti, 2016).

interest. Thus, the choice of using electric batteries to power the AV, with higher levels of automation, comes from the environmental concern of society (Egbue & Long, 2012).

However, full autonomation of vehicles are not mentioned in European transportation strategic goals, only partial automation is seen frequently. But, even though Autonomous Vehicles are not a plan, at least for now, there are various European Projects for investigation of automation technologies, communication and information. Just like some associations between new and old brands that invest in the research of automation technologies.

As Europe does not have as strategic goal the full automation of vehicles, there is a void of legislation when it comes to Autonomous Vehicles. However, it is not the only area in this situation, for example United States, Japan, Germany, United Kingdom and Swiss have void of regimentation on full automation, being sometimes prohibitive. An example is the Vienna Convention (Europe) indication that the driver should always be in control. In 2014, some European countries requested an amendment to allow autonomous vehicles, but only if they can be controlled or disconnected by the driver.

Provable Advantages with Autonomous Vehicles

- Facilitate response to emergency, improve public transport and optimize transport changes

Provable impacts with Autonomous Vehicles

- **Technology:** artificial intelligence sensors and systems still need some improvements most accurately detect the surroundings.
- **Commerce**
- **Cost:** High price of systems, such as LIDAR radar that cost 70000 dollars (Schreurs & Steuwer, 2015).
- **Data:** Data storage and protection.
- **Authorities and society acceptance**: acceptance by customers, acceptable price, technology related to behaviors and needs (Anselmetti, 2016).
- **Legislation:** technological developments in the automotive sector have caused pressure on governments to modify legislation and allow road testing for autonomous cars. From now on, the speed and quality of developments can force governments to intervene quickly and almost without preparation or knowledge on the subject to alter licenses, financial support and regulations. Leaving us doubting whether changes in Europe will be necessary for the same purpose. For example, in Nevada a specific license for the driver is required if these Autonomous Vehicles are launched to public.
- **Infrastructure:** Conditions of roads, needs of new structures with distinct characteristics and responsibilities.
- **AV Information:** Perceptions about AV are being given by their own brands, which can distribute information to ensure their interests. As for example Google quickly entered this market to gain public and political attention in relation to traditional brands already established in the markets (Schreurs & Steuwer, 2015).

2.1.5 Automation History

Autonomous driving dates back to the 1980s, when a car was tested in a motorway scenario, with a vision-based navigation system, it was based on processing static images and it was composed by 8086 processors, Kalman filters and pre-defined interpretations to restrict possible scenarios.

This vision-based navigation system caused blindly driving for some distance, and thus requiring the system needed to take a new photography each time. The event occurs due to the technology deficiencies in processing and analyzing the information.

These first cars had limited technology power and availability because of the inability of software and hardware to analyze the image and act accordingly.

Since that date until 1998 many developments were made in the vision-based navigation systems and were used in the European Prometheus project on the Daimer-Benz vehicle. The systems were:

- Longitudinal and latitudinal guidance guides;
- Road deviation warnings;
- Collision Prevention (Franke et al., 1998)

After this vision of the future, curiosity sky rocked, and new systems have been built to navigate on urban traffic, to enhance driving experience, and we know these as the Driving Assistance Systems (DAS). The first approach was the Intelligent Stop & Go. The system was able to follow a leader vehicle, or even without a leader, but for a limited distance. However in case of emergency situations, the control was returned to the driver, for example when the car needed to stop, view Figure 10 and Figure 11 (Franke et al., 1998; Vlacic, Parent, & Harashima, 2001).

From: *Vlacic, Parent, and Harashima 2001*

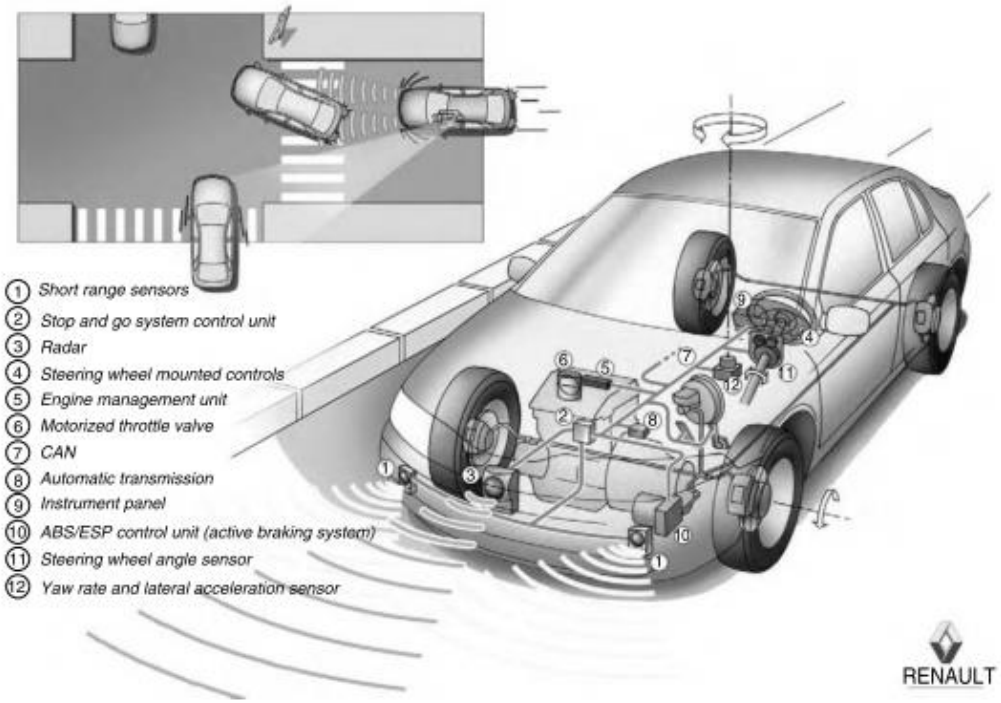

Figure 10 - Overview of Stop & Go system

From: *Vlacic, Parent, and Harashima 2001*

	ACC	Stop &Go
Conditions of operation	ACC performs driving assistance between 40 ± 10 km/h and 170 ± 10 km/h by action on accelerator and brakes	Stop &Go performs driving assistance between 0 km/h and 40 ± 10 km/h by action on accelerator and brakes
Preceding vehicle selection	Moving vehicles in the driving path of equipped vehicle	Moving and stopped vehicles in the driving path of equipped vehicle
Maximum braking capacity	Limited braking capacity (from -1.5 to -3.5 m/s^2, depending on the systems)	Automatic braking capacity enhanced until -4 m/s^2, or even -5 m/s^2

Figure 11 - Stop & Go versus Adaptive Cruise Control (ACC) systems

Some legal and technical issues were collected after this experience with Intelligent Stop & Go, such as the need to have appropriate hardware, wide-angle view, better dynamic range of the camera and quality at night. A legal dilemma has detected the system liability and acceptance of the actual problems of the system (Franke et al., 1998).

Driving Assistance Systems

Stop & Go is an extension of Adaptive Cruise Control (ACC)[4] systems, which is a driver assistance system, but not a collision system, which prevents accidents, and so the driver has authority and responsibility. ACC technique is an extension of traditional cruise control known for safety and comfort issues. This system contains more sensors and better control and detects vehicles in front of the car regulating the distance to the target. With ACC, the driver can release the foot from the accelerator by choosing the intended speed, but higher than 40 km/h. After setting the speed the car will maintain the velocity and slow down to achieve an identical speed and convenient distance from the vehicle in front, due to the sensors mounted on the front of the car and monitors. The driver can have two actions; brake and the system will automatically shut down or push the accelerator to go faster than the cruising speed for a short time (finishes when driver takes the foot of the pedal). The automated actions of the car (accelerate or decelerate) are based on monitors and sensors information, that calculate the distance and speed of the moving cars, while a curve sensor predicts the course of the moving car (Vlacic et al., 2001).

At the beginning of the century, autonomous driving vehicles comprised modular system structures to allow communication between the different and more evolved components. Volkswagen in cooperation with other groups presented a car that had the following components:

- Sensors: Vision System, Radar, Laser Scanners (on bumper);
- GPS;
- Video camera;
- INS module;
- Telemetry antennas;
- Surveillance cameras;
- Computer racks (on the back seats);
- Power supply (on trunk);
- Electronic copilot (on driver seat);
- Wireless LAN to transfer data between components and the application;

Withal, this new Volkswagen system had some deals, works at low speeds, and cannot adapt to difficult situations. These features required some work, needing improvements to:

- Increase speed;
- Quality control on complex scenarios.

Also to ensure system availability 24 hours independently from adverse weather (Franke et al., 1998; Weisser et al., 2000)

In short, the main technical problems for the development of these cars were the components of computer vision, the system architecture and the connection between components and system. (Franke et al., 1998).

[4] First called Intelligent Cruise Control (ICC) or Autonomous Intelligent Cruise Control (AICC).

2.1.6 Autonomous Vehicles Today

Today various vehicles are autonomous at least partially, such as:

- Airplanes which have automatic pilot that allows them to lift flight and travel according to the route set by the pilot, and by curiosity the greatest cause to crashes is human error, as it happens in cars (Hope, 2017).
- Trains which a new system to handle emergencies is being tested. This system is expected to be implemented in France by 2023 and can be piloted remotely, detect objects and brake if necessary (Toor, 2017).
- Cars with Driving Assistance Systems (DAS) are partially autonomous, such as anti-lock brakes, rear view alarm systems, lane departure warning systems and adaptive cruise control (Schreurs & Steuwer, 2015), and cars like Tesla have automatic pilot. This system can execute the following tasks:
    - Adapt the speed to traffic conditions;
    - Stay in range;
    - Automatically change lanes without the driver's indication;
    - Drive on a motorway and change to another;
    - Leave the freeway if the destination is near;
    - Park automatically in a free place near the destination;
    - Call and send the car to the garage (Tesla Motors, 2018).

2.1.7 Challenges & Problems

Word wide, traffic accidents are a big problem since every year nearly 1.2 million people die and 50 million get injured (Lu, Wevers, & Van Der Heijden, 2005). In addition, 90% of the accidents are caused by human error, and forecasts indicate that it will rise by 6.5% until 2025 if preventive measures are not applied (Bundesministerium für Bildung und Forschung et al., 2016; Lu et al., 2005).

And as already been cited one of the factors automation and full automation is born derive from enhancing the driving experience and safety (Kun et al., 2016). To do so, constant innovation is needed, that fact explains the strong competitiveness between car makers. However, attempts to innovate and bring new technologies to the market are often rejected with the today's evaluation metrics. Especially when considering disruptive technologies such as the autonomous car, which alters the architecture and production process, that are mostly rejected. As these decisions dictate the brands that will remain in the market in the coming decades and the rejection is recurrent derived from the evaluation metrics, new methods and information's to appraise innovation viability are required.

As described above this new era of automation requires changes in architecture and production process (Morgan & Daniels, 2001) and consequently a shift of focus mostly since the autonomous cars will co-exist on the road with level 0 cars, at least some years.

Thus, changing papers from systems that support the driver and reduce their distraction, to the exploration of applications and interfaces for greater security, that allow performing secondary tasks, is mandatory. In this light, four new challenges arise:

- **Safety systems**
  - Support driving reengagement. This measure requires knowing how quickly it would be possible, and in what way the car user could go back to driving.
  - Analyze the capability, how to give back driving task to the driver and the success of the task transference. For example, considering contextual data and evaluation of the driver's state through physiological measures, as experimented (Kun et al., 2016)
- **Privacy and security**
  - Connecting cars can contribute to the prevention of collisions; nonetheless, data stealing can occur.
  - Data sharing will require an improvement of hardware and software of the applications to ensure privacy and security, on the communication and integration between systems.
- **Change the concept of a car**
  - Mobility and interaction passes by how to convey security through the interface.
  - Preserve desired levels of driver autonomy (Granularity of Control). Examples:
    - Parking Assistance
    - Fully automated Parking
    - Point-to-point Mobility (Kun et al., 2016).

- **Accountability for unwanted events**
  - Such as badly injured or killed passengers or pedestrians in a driverless car, and is known that these events can occur, due to:
    - System failure
    - Bug's or lack of robustness of the software
    - Inadequate interface
  - However, due to the complexity in evaluating the main reason for the error or failure to occur sometimes it is hard to find the culprit. Not mentioning that often the focus is

mainly on finding the error instead of the reason for it to occur. Nowadays, it is easy to discard or dodge from responsibilities in witch concerns informatics, some excuses are:

  - Human aren't perfect, sometimes failures and errors take place, mostly when the complexity is high;
  - Misinterpretations of responsibility;
  - Systems fault;
  - Inability to do what feels right;
  - Absence of a direct link to the event;
  - Self- interest conflicts.

- Also, we need to have the notion that take as responsible someone that haven't got free will can be hard to do, because the thresholds between freedom and individual responsibility aren't well defined (Gotterbarn, 2001).

To achieve some of the challenges, new developments and studies have to be done and User Interface (UI) will help passengers to engage new secondary tasks while traveling (Kun et al., 2016). Also, legislations, brands and systems have to be actualized and consider the challenges mentioned above.

2.2 Technology Adoption

According to Rogers, to adopt a product or a technology or idea is a decision of “full use of an innovation as the best course of action available”, by contrary, the rejection is the decision “not to adopt an innovation” (Rogers, 2003). In addition, consumers tend to reject a technology when it is new, untested or different, due to the lack of information, high initial costs and none or low tolerance to risk (Egbue & Long, 2012).

Those decisions can change, according to the user preferences, which along the years has contributed to develop more sophisticated and electronic controlled vehicles, such as doors, seats, lights, entertainment, brakes, suspension and steering. And for example, nowadays large part of the consumers utilize cars as offices, requiring the use of a cellphone, internet and map access (Morgan & Daniels, 2001). Generally a consumer is more prone to adopt a technology when it’s useful, on budget and has known alternatives.(Egbue & Long, 2012)

Although, the companies and others need to choose and select marketing strategies to best target the consumers in each market, to accomplish that, the need to identify consumers’ needs in each market, can help to better select the investments (Kim, Forsythe, Gu, & Moon, 2002), because innovation is self-sustaining only when it reaches the critical mass (Rogers, 2003).

2.2.1 Purchase Reasons

The user needs are the major motive to purchase a technology. The classification of this need is as follows:

- Functional, to prevent and solve problems. Individuals give more value to intrinsic aspects (e.g. reliability and security associated to Toyota Corolla)
- Social, for self-expression, self-esteem and social approval.
- Experimental, need of novelty, variety and pleasure. Considered a relevant factor in consuming.

Due to the personal and individual values, there are qualities that consumers try to find to satisfy the needs. These qualities, by Shim and Drake, are market segments, which are quality, economic, convenience and social (Ajzen, 2014). However, Jenkins and Dickey (1976) differentiate the market segments for women dividing in design, simple aesthetic, pragmatic / worried and quality. Moreover, Park (1986) sums these as functional, including pragmatic / worried and quality, social and experimental (design).

Apart from the market segments, some variables are relevant when deciding to purchase a vehicle. According to a public survey done in four Asian countries (Malaysia, Singapore, Thailand and Philippines), there are two main reasons, first to replace an old car and second purchase a car for a family member. To make the decision of which car suits best to their needs, the consumers rely on the

opinion of car dealers or manufacturers, friends, family and web reviews. In addition, the price is the main factor to finalize the decision coming comfort and safety next, comprehending these 3 factors 64, 4% of the considered important factors. Although Malaysia is different when compared to the other Asian countries, having as first priority safety, in second comfort and price as third. These shows that Malaysians would prefer to buy a car with approved safety performance tests, view Figure 12.

The other factors considered relevant in the analysis and considered when deciding to purchase a car, are:

- Style/Design;
- Cost of Maintenance;
- Performance (power and handling);
- Reliability;
- Brand;
- Interior/Luggage Space;
- Resale Value;
- Environmental Friendly (Mohd Jawi et al., 2013).

Figure 12 - Automotive safety programs across world.

From: Mohd Jawi et al. 2013

2.2.2 Technology as Influencer in Adoption

The chapter describes the main influences related to the technology of the car, car components, maintenance and the car system.

Car Components

The components and systems of the car can be an acceptance factor, some of these are:

- Manual / Automatic Transmission (Kun et al., 2016; Litman, 2017)
- Energy / Fuel (Egbue & Long, 2012; Litman, 2017)
- Design (Egbue & Long, 2012)
- Safety, components, system without fault, car structure (Egbue & Long, 2012; Litman, 2017)
- Comfort (Egbue & Long, 2012)
- Experiences during driving (televisions, music, movies, …) (Kun et al., 2016)
- Maintenance needs (Litman, 2017)
- Cost (Egbue & Long, 2012; Litman, 2017)

- Brand (Egbue & Long, 2012)
- Luggage space (Egbue & Long, 2012)
- Power (Egbue & Long, 2012)
- Warranty (Egbue & Long, 2012)
- Reliability (Egbue & Long, 2012)
- Interior and luggage (Egbue & Long, 2012)

However, some technologies still present some technical problems, such as batteries from electric vehicles. Some of the technical issues are the weight, size, capacity and cost, but when seen at social level the problems are different, focusing more on:

- Maximum battery distance, which is the main problem for men;
- Existence of charging stations, especially on long journeys;
- Price being the main problem for women;
- Power;
- Charging speed of the battery;
- Cost to replace the uncharged battery with an already charged;
- Level of battery degradation and failure.
- Some people do not consider the car as environmentally friendly, since electricity uses fossil fuel. However, due to the rise in fuel prices, the oil dependence and the emission of greenhouse gases may influence users to adopt these electric cars. According to Amnesty International, human rights are violated with the extraction of cobalt with the exposure of society to serious health problems. With the extraction of lithium, immense amounts of water are used. It is also a problem ores extraction on the deep ocean floors (Tidey, 2019).
- These differences between technical and social issues is known for "social technical" technologies (Egbue & Long, 2012).

Maintenance

Along the usage of the car some costs arise, see Table 5, these costs are the maintenance. And, when it comes to that factors such as age, gender, time and cost have influence, according to a 2017 study preformed on Nigeria. The major conclusions by each factor are, view Table 6:

- Women resort less to maintenance services, only 21,7%;
- People between 26 to 49 years are more frequent clients;
- Maintenance is done Monthly in 50% of cases and them quarterly 32,6%;
- 47.8% of the respondents indicated a cost between 5,000 Naira and 10,000 Naira (12,45€ and 24,9€) (Omosule, Olusegun, Oluwole, & Feyisetan, 2017)

Table 5 - 2nd phase of vehicle cycle of life, Ownership or usage.

Type of cost	***Description***	***Fixed/Variable***
Trip	Fuel, toll and parking	Variable
Legal	Road tax and driving license	Fixed per annum
	Traffic and parking violation	Variable to users; fixed per offense
Risk	Insurance	Fixed per annum
Aftermarket	Maintenance (preventive, corrective, predictive)	Variable

Retrofitting (for performance, and/or aesthetics)	Variable

From: Mohd Jawi et al. 2013

Table 6 - Demographic factors in maintenance services for modern cars in Nigeria, 2017.

Gender	Frequency	Percentage (%)
Male	36	78.3
Female	10	21.7
Total	**46**	**100.0**
Age		
18-25years	3	6.5
26-33years	13	28.3
34-41years	14	30.4
42-49years	12	26.1
50years & above	4	8.7
Total	**46**	**100.0**
Type of maintenance adopted		
weekly	8	17.4
Monthly	23	50.0
Quarterly	15	32.6
Total	**46**	**100**
Car maintenance cost		
<#5,000	11	23.9
#5,000-#10,000	22	47.8
#11,000-#20,000	6	13.0
#21,000-#25,000	1	2.2
#26,000-#30,000	2	4.3
#31,000 & above	4	8.7
Total	**46**	**100.0**

From: Omosule et al, 2017

System (Human Machine Interaction)

Humans have control when using a system by processing and interpreting the information, nonetheless many are the elements that can affect this experience, and these are call the **Performance-Shaping Factors (PSF)**. Those reasons can derive from user, task, environment, context and technical system, and to improve this interaction is to increase usability and satisfaction.

The PSFs divide into three factors:

- **Internal** – age, vision, personality, motivation, gender, educational background, cultural, expertise and knowledge difference (physical and mental conditions).
- **External** – environment, equipment, procedures and interface (operational issues).
- **Stressor** – mental pressure, high workload or high work pace, pain, exhaustion and long-term stress (physiological and psychological issues).

These factors can influence the interaction individually or combined which causes difficulties when designing interfaces, by knowing each one engineers can optimize the design interaction. In the beginning, cognitive process was a major focal point in design methodologies, but currently changed the focus to a better and more efficient communication between system and user. The change leads to necessity in covering the various types of interactions users wish to have, once we are on a User-Centered Design (UCD) era, meaning the user is the center of the design process. Today the system interface definition is done active user participation in the design and iteration, having the engineers predict and validate based on their assumptions the interaction users will have. All of this, forces the user to change model or behavior to adopt the design, based on their wants, needs and limitations to develop a system that responds to the user requirements (Liu, Osvalder, & Karlsson, 2010).

2.2.3 Societal Influences in Adoption

Consumers can choose a particular product or brand derived from the functionalities, the expected performance, but also to reflect the personality of each individual, the social status or even the need to change or induce new things. Summing up, the choices made may be for symbolic or emotional purposes.

However, these factors vary greatly due to the highly volatile social complexity, adding the fact that it is prone to changes over time that influence the environment and consumption factors. These social components are social, cultural, economic and environmental values of the market, this is, these values vary according to the market. Purchase choices are largely influenced by the social part and the environment where the consumers live. These may affect the individual values and decisions of consumers influencing the purchase decision. In addition, according to Allen (2001), the values can influence directly or indirectly the preference of the consumer towards a brand.

In brief, regarding to the purchase of cars and others, there is a hierarchical link between values, needs (attitudes, such as activities, interests and opinions) and behaviors, since values influence the priority of needs and in turn the decision purchase (Kim et al., 2002).

2.2.4 Individual Personality and Competencies as Influencers in Adoption

Adoption of Technology Profiles

As already referenced, the purchase decision by each consumer for a specific brand or product can reflect the social status, the personality of the individual or the need of change and novelty. However, considering distinct factors may be necessary, due to the differences in segment and market and even according to the gender. Some consumers connection may have different priorities consider such as design and fashion, low value, quality and some are most pragmatic to use a certain technology (Kim et al., 2002).

Therefore, different people react in different ways to new ideas, influencing the acceptance of technologies, according to Rogers' theory of the diffusion of innovation (Rogers, 2003). This is due to the variation in the predisposition to take risks when experiencing an innovation, so if there is hesitation on the part of the user this will have a greater difficulty accepting the technology.

These characteristics can be variable or invariant even with different technologies, so when associated with the rapid development of technologies, it is crucial to identify the invariant characteristics, since they are essential for determining the feasibility of the solution, as well as helping to classify potential consumers and select the best marketing strategy.

These characteristics of innovation are innate to the individual (Roger 2003; Midgley & Dowling 1978) and it is through this that the categories of adoption are made, based on the ways of dealing with innovation between cultures and types of innovation domain (Mun, Kirk, & Jae, 2006).

However, the evaluation of innovation is difficult to measure since it involves personal and situational characteristics, that is, of salary, relation and adoption behavior towards similar products. Thus, Rogers, Moore and Midgley classified the adoption categories as follows:

- Innovators: high social status and high probability of adopting innovation before the majority, since they can more easily identify the benefits, are more open to radical changes and have more technical knowledge.
- Early adopters: more likely to adopt innovation before the majority, since they can more easily identify benefits.
- Early Majority: individuals that change derived from the practicality of the technology. However, they need well-established references from users who have experienced the technology.
- Late Majority: only acquire technology after becoming a standard and acquired by well-known people / brands and only when the individuals feel capable to deal with the technology.
- Laggards:-only adopt the technology when it becomes a necessity (Rogers, 2003)

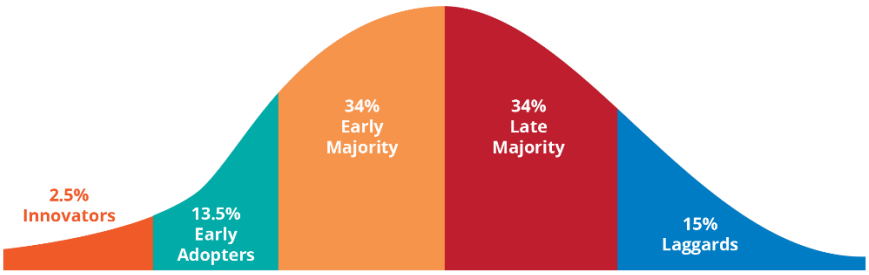

Figure 13 - Adoption Categories according to Rogers, 1995 (Urban Adollescent SRH SBCC Implementation Kit, 2018)

Meanwhile, Dowling classifies individuals in two categories:

- Innate innovators: more likely to be early adopters if they have an interest in the product category and see it as favorable.
- Non-innovators: are highly variable as they can become early adopters or later adopters depending on the time the communication is received or if they have a favorable experience that made to an opinion change, making it favorable (Midgley & Dowling, 1978; Mun et al., 2006).

In addition, the rapid evolution of technology along the years allowed us to execute more and more functionalities to professional or individual usage, such as design, learn, share knowledge, use social networks, do leisure activities and make video conferences in mobile devices. Today, technology is accessible even for seniors and children and continuing to evolve at a fast pace, requiring people to handle and learn how to use technology (Attig, Wessel, & Franke, 2017).

Individual Differences

The user differences and tasks create Human Technology Interaction issues according to Nielson (1993). These issues arise due to the dissimilarities in age, vision, personality, body dimension, training, motivation, gender, educational background, cultural, expertise and knowledge. These characteristics can influence the context and affect the interaction experience, which motivated the definition of the users in classes to allow researches about their performance and acceptance. Many differences affect the user profile and consequently the user's experience, some of them are as follows:

- **Age**. Elderly have more problems with mobile phones and are more prone to make errors, take more time to do the tasks and have problems with input devices.
    - Cons, by Hawthorn (2000) after mid-forties the factors bellow decline more rapidly.
        - Physiology and neurology of the eye
        - Physical and cognitive factors
        - High-order cognitive problems (attention)
        - Slower speed in tasks of rapid performance
    - Pros
        - More cautious and prone to plan rather than try and correct approach, that causes frustration
- **Gender**. While men are more abstract, intuitive and undirected women are more anxious, analytical and organized. Also in design features, men prefer perceptual aids rather than haptic aids.
- **Cultural** background such as nonverbal behaviors that increases the problem detention in usability.

- **User expertise**
  - Shneiderman (1992) and Nielson (1992) indicated three classifications of expertise, having a similar view of the topic. However, the boundaries between the three are vague, once the by practice and learning users move to the next category, but that passage is hard to detect. Even though, differences exist between them such as performance, errors, time, decisions and solving questions. By the first author the classifications are:
    - Novice users – little or none knowledge;
    - Knowledgeable intermittent users – have knowledge although they may have difficulties due to the non-frequent use;
    - Expert frequent users – have deep knowledge about the tasks and actions needed. Generally, this have less errors and with low severity when comparing o novice users. And also, are better at design defaults, functional relationships, problem-solving strategies.
- **Mental Models –**Concept formulated in 1943 by Kenneth Craik to explain human behaviors, philosophies and emotions when executing a task. According to Burns (2000), well-detailed structure of mental models is key to understand the information processing done by humans in various situations. However, many researchers disagree on how they influence the Human-system interaction and their creation. In 1983 Norman inferenced, that to achieve a better usability we need to assume that designers and target user's mental models are identical. This assumption can lead to incorrect and incomplete representation of the system. Also, by the same author, when systems are similar may cause confusion in user's interaction.

A fact is that, not every people use the same technologies or have the same experience of use, that derives from different personalities which impacts technology acceptance and interaction (Attig et al., 2017). And to create the user interface, that represents real user's differences (described above), the mental, physical and demographic characteristics of the target group such as age, work, attitudes, goals and skills are defined on a user profile, this is a fictional individual user (persona). So, designers use this information's to learn about the users and create the user interface, (Liu et al., 2010) once quality interfaces may reduce time of execution, errors, costs and increase user satisfaction (Ziefle & Jakobs, 2010).

Technological progress nowadays goes beyond the technological innovations, focusing mainly in the quality of the human interaction with the technology and systems. That is, technology attends cognitive, affective and communicative needs of the user according to Ziefle and Jakobs, and by Attig, Wessel, and Franke cognitive (attitudes and beliefs), motivational (interests) and affective patterns (anxiety) affect the technology acceptance (Attig et al., 2017; Ziefle & Jakobs, 2010).

These needs or patterns are affected by personality, which according to the Big 5 Personality Dimensions can be measured by "Openness to experience", "Conscientiousness", "Extraversion", "Agreeableness" and "Neuroticism".

One of the most frequent constructs used to study technology acceptance is Computer attitude that comprises anxiety and confidence. Although it is losing importance in Human Technology Interaction (Attig et al., 2017), which is an topic of importance to several areas and disciplines, being named as one of the disciplines of the century (Ziefle & Jakobs, 2010). These studies are diverse, and include, for instance, dialogue techniques, gestural analysis and multimodal interfaces, computer graphics,

computational linguistics, spatial cognition, robot navigation and wayfinding, input styles or devices, and monitor screens etc. (Liu et al., 2010).

In detriment of computer anxiety, other constructs are gaining importance, being these:

- Control beliefs: extent to which the response (action) corresponds to the action expected by the user;
- Affinity for technology: enthusiasm; competence, positive and negative attitudes towards technology;
- Computer-related motivation: utilitarian use (activities that help in day to day) and hedonic motivation (activities to leisure and communication);
- Geekism: curious users that fiddle and explore technologies to better understand them (Attig et al., 2017).

Technological progress brought and increasing exigence of the users, bringing new technological and social challenges, such as:

- Invisible technology;
- Short life cycles of technologies and systems;
- Quick changes in Mental Models[5];
- Complexity of the technologies, due to the ubiquity of embedded systems;
- More aged workers;
- Increasing diversity of users, contexts;
- New ways of interacting, such as the three HCI innovations these are Direct Manipulation of Graphical Objects, Windows and Hypertext (Ziefle & Jakobs, 2010).

Competencies

Competencies involves transformation of knowledge in a certain context by using skills, psychological, social and cognitive resources combined with creativity, skills and attitudes. According to studies held by the Organization for Economic Co-operation and Development (OECD) a competency must lead to positive outcomes, be important and help to meet the needed exigencies. Having these, three basic category competencies are defined to live in society, in a modern life:

- Interactive use of tools, well enough to adjust to the individual needs (tools include language and technology):
- Engage with others regardless of the differences of the groups;
- Manage and take responsibility for their lives, including social context (OECD, 2005)

Quoting Meyers, Volbrecht, and Kaster-Bundgaard (1999), “Being physically able to drive does not necessarily suggest being competent to drive. Knowing why and where to drive is also an important function in the safe operation of a motor vehicle”. According to the Portuguese legal enabling regulation to drive establishes a physical and mental assessment to classify as able to drive. The minimum conditions for driving are:

- **Vision**
  - Acuity: minimum of 0.5 with or without optical corrections;
  - Diplopia: not accepted;

[5] Concept formulated in 1943 by Kenneth Craik to explain human behaviors, philosophies and emotions when executing a task.

  - Field and Peripheral vision: horizontal superior to 120.º, minimum extension 50.º right and left and 20.º top and bottom;
  - Chromatic vision: red color disorder not accepted;
  - Night vision: Some restrictions;
  - Progressive ophthalmological diseases: medical examination annually required;
- **Audition:** acuity required;
- **Locomotor system:** Physical disability in the locomotion imposes restriction as the type of adaptations needed in the vehicle as well as the use of an orthopedic device should be indicated by medical teams. The most severe cases, such as Paraplegia are not able to drive.
- **Cardiovascular diseases**: not able if susceptible sudden failures of the cardiovascular system and changes on brain functions.
- **Neurological diseases (such as epilepsy) and apnea:** If severe are not able to drive;
- **Mental disorders:** not able to drive;
- **Alcohol**: If dependent cannot drive;
- **Drugs:** If consumes ppsychotropic substances in excess cannot issue the driving license;
- **Renal insufficiencies:** require revalidation in shorter periods and in some cases may not be able to drive;
- **Other issues:** that may affect security or incapacity can be considered.
- (República Portuguesa Saúde, Serviço Nacional de Saúde, & Direção-Geral da Saúde, 2013)

2.2.5 Information and Communication as Influencer in Adoption

Communication, cited from Rogers “is a process in which participants create and share information with one another to reach a mutual understanding” (Rogers, 2003), and it can be used by the media. These communications can affect the decision process of adopting a technology, mainly if the aim is consumer persuasion. Although, the effects depend on the effectiveness of the information conveyed in the message that should be highly related to the nature of the content, quoting Fishbein and Ajzen “Information is the essence of the persuasion process”.

The aim of communication mainly in advertisement is persuasive and tries to influence the most significant beliefs in consumers, those in which most believe, to influence the intention to perform a certain behavior. Persuasion to be achieved should try to convey that the results obtained by executing a certain behavior are mostly positive, this way intention being a function of 2 factors personal nature and social influence can be achieved. Also, communication should have as target the affective feelings (attitudes) and or the cognitions (beliefs) of the consumer, to impact the intention and consequently behaviors (Fishbein & Ajzen, 1981).

Since the information shared on the media and interpersonal contacts can influence the opinion, mostly when conveyed by an opinion leader (such as famous actors, bloggers, others). However, “the intermediaries called change agents and gatekeepers are also included in the process of diffusion” (Rogers, 1995).

Chapter 3 - Methodology

A research's methodology is chosen bearing in mind the steps, procedures and strategies used to gather the data that will be used to be able to answer the research questions. Hence, all the steps required, and the methods used to gather all the data for this study, will be carefully addressed here, because this process has impact on the quality, integrity and interpretation of the results.

This chapter begins by: a) identifying the characteristics of the context and place were the research was made; b) identifying the study's population; c) specify the methods and instruments used to gather the data; d) specify the methods and instruments used to analyze the gathered data and, finally, the study's limitations.

3.1 Design

3.1.1 Context and place of the research

This study took place in ISCTE-IUL, during July and August of 2018. As our population universe has a total of 4056 and considering the smallest sample that would allow a trust interval of 95%, with a 5% of error margin, we opted to use as minimum sample 203 students.

4056 x 0.05 = 202,8 | population x margin of error = sample

As shown on table 4, the inquired students were older than 18 years old, all Portuguese, and attending the following degrees in ISCTE: in Marketing, Economics, Human Resources, Architecture, Information Systems, Computer Engineering, Sociology and Organizations' Management and Informatics. They were randomly selected through posts in various university groups on social networks.

Teachers were also asked to answer a questionnaire, and a total of 21 did so.

Table 7 - General study information.

Study Period	*From July to August 2018*
Participants	Students and Teachers from ISCTE
Target Dimension	Minimum sample calculated for a 95% confidence interval with a 5% margin of error, although the investigation was non-probabilistic, we chose to use it as a reference for the minimum responses required. Target dimension: 203 considering 5% of Population (see calculus)
Calculus	ISCTE Teachers Total: 21 Students Total: 4035 In Marketing, Economics, Human Resources, Architecture, Information Systems, Computer Engineering, Sociology and Organizations' Management and Informatics

	Total Population: 4056
Target population	Portuguese Students and Teachers older than 18 with or without driver license, within the courses mentioned above from ISCTE.
Data gathering	Random Sample. At the target, student respondents were randomly selected through posts in various university groups on social networks. Teachers at target, were randomly select by an array of email sent to email database.
Data gathered	216 all of them considered valid

3.1.2 Designing the inquiries while considering the study's goals and research questions

In an era of technology and innovation rapid developments are made and competitiveness is high, namely in the main theme of the study, the automotive world that has evolved very quickly and led us to automation.

This evolution has led to investigations and regulatory changes in some countries and has been a subject of increasing attention, due to the doubts caused by the lack of information and its forecast to be introduced in society. Thus, it becomes relevant to answer the main question of the study, see Table 3, in Questions and objectives of investigation.

1.1.1.1 Designing the inquiry

Considering this study's research questions (RQ), its theoretical framework, and the information availability limitations, the objectives proposed on this study considers opinions, decisions and factors. This means that, to successfully answer the RQ there is a need to gather qualitative and quantitative data, making it a mixed nature study.

It is then important to distinguish between the quantitative approach and the qualitative approach.

According to F. Punch (2013), the research approaches are shortly summed as:

- "Quantitative research is empirical research where the data are in the form of numbers.
- Qualitative research is empirical research where data are not in the form of numbers"

Where:

"…the first level of abstraction, we have first-order concepts (qualitative) and variables (quantitative)… At the next level, the second order of abstraction, we have second-order concepts (qualitative) and factors (quantitative). Again, factor analysis (and cluster analysis) in quantitative work formalize this idea."

Therefore, to reach the objectives, in the study factors and decisions where considered quantitative while opinions are qualitative data.

The selected method to gather information is the questionnaire, based on a mixed method using closed and open questions (types of questions selected are visible in the Table 8 (Saunders, Lewis, & Thornhill, 2008).

Table 8 - Types of Closed and Open question selected for the research.

Closed	Open
Rating (Likert)	Personal behavior or opinion
Ranking	Comment
Personal facts (age, employment state)	
Semantic differential scales	
Grid	

The information to create the questions for the questionnaire were based on the variables in IAR model (see Charter 2), newspaper articles and articles from automotive manufacturers (see Table 10). The scales for questions where based on inquiries from other studies, such as (Teixeira, 2007) as well as on the nature of the issue (see Table 9).

Table 9 - Variables of the model and information used to design the inquiry.

VARIABLE	DEFINITION	INFORMATION	MODEL
	MOTIVATIONAL INFLUENCES		
Perceived Self-Identity	Influences attitudes and intentions in positive direction, as the more meaning the technologies makes for the individual personal and social identity, once people normally act according to their individuality.	Age; Gender; Activities; Occupation; Home city; Education	TPB
Perceived Usefulness	Influences attitudes and intentions thought positive functional outcome (goal achievement or reward), in AV is an extrinsic motivation, in a way that enables the consumer to have more free time, mobility and simpler life.	Wish to purchase; Wish to purchase	TPB TAM
Perceived risk	Influences negatively attitude, as they increase the likelihood of failure in innovation adoption, thus being the negative goals of extrinsic motivation. And, influences negatively attitude.	Vehicle Safety; Trust in technology	TAM DIM
Perceived enjoyment	Influences intention due to the satisfaction in using AV that may cause positive influences on intrinsic motivations. And, influences positively intentions and perceived usefulness.	Feelings when using	TAM
	RESOURCE RELATED INFLUENCES		
Perceived ease of use	Influences attitudes once people wish to minimize their effort when using a technology such as AV. And, influences positively intentions and perceived usefulness.	Car Owner; Technologies use; Capabilities when using technology;	TAM TPB
	AUTOMATIC INFLUENCES		
Compatibility	Influences positively intention and perceived usefulness. People create future intentions based on their past, thus past offerings can increase the likelihood of observing advantages in innovations when compatible with the lifestyle of the consumer.	Interests; Future intentions	DIM
	NORMATIVE INFLUENCES		
Personal norms	Influences intention positively.	Behaviors; Needs; Values; Favorite characteristics	TPB
Social norms	Influences intention directly in a positive direction, since in case of doubt external opinion, of family, friends, others can be considered.	Sustainability; Word of Mouth	

Table 10 - Authors based to define questions of inquiry.

AUTHOR	QUESTION
(Egbue & Long, 2012; Kim, Forsythe, Gu, & Moon, 2002; Litman, 2017)	36
(Attig, Wessel, & Franke, 2017)	5,9, 9.1, 10, 11, 17, 19, 21, 23, 23.1, 25
(Attig et al., 2017; Liu, Osvalder, & Karlsson, 2010)	4, 12
(Attig et al., 2017; Axsen, Bailey, & Andrea, 2015)	6
(Attig et al., 2017; Rijnsoever, Farla, & Dijst, 2009)	18, 24, 27
(Bay & Nysveen, 2016; Rijnsoever et al., 2009)	29
(Schreurs & Steuwer, 2015)	41
(Kim et al., 2002)	33, 34, 35, 38, 39
(Kim et al., 2002; Rijnsoever et al., 2009)	31
(Egbue & Long, 2012; Litman, 2017)	32, 37, 37.1
(Liu et al., 2010)	7
(Axsen et al., 2015; Liu et al., 2010)	8

When creating the questionnaire, filter questions were avoided to decrease error and no response issues, however sometimes they were also used to separate non-relevant topics to certain individuals (Saunders et al., 2008). The selected tool to implement the questionnaire was Google Forms, to better reach the population and avoid fill errors derived from the use of filter questions.

After the last version of the questionnaire was ready a pretest with three experts was carried on, so they could validate the form. Through the comments and evaluation made, the form has undergone several revisions until its final release. In addition, their responses to form where not considered in the final analysis.

3.1.3 Data Analysis Procedures

Quantitative Analysis

After collecting all the questionnaires, the Google Forms was closed and the results refined in Excel and finally imported into the chosen analysis software, *Statistical Package for the Social Sciences* (SPSS), to retrieve the results, and have the data analyzed according to its nature.

The quantitative data was first analyzed regarding the demographic nature, and then submitted to an absolute and relative frequency, univariate analysis of measures of central tendency (average), measure of dispersion (standard deviation) tests. The intensity of the relation between variables were analyzed by the Pearson correlations, with a statistical significance between variables assumed at $p<.05$. These tests were conducted with *Statistical Package for Social Sciences* (SPSS, IBM Corp., Armonk, NY, USA).

Qualitative Analysis

The results of the open questions where carried out on QDA Miner Lite. The method applied to analyze the data is the is content analysis, also called conventional analysis, chosen due to the limited information concerning the topic. This method has some advantages as it does not require imposed categories. The analysis is based on a deep reading of the questions to create codes for the answers, according to the reading. Firstly, key words were identified, then these were worked and refined according to the reading and global vision. Lastly, the codes were grouped into categories and/or subcategories having these a description associated (Freitas & Moscarola, 2002; Hsieh & Shannon, 2015).

Below is a resume of all codes, categories and definitions for each opened question.

Question	*What kinds of impact could a car have on people's lives.*		*List the moral and ethical issues that, in your opinion, associate with the use of Autonomous Cars, which consider to be worrying*		
Category	Positive	Negative	Freedom	Legislation	None
Codes	Decreased Stress/ Tiredness	Take pleasure in driving	Lack of decision	Privacy	None
	Activities in traffic	Lack of control and security	Trust In the machine	Guilty of accident	
	Shorter travel time		Decisions in cases of collision	Road Code	
	Economic and Sustainable				
	Reduction od accidents				
	Ease of use				
Question	*Justify the answer given considering the safety of the car*		*What are the reasons for buying an autonomous car?*	*What are your questions about the Autonomous Car?*	*Which features do you least value in a car?*
Category	Positive	Negative	Buy Motives	Doubts	Least Relevant
Codes	Current information available	Faults and errors	Economic and Sustainable	Possible Human Control	Design
	Good production quality	Wrong or limited decisions	Activities in transit	Maximum Speed	Accessories
	Trusted System	Data sharing	Shorter travel time	Security and reliability guarantee	Size
		Unfamiliarity	Decrease Stress/ Fatigue	Available when	DAS
		Dubious production quality	Facility	Responsible in case of accident	Extras
		Absence of human decision	Lux and Innovations	Data Privacy Protection	Small cars
		Reliability Testing	Price	Real existence of the car	Power

		Unsafe System	Safety	System Operation	Color
		Hacking	Comfort	Consumption	Technologies/electronics
			Design	Car Price	Age
			Lack of alternative	Complexity of technology development	Automatic Gearbox
			Driving pleasure	Current point of development	Dimension
			I did not buy	Communication between System and Driver	Manual Gearbox
Question	*Describe in a few words what you think about the AV?*			Use by unfit	Inconclusive
Category	Positive	Negative		Real environmental advantages	All important
Codes	Innovative	Take pleasure out of driving		Doubts in the realization	Lux
	Good for those who do not like driving	Unsafe		City / population preparation	Brand
	Enjoy the time	Hacking			Interior/Upholstery
	Facilitates everyday life	Costs of maintenance			Velocity
	Use by unfit	Needs further development /studies			Registration
	Safe	Unnecessary Technology			Car Dine
	Futuristic and interesting	Stressing and scary			Number of seats
	Ecological	Absence of human decision			Price/ Expenses
	Less traffic	Doubts in realization			
	More comfort	Decisions and ethics			
	Decrease Stress/Fatigue	Lack of road condition			

Chapter 4 - Analysis and discussion

4.1 First Section – Sample characterization

4.1.1 Quantitative Data

The study obtained 216 responses, all of which were considered valid. Of the sample, most are man (128♂ and 88♀), see Table 11. Of those, 59,3% (128) have ages between 17 years and 18 years, and in the female sex the maximum age is 67 years, with the mean age being 22,7 years, the fashion 18 years, median 20 years and the standard deviation is 7,7 (Table 12).

Table 12 - Question 1 - Participants Age by groups. (Relative -RF and Absolut Frequencies- AF)

Mean = 22,74 | Median = 20 | SD= 7,7 |		
Age Group	***RF (%)***	***AF***
17-18	30,5%	66
19-20	25%	54
21-24	25%	54
25-67	19,4%	42
Total	**100%**	**216**

Table 11 - Question 2 - Participants gender (Relative and Absolut Frequencies)

Gender	***RF (%)***	***AF***
Female	40,7%	88
Male	59,3%	128
Total	**100%**	**216**

The most frequent activity is either being a student or a worker / student, 72,7% and 24,1% respectively (Table 13).

Table 13 - Question 3 and 2 - Professional Activity (Relative and Absolut Frequencies)

	AF			
	Teacher/Professor	**Student**	**Student/Worker**	**Total**
Male	5	95	28	128
Female	2	6	23	88
Total	**7**	**157**	**52**	**216**
RF (%)	**3,2%**	**72,7%**	**24,1%**	**100%**

Most of the sample spend most of their time in the Capital City of District where they live in (59,9%) or in the City of residence (38,0%), see Table 15.

Most of the sample has answered to have a Computer (99,1%), a Tablet (64, 4%) and a Smartphone (79,6%), as we can observe on Table 14, making it possible to infer that they are adepts of digital technology and possibly innovators (31,5% see Table 16), since they have invested largely in digital devices, and with the large majority (80,6%) having stated to use several digital devices (25%), being adept and use several digital devices (24,1%) and being a big adept of such innovations (31,5%).

Table 15 - Question 4 - Where do you spend most of your time? (Relative and Absolut Frequencies)

	RF (%)	AF
Azores-hometown	0,5%	1
Hamlet	1,9%	4
Hamlet near city	3,2%	7
City	38%	82
District capital city	50,9%	110
Village	5,6%	12
	100%	**216**

Table 14 - Question 5 - What technological devices have you joined? (Relative and Absolut Frequencies)

	RF (%)	AF	Valid
Mobile phone	74,5%	161	216
Tablet	64,4%	139	216
Smartphone	79,6%	172	216
Computer	99,1%	214	216
Smart Tv	47,7%	103	216
Smart home appliances	25%	54	216
	100%	**216**	

Table 16 - Question 6 -What is your level of ease using the technological device above indicated? (Relative and Absolut Frequencies)

	RF	AF
I have too much difficulties	3,2%	7
I don't like, I don't use, I am against	0,0%	0
I have some difficulties	1,9%	4
I only use on work since I am obligated	0,0%	0
I use it with relative ease and I like to use it	12,0%	26
I use it with relative ease, but I don't it very much	2,3%	5
I use with relative use several devices	25,0%	54
I am a big adept and have a lot of ease in its usage	24,1%	52
I am a big adept, I have a lot of ease in its usage and I review myself in innovations	31,5%	68
	100%	**216**

Currently the main hobbies of the respondents, according to Table 17, are watch movies, series and documentaries (27,6%), activities with friends (24,9%), concerts (11,4%), reading (11,4%), (11,4%) and travel around the country (11,0%).

Table 17 - Question 7 - What do you dedicate yourself in your free time? (Relative, Absolut Frequencies, Cases)

	RF (%)	AF	Case (%)
Read	11,4%	80	37,0%
Concerts	11,4%	80	37,0%
Walking	11,4%	80	37,0%
Travel the Country	11,0%	77	35,6%
Mountain Activities	2,7%	19	8,8%
Nautical Activities	2,7%	19	8,8%
Leaning new areas	5,3%	37	17,1%
Movies, Series, Documentaries	27,6%	194	89,8%
Activities with friends and family	24,9%	175	81,0%
Others			
Sports	5,1%	11	5,1%
To schedule	1,4%	3	1,4%
Games	1,9%	4	1,9%
Social support	0,5%	1	0,5%
Photography	0,5%	1	0,5%
Gardening	0,5%	1	0,5%
Walking the dog	0,5%	1	0,5%
Music production	0,5%	1	0,5%
Walking the dog	0,5%	1	0,5%
Repair and modification of automobiles	0,5%	1	0,5%
	100%	**702**	**325%**

According to Table 18, most of the sample considers the values "Family" and "Comfort" as most significant in a set of characteristics (work, family, comfort, organizing well the time, driving safety, environmentally friendly technologies, saving, need to be innovative). It is relevant to note that the "Work" was not chosen by any individual in this sample. All other characteristics are referred to equally by the respondents as something which they value and defines them. Also, it is pertinent to reference that none of the individual choose the "I do not identify myself" for the "Save Money" characteristic, meaning in some way it is important to save money.

Table 18 - Question 8 - Which Characteristics define you/value? (Relative and Absolut Frequencies)

Values	Scale	RF (%)	AF
Family	I do not identify myself	0,5%	1
	I identify myself a little	4,2%	9
	I identify myself	20,8%	45
	I identify myself a lot	26,4%	57
	It's essential to me, I fully identify myself	48,1%	104
Comfort	I do not identify myself	0,5%	1
	I identify myself a little	2,3%	5
	I identify myself	20,8%	45
	I identify myself a lot	37,5%	81
	It's essential to me, I fully identify myself	38,9%	84
Time Well Organize	I do not identify myself	3,2%	7
	I identify myself a little	21,8%	47
	I identify myself	29,2%	63
	I identify myself a lot	26,9%	58
	It's essential to me, I fully identify myself	19,0%	41
Driving Safety	I do not identify myself	4,2%	9
	I identify myself a little	6,0%	13
	I identify myself	28,7%	62
	I identify myself a lot	37,0%	80

	It's essential to me, I fully identify myself	24,1%	52
Ecological Technology	I do not identify myself	2,8%	6
	I identify myself a little	13,9%	30
	I identify myself	30,1%	65
	I identify myself a lot	31,5%	68
	It's essential to me, I fully identify myself	21,8%	47
Save Money	I do not identify myself	0%	0
	I identify myself a little	6,9%	15
	I identify myself	28,2%	61
	I identify myself a lot	38,4%	83
	It's essential to me, I fully identify myself	26,4%	57
Necessity of Innovating	I do not identify myself	4,2%	9
	I identify myself a little	16,7%	36
	I identify myself	36,1%	78
	I identify myself a lot	28,2%	61
	It's essential to me, I fully identify myself	14,8%	32
		100%	**216**

Regarding the types of driving license (see Table 21) and the ownership of a car (see Table 19), most of the individual (154) own a driving license (car, boat and/or motorcycle) having most of them car license (140), boat and motorcycle are greatly reduced compared to the car (Table 21).

In addition, most of them have a car or a family owned car, and drive daily (30,6%) on journeys of less than 1 hour (Table 24) in a manual box car (67,7% see Table 22). However, the sample shows interest in trying an electric car (mean “I Would like”), as opposed to the LPG car (mean “I Would not like”).

Table 21 - Question 9.1 - Types of Driving Licenses (Relative and Absolut Frequencies)

	RF (%)	***AF***
Car	83,1%	128
Motorcycle	1,9%	3
Boat	0,6%	1
Car and Motorcycle	13,0%	20
Car, Motorcycle and Boat	1,3%	2
	100%	**154**

Table 19 - Question 10- Do you own a car? (Relative and Absolut Frequencies)

	RF (%)	***AF***
Yes	40,3%	79
No	23,1%	50
Only family member	36,6%	79
	100%	**216**

Table 20 - Question 11 - How often do you drive? (Relative and Absolut Frequencies)

	RF (%)	***AF***
I don’t drive	29,2%	63
I drive during the week	9,3%	20
I drive only in the weekend	16,2%	35
I drive everyday	30,6%	66
I drive sometimes	14,8%	32
	100%	**216**

Table 22 - Question 14 - In the driving I do today I think that... (Relative, Absolut Frequencies, Mean and SD)

		RF (%)	AF	Mean and SD
I Drove (Drive) An Electric Car	I Would like	72,3%	112	I Would like *1,42 ; ± 0,761*
	I Would not like	9,7%	15	
	I have already drove	16,1%	25	
	Driving now	1,9%	3	
I Drove (Drive) A GPL Car	I Would like	37,0%	57	I Would not like *1,79 ; ± 0,730*
	I Would not like	48,1%	74	
	I have already drove	13,6%	21	
	Driving now	1,3%	2	
I Drove (Drive) A Gasoline Car	I Would like	3,9%	6	I have already drove *3,15 ; ± 0,815*
	I Would not like	12,3%	19	
	I have already drove	47,1%	73	
	Driving now	36,8%	57	
I Drove (Drive) A Diesel Car	I Would like	5,2%	8	I have already drove *3,31 ; ± 0,752*
	I Would not like	3,2%	5	
	I have already drove	48,4%	75	
	Driving now	43,2%	67	
I Drove (Drive) A Car with Manual Gearbox	I Would like	3,9%	6	I have already drove *3,61 ; ± 0,658*
	I Would not like	1,9%	3	
	I have already drove	26,5%	41	
	Driving now	67,7%	105	
I Drove (Drive) A Car with Automatic Transmission	I Would like	31,6%	49	I Would not like *2,15 ; ± 0,934*
	I Would not like	24,5%	38	
	I have already drove	40,6%	63	
	Driving now	3,2%	5	

Scale: 1= I Would like, 2= I Would not like, 3= I have already drove, 4= Driving now

Of the auxiliary systems available in cars, as seen in Table 23, the most used is the GPS (41,7%), parking sensors (34,3%) and cruise control (25,9%). And 16,2% have never used any system.

Nowadays, most agree that the cost of fuel is awfully expensive ("Fuel Has High Price" mean "I Strongly

Table 23 - Question 12 - Auxiliary systems of cars that you drive/drove? (Relative, Absolut Frequencies and Case)

	RF (%)	AF	Case (%)
GPS	58,1%	90	41,7%
Cruise Control	36,1%	56	25,9%
Parking Sensors	47,7%	74	34,3%
Never Used Any System	22,6%	35	16,2%
Emergency Braking	12,3%	19	8,8%
Rear Viewer with Dead Angle Vision	11,0%	17	7,9%
Anti-Splash System (Abs)	1,3%	2	0,9%
Semi-Autonomous Driving	0,6%	1	0,5%
Total	**100%**	**294**	**136,1%**

agree"), and most agrees that there is a lot of traffic, the maintenance is expensive, parking is expensive and there is lake of it and, that car users like to drive (all of them have as mean "I Agree"). In addition, driving a manual gearbox car is not tiring and trips are shorter than 1 hour ("Drive with Manual Gearbox is Tiring" and "Trips Are Long (More Than 1hour)" mean "I Disagree"). In the other side, some are

uncertain about the frequency of maintenance, the use of auxiliary systems and the frequency of driving (all with mean “I Do not agree or disagree”) (Table 24).

Table 24 - Question 13 - In the driving I do today I think that... (Relative, Absolut Frequencies, Mean and SD)

		RF (%)	*AF*	*Mean and SD*
Maintenance Cost is High	I Strongly disagree	3,2%	5	I Agree 3,57 ± 0,99
	I Disagree	12,3%	19	
	I Do not agree or disagree	23,2%	36	
	I Agree	46,5%	72	
	I Strongly agree	14,8%	23	
Need for Frequent Maintenance	I Strongly disagree	3,9%	6	I Do not agree or disagree 3,28 ± 0,94
	I Disagree	16,1%	25	
	I Do not agree or disagree	34,8%	54	
	I Agree	38,7%	60	
	I Strongly agree	6,5%	10	
Parking is Expensive	I Strongly disagree	3,2%	5	I Agree 4,13 ± 1,00
	I Disagree	3,9%	6	
	I Do not agree or disagree	13,5%	21	
	I Agree	35,5%	55	
	I Strongly agree	43,9%	68	
Lack of Parking	I Strongly disagree	3,9%	6	I Agree 4,11 ± 1,04
	I Disagree	5,2%	8	
	I Do not agree or disagree	10,3%	16	
	I Agree	37,4%	58	
	I Strongly agree	43,2%	67	
High Traffic	I Strongly disagree	1,3%	2	I Agree 4,23 ± 0,91
	I Disagree	5,2%	8	
	I Do not agree or disagree	9,7%	15	
	I Agree	36,8%	57	
	I Strongly agree	47,1%	73	
Fuel Has High Price	I Strongly disagree	0,6%	1	I Strongly agree 4,69 ± 0,62
	I Disagree	0,6%	1	
	I Do not agree or disagree	2,6%	4	

	I Agree	21,3%	33	
	I Strongly agree	74,8%	116	
Drive with Manual Gearbox is Tiring	I Strongly disagree	34,8%	54	I Disagree *2,26* *± 1,23*
	I Disagree	29,0%	45	
	I Do not agree or disagree	17,4%	27	
	I Agree	12,3%	19	
	I Strongly agree	6,5%	10	
I Use Auxiliary Systems (parking sensors, cruise control, GPS, etc.)	I Strongly disagree	14,2%	22	I Do not agree or disagree *3,07* *± 1,28*
	I Disagree	21,9%	34	
	I Do not agree or disagree	20,6%	32	
	I Agree	29,0%	45	
	I Strongly agree	14,2%	22	
Driving is Frequent	I Strongly disagree	12,3%	19	I Do not agree or disagree *3,43* *± 1,41*
	I Disagree	17,4%	27	
	I Do not agree or disagree	18,7%	29	
	I Agree	18,7%	29	
	I Strongly agree	32,9%	51	
Trips Are Long (More Than 1hour)	I Strongly disagree	23,9%	37	I Disagree *2,35* *± 1,10*
	I Disagree	38,7%	60	
	I Do not agree or disagree	18,7%	29	
	I Agree	15,5%	24	
	I Strongly agree	3,2%	5	
Like to drive	I Strongly disagree	5,8%	9	I Agree *4,21* *± 1,09*
	I Disagree	1,9%	3	
	I Do not agree or disagree	10,3%	16	
	I Agree	29,7%	46	
	I Strongly agree	52,3%	81	

Scale: 1 = I Strongly disagree, 2= I Disagree, 3= I do not agree or disagree, 4= I Agree, 5= I Strongly agree

4.1.2 Qualitative Data

In 152 valid answers (from 216 responses 64 where considered inconclusive) the most cited features as being the least valuable on the car are the design (16,2%), DAS, extras and color (all with 9,6%).

Table 25 - Question 15 – Which features do you least value in a car?

Category	Count	%
Design	27	16,2%
Accessories	1	0,6%
Size	6	3,6%
DAS	16	9,6%
Extras	16	9,6%
Small cars	2	1,2%
Power	10	6,0%
Color	16	9,6%
Technologies / electronics	8	4,8%
Age	2	1,2%
Automatic gearbox	9	5,4%
Dimension	1	0,6%
Manual gearbox	2	1,2%
All important	10	6,0%
Lux	2	1,2%
Brand	5	3,0%
Interior / Upholstery	7	4,2%
Velocity	8	4,8%
Registration	4	2,4%
Car Dine	9	5,4%
Number of Seats	2	1,2%
Price / Expenses	4	2,4%
	167	**100,0%**

4.2 Second Section – Imagine that …

4.2.1 Quantitative Data

Although autonomous cars are a recent theme, the sample already knows the concept (84,7%), mainly derived from the internet (53,7%), television (14,8%) and social networks (6,0%), see Table 28 and Table 27.

Table 28 - Question 16 - Have you already heard in the term autonomous car? (Relative and Absolut Frequencies)

	RF (%)	AF
Yes	84,7%	183
No	15,3%	33
	100%	**216**

Table 26 - Question 17 - Do you imagine yourself using an Autonomous Car? (Relative and Absolut Frequencies)

	RF (%)	AF
Yes	35,2%	76
No	22,2%	48
Maybe	42,6%	92
	100%	**216**

Table 27 - Question 16.1 - Where have you hear the term autonomous car for the first time? (Relative and Absolut Frequencies)

	RF (%)	AF
Internet	53,7%	116
Magazines/ Newspapers	4,2%	9
Television	14,8%	32
Social Media	6%	13
School	0,9%	2
Others	5,1%	11
Other: Scientific Articles in the Field of Transport	0,5%	1
Other: At home	0,5%	1
Other: In Conversation	0,5%	1
Other: At work	0,5%	1
Other: Websummit	0,9%	2
	100%	**216**

92 out of 216 sample members stated that they might use an AV (42,6%) and 76 said they would use it. Concerning how people would feel, the main are curious (25,9%), enthusiastic (17,0%) and anxious (16,6%). In addition, when observing the difficulty in use of an AV, 39.8% agrees that the car would be of intermediate difficulty, others consider low (25, 5%) or very low (24,1%). Where only 3,2% considers being very difficult.

Table 30 - Question 18 - How would you feel on an Autonomous Car? (Relative, Absolut Frequencies and Case)

	RF (%)	AF	Case (%)
Frightened	9,7%	47	21,8%
Anxious	16,6%	81	37,5%
Confused	6,8%	33	15,3%
Curious	25,9%	126	58,3%
Courageous	2,5%	12	5,6%
Enthusiastic	17,0%	83	38,4%
Happy	6,6%	32	14,8%
Luxurious	9,4%	46	21,3%
In panic	2,3%	11	5,1%
Vain	3,3%	16	7,4%
	100%	**487**	**225,5%**

Table 29 - Question 19 - Do you consider difficult driving an Autonomous Car? (Relative and Absolut Frequencies)

	RF (%)	AF
Very difficult	3,2%	7
Difficult	7,4%	16
Medium	39,8%	86
Easy	25,5%	55
Very easy	24,1%	52
	100%	**216**

According to the Table 31, capacities and competencies needed to use an AV are to use technology with ease (76,9%), to own a driving license (45,4%), to be able to make decisions (41,7%), to be absent of mental and behavioral disorders (39,4%) and to be absent of excessive non-consumption of drugs and medicines with influence on driving (32,4%). Other hand, we have very few respondents who have chosen features such as locomotive capabilities and some even state they do not need any skills to use an autonomous car.

Table 31 - Question 20 - What kind of skills or capacities do you think are needed to use an Autonomous Car? (Relative and Absolut Frequencies)

	RF (%)	AF	Case (%)
Ease of use of technologies	26,3%	166	76,9%
Decision-making ability	14,2%	90	41,7%
No serious cardiovascular diseases	5,1%	32	14,8%
Absence of mental and behavioral disorders	13,4%	85	39,4%
Absence of excessive alcohol	12,7%	80	37,0%
Non-consumption of drugs and medicines with influence on driving	1,11%	70	32,4%
Locomotive capacities	1,3%	8	3,7%
Driving license	15,5%	98	45,4%
No competence	0,5%	3	1,4%
	100%	**632**	**292,6%**

Regarding the usefulness of an Autonomous Car in this sample, 32,4% state the such vehicle would be medium advantageous, and most doubt if the impact in daily basis would be positive or negative (47,2%).

Table 33 - Question 21 - Do you consider an Autonomous Car advantageous / useful in your daily life? (Relative and Absolut Frequencies)

	RF (%)	***AF***
Nothing	5,1%	11
Little	12,5%	27
Medium	32,4%	70
Something	26,4%	57
Very	23,6%	51
	100%	**216**

Table 32 - Question 23 - In your opinion an Autonomous Car had a positive impact on your daily life? (Relative and Absolut Frequencies)

	RF (%)	***AF***
Yes	39,4%	85
No	13,4%	29
Maybe	47,2%	102
	100%	**216**

Regarding the benefits of an Autonomous Car (Table 34) participants are neutral regarding the ability the ability of the system to take the decisions without human intervention as disadvantageous. However, they consider advantageous the possibility to park anywhere without a driver, and the capacity of the system to define the fastest route to destination.

Table 34 – Question 24 - Regarding the benefits of an Autonomous Car, classify the following affirmations as you consider them advantageous?

		RF (%)	***AF***	***Mean and SD***
Can Park Anywhere Without A Driver	Very Disadvantageous	2,8%	6	Advantageous *4,03* ± *0,92*
	Disadvantageous	0,5%	1	
	Neutral	22,2%	48	
	Advantageous	40,3%	87	
	Very Advantageous	34,3%	74	
Execute Other Activities During Travel	Very Disadvantageous	3,2%	7	Advantageous *4,07* ± *0,98*
	Disadvantageous	1,9%	4	
	Neutral	19,4%	42	
	Advantageous	35,2%	76	
	Very Advantageous	40,3%	87	
The System Calculates the Fastest Route to the Destination	Very Disadvantageous	2,3%	5	Advantageous *4,05* ± *0,91*
	Disadvantageous	0,9%	2	
	Neutral	22,2%	48	

	Advantageous	38,4%	83	
	Very Advantageous	36,1%	78	
Allowing Children, Elderly and Others Without Driving Capability to Release	Very Disadvantageous	6,0%	13	Neutral *3,80 ± 1,16*
	Disadvantageous	6,0%	13	
	Neutral	25,0%	54	
	Advantageous	28,2%	61	
	Very Advantageous	34,7%	75	
Decisions Taken by The Car Without My Intervention	Very Disadvantageous	18,5%	40	Disadvantageous *2,77 ± 1,22*
	Disadvantageous	22,7%	49	
	Neutral	31,5%	68	
	Advantageous	17,6%	38	
	Very Advantageous	9,7%	21	

Scale: 1 = Very Disadvantageous, 2= Disadvantageous, 3= Neutral, 4= Advantageous, 5= Very Advantageous

Regarding the advantages of obtaining an autonomous car most respondents state comfort (20,7%), ecology (19,8%) and travel time to dedicate to other activities (19,0%) as the main advantages (Table 35).

Table 35 - Question 25 - What other advantages do you think you would like to obtain using an autonomous car?

	RF (%)	AF	Case (%)
Comfort	20,7%	142	65,7%
Ecology	19,8%	136	63,0%
Rest	17,9%	123	56,9%
Safety	12,1%	83	38,4%
Less traffic	10,1%	69	31,9%
Travel time to dedicate to other activities	19,0%	130	60,2%
None	0,4%	3	1,4%
	100,0%	**686**	**317,6%**

According to the sample, the main factors for choosing an autonomous car are price (16,8%), safety (14,6%) and comfort (11,9%), the type of fuel (3,4%), steering wheel and pedals (4,4%).

Although, 79,6% of the sample states that if they knew that an autonomous car could drop the consumption of fuel and gaseous pollutants, it would be considered a good thing.

Table 37 - Question 30 - Decisions factors in the choice of purchase of an autonomous car

	RF (%)	AF	Case (%)
Type of bodywork	4,8%	53	24,5%
Price	16,8%	184	85,2%
Fuel	3,4%	37	17,1%
Potency	6,6%	72	33,3%
Confort	11,9%	131	60,6%
Design classic, modern, futuristic	6,7%	74	34,3%
Security	14,6%	160	74,1%
Ecology	10,4%	114	52,8%
Car decision system	10,6%	116	53,7%
Brand confidence	9,8%	107	49,5%
Steering wheel and pedals	4,4%	48	22,2%
	100%	**1096**	**507,4%**

Table 36 - Question 22 - If you knew that an Autonomous Car would help reduce the consumption of fuel and gaseous pollutants would you think it would be a good thing to get a car like that?

	RF (%)	AF
Yes	79,6%	172
No	6,9%	15
I don't know	13,4%	29
	100%	**216**

On the other hand, most respondents state as disadvantages when using an autonomous security (75,5%), price (69,0%) and limited decision making (61,1%), being the least mentioned hacking (0,5%).

Table 38 - Question 27 - What Are the Disadvantages You Consider Concerning When Using an Autonomous Car? (Relative, Absolut Frequencies and Case)

	RF (%)	AF	Case (%)
Privacy (the cars would communicate with each other)	17,7%	114	52,8%
Security (the car decides everything for itself)	25,3%	163	75,5%
Limited decision making	20,5%	132	61,1%
Autonomy (electric vehicles)	9,8%	63	29,2%
Price	23,2%	149	69,0%
Traffic	2,6%	17	7,9%
None	0,6%	4	1,9%
Others: Hacking	0,2%	1	0,5%
	100%	**643**	**297,7%**

Regarding the future activities if participants acquire an autonomous car most respond that they would watch more movies, series and documentaries (57,4%), read (45,8%) and learn new areas (45,8%). Where the least stated was others, such as sports, sleep, study, traveling and others (all with 0,5%, each).

Table 39 - Question 26 - What activities would you like to dedicate in the future if you had an AV?

	RF (%)	AF	Case (%)
Read	19,0%	99	45,8%
Family and friends activities	15,9%	83	38,4%
Movies, series and documentaries	23,8%	124	57,4%
Concerts	5,6%	29	13,4%
Walking by foot	5,2%	27	12,5%
Traveling cross country	13,1%	68	31,5%
Activities in the mountains	3,5%	18	8,3%
Water activities	2,9%	15	6,9%
Learning new areas	9,8%	51	45,8%
Others			
Mountaineering	0,2%	1	0,5%
Sports	0,2%	1	0,5%
Sleep	0,2%	1	0,5%
Study	0,2%	1	0,5%
Music	0,4%	2	0,9%
Traveling outside the country through Europe	0,2%	1	0,5%
	100,0%	**521**	**263,4%**

Regarding the price people would pay, in this sample the results indicate that most would pay between 20,000 and 25,000 (27,8%) or 15.000 to 20.000 (17,6%), while 19,9% would not be willing to pay for an autonomous car (Table 41).

I price of an AV is high, most see an alternative to the own car, the public transports (76,9%) and ridesharing (Uber, Cabify, Taxi, Blablacar, etc) (43,5%), where the least chose is 0,5% like, none and motorcycle (Table 36).

Related to the emotions of acquiring the car of your dreams most respondents answer that would feel happiness (74,1%), enthusiasm (64,8%) and purpose accomplished (62,5%) where the least state was the courage (4,6%).

Table 41 - Question 28 - How much you would pay for an autonomous car?

	RF (%)	AF
10.000 a 15.000	10,6%	23
15.000 a 20.000	17,6%	38
20.000 a 25.000	27,8%	60
30.000 a 40.000	12%	26
Others		
It depends	2,17%	1
Would not be willing to pay	19,9%	43
I don't know	26%	12
Any amount	6,0%	13
	100%	**216**

Table 40 - Question 31 - Emotions that you would feel if you had acquired your dream car

	RF (%)	***AF***	***Case (%)***
Happiness	22,3%	160	74,1%
Purpose accomplished	18,9%	135	62,5%
Anxiety	2,4%	17	7,9%
Courage	1,4%	10	4,6%
Euphoria	8,5%	61	28,2%
Enthusiasm	19,6%	140	64,8%
Excitement	13,5%	97	44,9%
Lust	6,1%	44	20,4%
Vanity	7,3%	52	24,1%
	100%	**716**	**331,5%**

Table 42 - Question 29 - In case the autonomous cars come to have a high price would consider any of the following possibilities for your displacement?

	RF (%)	AF	Case (%)
Ridesharing (Uber, Cabify, Taxi, Blablacar, etc)	28,5%	94	43,5 %
Carsharing (Drive Now, City Drive, etc)	19,1%	63	29,2 %
Public Transports	50,3%	16	76,9
Walk	0,6%	2	0,9%
Bicycle	0,9%	3	1,4%
Motorcycle	0,3%	1	0,5%
None	0,3%	1	0,5%
Total	**100%**	**330**	**152,8 %**

		6	%
Other			

4.2.2 Qualitative Data

Negative and positive points were pointed out when scrutinizing the 183 valid answers when asked to imagine the use of an AV and to analyze if this would have an impact in everyday life.

In general, more positives than negatives were found, the most pointed being, the optimization of time when doing other activities during the trip, and then the fact that it allows rest and reduce stress. Other positive points were ease of use, economical and sustainable, shorter travel time and reduction of accidents. Already the negatives, only two were mentioned, that the car would take away the pleasure of driving and the lack of control and safety.

This is, people could have more time to perform other activities (such as reading, speaking, surfing the internet, studying, preparing other activities), for example not having to look for parking, the second the extinction of the need to an active driving and technical driving skills. However, some are apprehensive and do not consider these as positive, due to loss of control, safety and even for not being able to drive.

Regarding the impacts of an AV on people's lives, it should be noted that the need for experimentation is evoked by most as being essential for a more concise view.

Table 43 - Question 23.1- What kinds of impact could a car have on people's lives. (category and sub category)

Category	***Sub Category***	***Count***	***%***	***Description***
Positive	Decreased Stress / Tiredness	31	17,8%	Includes relaxation and comfort
	Activities in traffic	42	24,1%	
	Shorter travel time	12	6,9%	Includes less traffic
	Economic and sustainable	17	9,8%	
	Reduction of accidents	9	5,2%	
	Ease of use	21	12,1%	Driving and parking
Negative	Take pleasure in driving	23	13,2%	Includes annoyance
	Lack of control and security	19	10,9%	Includes an increase in accidents
		174	**100,0%**	

4.3 Third Section – Decisions

4.3.1 Quantitative Data

Related to reliability of an autonomous car, more than half of the sample, have said to have doubts in the system of the car (51,4%).

Table 45 - Question 37 - In what way do you consider an Autonomous Car safe?

	RF (%)	AF
Unsafe	1,4%	3
Completely Unsafe	15,7%	34
Neutral	27,8%	60
Save	34,3%	74
Completely Save	5,1	11
	100%	**216**

Table 44 - Question 32 - Do you consider the systems of Autonomous Car Reliable?

	RF (%)	AF
Yes	27,3%	59
No	21,3%	46
Maybe	51,4%	111
	100%	**216**

Of the sample, 33,8% have no opinion on whether there are ethical problems related to technology and 21,3% do not consider at all a problem. And the same opinion holds when we talk about the impact of car decisions on personal values, 32,4% consider null impact and 20,4% do not consider to have impact.

Table 47 - Question 33 - In what way do you consider that the decisions taken by an Autonomous Car can represent problems and considerations regarding values / ethics?

	RF (%)	***AF***
I fully consider	9,3%	20
Consider	19,9%	43
Neutral	33,8%	73
No consider	15,7%	34
I don't fully consider	21,3%	46
	100,0%	**216**

Table 46 - Question 34 - In what away do you consider that the decisions taken by an Autonomous Car may have impact in the values/ethics?

	RF (%)	***AF***
I fully consider	11,1%	24
Consider	19,0%	41
Neutral	32,4%	70
No consider	17,1%	37
I don't fully consider	20,4%	44
	100%	**216**

Sample has questioned to imagine the use of an AV and evaluate a set of items in a scale of 5 from "Strongly disagree" to "Strongly agree".

Having agreed that, decision taken by the system may be different the personal ones, and that privacy can be a problem.

As for the remaining variables, which are "Trust in the system decisions," "The autonomous system in nothing impacts my values" and "Safety of the autonomous car" were considered as neutral or without opinion, see Table 49.

Table 48 - Question 39 - If a close friend or family (parents, husband, women) advice you to utilize an Autonomous Car, would you consider that opinion?

	RF (%)	AF
Yes	50,5%	109
No	14,4%	31
Maybe	35,2%	76
Total	**100%**	**216**

Table 49 – Question 36 - Evaluation of the items when using an AV

		RF (%)	***AF***	***Mean and SD***
Privacy may be affected	Strongly disagree	5,6%	12	I Agree *3,61; ± 1,11*
	I disagree	9,3%	20	
	I do not agree or disagree	26,9%	58	
	I agree	35,2%	76	
	Strongly agree	23,1%	50	
System decision may be different from me in certain situations	Strongly disagree	1,4%	3	I Agree *4,20; ± 0,80*
	I disagree	0,9%	2	
	I do not agree or disagree	13,0%	28	
	I agree	45,8%	99	
	Strongly agree	38,9%	84	
I trust in system decisions	Strongly disagree	4,2%	9	Neutral *3,14 ; ± 0,94*
	I disagree	17,6%	38	
	I do not agree or disagree	46,3%	100	
	I agree	24,1%	52	
	Strongly agree	7,9%	17	
The autonomous system in nothing impacts my values	Strongly disagree	8,8%	19	I do not agree or disagree *2,99 ; ± 1,10*
	I disagree	22,7%	49	
	I do not agree or disagree	40,3%	87	
	I agree	17,6%	38	
	Strongly agree	10,6%	23	
Safety of the autonomous car	Nothing safe	1,6%	3	Neutral *3,31 ; ± 0,90*
	Little safe	18,7%	34	
	Neutral	33,0%	60	
	Safe	40,7%	74	
	Completely safe	6,0%	11	

Scale: 1= Nothing safe, 2= Little safe, 3= Neutral, 4= Safe, 5= Completely safe
Scale: 1= Strongly disagree, 2= I disagree, 3= I do not agree or disagree, 4= I agree, 5= Strongly agree

4.3.2 Qualitative Data

Relating to moral and ethical concerns when using an AV, see Table 50, it should be noted that most believe there are no problems (85 of 195 valid responses). However, those who believe in them, state freedom and legislation, being the last one the most relevant after those who cannot see issues. Be biggest concerns are the lack of decision, the road code and trust in a machine. These regard to the process of decision making, which may be linked to the fact that they are unaware of what data is used and how is the process to reach a decision, does the car decides based on the socio-demographic data for example? Or also, how the car would react in a scenario of carjacking. All these uncertainties make it difficult for humans to trust in a machine.

The least pointed out concerns to the guilty when in case of accident, in the category legislation. Relating to this last category, some changes need to occur in laws that concern driving abilities, insurance and privacy of the data.

Table 50 - Question 35 - List the moral and ethical issues that, in your opinion, associate with the use of Autonomous Cars, which consider to be worrying.

Category	***Sub Category***	***Count***	***%***	***Description***
Freedom	Lack of decision	45	20,7%	Absence of freedom of decision. Rational Decisions without awareness.
	Trust in the Machine	24	11,1%	Technology Dependence, Hacking, Machine Failure and Confidence, Security
	Decisions in cases of collision	13	6,0%	Save Driver / Pedestrians, Based on Age, Social Status, Ethnicity, Other
Legislation	Privacy	10	4,6%	Data Sharing and Privacy
	Guilty of the accident	9	4,1%	Partilha e Privacidade de dados
	Road Code	31	14,3%	Use by Minors, Respect and Cordiality on the Road, Driving License, Disclaimer (Alcohol, inattention)
None	None	85	39,2%	
		217	**100%**	

Security is a relevant feature and to which the sample has some doubts, so it is a particularly important topic. It is observable from the 196 valid answers that more negatives were pointed out than positives, among them unfamiliarity, insecure system and erroneous or limited decisions (Table 45). However, in controversy the most mentioned point was a positive point, the system reliable, which leads one to realize the psychological confusion that makes the security of the AV. Thus, the need for experimentation arise again (see Table 51 and Figure 14).

The results in this question show some divergences, however, most acknowledged that technologies used in AV's need improvements and refinements to reduce risk and become more secure.

In addition, some participants apprehend that artificial intelligence will reduce the mistakes when compared to the human, due to the quicker decisions and manage to be focused on one task. And that is also the company's best interest to offer the best possible system and assure its safety, which is imperative to the success, to minimize issues associated with fines and for the financial health of the company.

Table 51 - Question 37 – Justify the answer given considering the safety of the car

Category (C) | Sub Category (S) | Opinion on safety – Count (O)	Subtotal (C, S)	%
C: Negative	**148**	**71,2%**
S: Absence of Human Decision	**19**	**9,1%**
O: Completely safe 1 | Completely Unsafe 2 | Do not know 2 | Neutral 5 | Unsafe 9		
S: Wrong or Limited Decisions	**20**	**9,6%**
O: Do not know 2 | Neutral 9 | Unsafe 4 | Safe 5		
S: Unfamiliarity	**28**	**13,5%**
O: Do not know 11 | Neutral 12 | Unsafe 1 | Safe 4		
S: Dubious production quality	**10**	**4,8%**
O: Do not know, 3 | Neutral 5 | Unsafe 2		
S: Faults and errors	**13**	**6,3%**
O: Completely Unsafe 3 | Neutral 2 | Unsafe 3 | Safe 5		
S: Hacking	**2**	**1,0%**
O: Neutral 2		
S: Data Sharing	**7**	**3,4%**
O: Do not know 1 | Safe 6		
S: Reliability Testing	**19**	**9,1%**
O: Do not know 4 | Neutral 11 | Unsafe 1 | Safe 3		
S: Unsafe System	**30**	**14,4%**
O: Completely Unsafe 1| Do not know 2 | Neutral 6 | Unsafe 12 | Safe 9		
C: Positive	**60**	**28,8%**
S: Good production quality	**3**	**1,4%**
O: Completely safe 3		
S: Current information available	**2**	**1,0%**
O: Completely safe 2		
S: Trusted System	**55**	**26,4%**
O: Completely safe 10 | Neutral 1 | Safe 44		
Total	**208**	

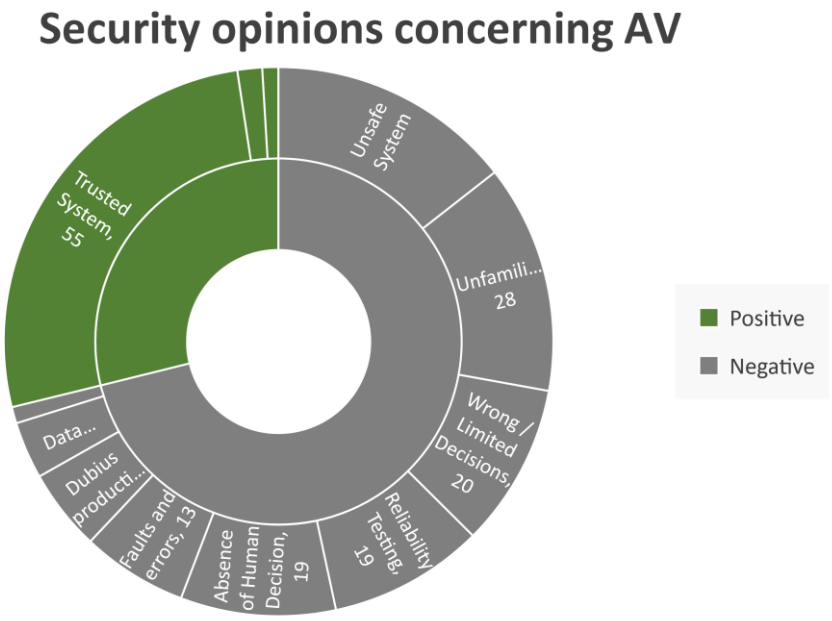

Figure 14 -Opinion considering Safety a positive or negative characteristic.

As for the reasons for buying the car, there are dissimilar opinions, some participants would buy, and others would not.

Seeing the Table 52, the most cited characteristics when deciding to buy an AV are the ability to contribute positively in ecological matter, time to carry out other activities during travel time, comfort and the facilitation that it brings, not having to drive and park, or worry about traffic, making a total of 60,8% of the mentions. The least important mentioned are “Design,” “Lack of alternative” and “Driving Pleasure” (all with 1,1%).

In addition, when analyzing the answers, some mentioned it may increase security due to artificial intelligence decision-making and that it would be a new experience and may be linked to social status and lifestyle.

Table 52 - Question 38 - What are the reasons for buying an autonomous car?

Category	***Count***	***%***	***Description***
Economic and sustainable	34	18,3%	Consumption and ecology
Activities in transit	30	16,1%	
Shorter travel time	8	4,3%	
Decrease Stress / Fatigue	17	9,1%	Includes relaxation and comfort
Facility	21	11,3%	Easy driving and parking, even for people who would not be able to drive. Lack of responsibility and traffic concerns
Luxury and Innovation	9	4,8%	
Price	8	4,3%	
Safety	16	8,6%	

Comfort	28	15,1%
Design	2	1,1%
Lack of alternative	2	1,1%
Driving pleasure	2	1,1%
I did not buy	9	4,8%
	186	**100,0%**

From the 184 answers evaluated, it is observable some reluctancy if society, countries and people are prepared for the AV, and will use them correctly and if it makes better decisions. The answers are both negative and positive have 11 subcategories, although the positive have higher count frequency 171 when compared to negative (92), see Table 53.

In positive category, 71 agrees that the AV is a “Futuristic and interesting” technology, 20 say that it is “Innovative” and that “Facilitates everyday life” and 17 consider it “Safe”. In this category, the least relevant are “Decrease Stress / Fatigue” and “Good for those who do not like driving” with 2 counts.

The most negative point cited is “Unsafe” (35 answers) and the second “Needs further development / studies” (14 answers).

In sum, participants find that technologies in the AV need better development, but undoubtedly consider it as the future, nevertheless some consider that perhaps the DAS would be enough, being unnecessary the complete automation.

Table 53 - Question 40 - Describe in a few words what you think about the AV?

Category	***Sub category***	***Count***	***%***	***Description***
Positive	Innovative	20	7,6%	
	Good for those who do not like driving	2	0,8%	
	Enjoy the time	12	4,6%	
	Facilitates everyday life	20	7,6%	
	Use by unfit	4	1,5%	Such as children and elderly
	Safe	17	6,5%	
	Futuristic and interesting	71	27,0%	
	Ecological	14	5,3%	
	Less traffic	4	1,5%	
	More comfort	5	1,9%	
	Decrease Stress / Fatigue	2	0,8%	
Negative	Take the pleasure out of driving	7	2,7%	
	Unsafe	35	13,3%	Unsafe. Failed Systems
	Hacking	2	0,8%	
	Costs of Maintenance	2	0,8%	
	Needs further development / studies	14	5,3%	
	Unnecessary Technology	10	3,8%	Unnecessary and futile with high expenses and or uninteresting

	Stressing and scary	2	0,8%	
	Absence of Human Decision	8	3,0%	
	Doubts in the realization	7	2,7%	Lots of time to be sold, mass membership unlikely, or time to do it now
	Decisions and ethics	3	1,1%	
	Lack of road condition	2	0,8%	
		263	**100,0%**	

From 53 valid responses, the major doubts concern “Security and reliability guarantee”, “System operation” and “Possible Human Control” with 22, 11 and 7 answers respectively.

This lack of confidence in the safety of the car can also be seen in the results obtained in question 37, where 71,2% (**Table 45**) of the sample lists negative points in the safety of the AV.

In sum, the main questions where safety, process of decision making, ethics and data protection, production and sale price and human control.

Some of the questions are:

- Security and reliability guarantee
  - What forms of data protection?
  - How do you protect yourself from external attacks?
  - What are the guarantees that it is safe?
- System operation
  - How do you make decisions in an accident?
  - Does the car really know all the circuits and routes? How do you behave in those you do not know?
  - What is the relationship between speed and decision making?
  - In case the car has no responsiveness what happens?
- Possible Human Control
  - Is there any possibility of taking over as soon as you like?
  - Can I stop the car immediately?
- Others
  - When will they be available?
  - Who is responsible for the accidents?
  - What are the environmental advantages?
  - What is the top speed?
  - Where do you buy it?
  - What is the production price?
  - Is it possible to drive without a license?
  - How is the communication between the system and the user (voice, touch) made?
  - How to test your viability?
  - Is the owner or the company responsible?
  - How long does it take for society to be prepared?

Table 54 - Question 41 - What are your questions about the Autonomous Car?

Category	*Count*	*%*
Possible Human Control	7	11,5%
Maximum speed	3	4,9%
Security and reliability guarantee	22	36,1%
Available when	1	1,6%
Responsible in case of accident	2	3,3%
Data Privacy Protection	3	4,9%
Real existence of the car	3	4,9%

System operation	11	18,0%
Consumption	1	1,6%
Car Price	2	3,3%
Complexity of technology development	1	1,6%
Current point of development	1	1,6%
Communication between System and Driver	1	1,6%
Use by unfit	1	1,6%
Real environmental advantages	1	1,6%
Doubts in the realization	1	1,6%
	61	**100,0%**

4.4 Shared characteristic's

To understand if there is some common characteristic's shared by the population some correlations were studied considering these variables from section:

- Sample characterization
  - Individual values (question 8)
  - Thoughts concerning today's driving (question 13)
- Imagine that …
  - Ecology (question 22)
  - Dream car feelings (question 31)
  - Competencies and capacities to drive AV (question 20)
  - Use or pretend to use (question 14)

The method used is Pearson correlation coefficient (PCC) in which the correlation ranges are from −1 to 1, the closer to 1 the greater the correlation, i.e. it is a perfect relationship. If 0 there is no relationship between variables, until 0,3 is considered weak relationship, until 0.5 is a moderate relationship and 0,7 or more is considered strong. When negative implies that the relationship is opposite (Y decreases as X increases).

4.4.1 By Individual values

Regarding the individual characteristics, several relationships can be observed, described below in the Table 55.

In short, through the relations, it is verified the probability of adopting an AV that:

- It is inclusive the adoption of the car in those who identify themselves with the “Environment Friendly Technologies,” “Organization of Time", “Savings” and “Family"
    - To “Environment Friendly Technologies,” profile the decision to buy the AV would go through the existence of pedals and steering wheel. Locomotive capacities are not required to drive an AV to “Family” profile. All the profiles consider ecology a benefit of the AV, and for the a “Savings” and “Environment Friendly Technologies” profiles the ability to park without a driver is also an advantage.
- Those who identify with "Need to innovate" are most prone to adopt this type of car
    - This consider safety an advantage of the AV and if driving the car, they would not feel anxious they would rather feel luxurious. For them ecology, type of car and design are the most relevant factors when deciding to buy an AV.
- Those who relate to "Comfort" and "Safety in driving" are less likely to adopt the car.
    - For those who are less prone to adopt an AV could feel panic (“Comfort” profile) or be anxious (“Safety in driving” profile) if driving this car. However, the “Safety in driving” profile see as benefits of the AV the ability to park anywhere without a driver, and the system skill to calculate the fattest route to destination.

Table 55 - Correlation between variables by Individual values.

People who relate to: Family		
- They are driving or already drove a gasoline car, those like to drive and do it more often, in trips that tend to be longer (more than 1 hour). - Do not think that locomotive capacities are essential competences for driving an AV and consider ecology as one of the benefits of the AV, and by opposite rest is seen as disadvantage. - When acquiring the car of your dreams, happiness and sense of purpose achieved are the main feelings.	,174*	I drive very often
	,210*	Usually the trips are long (more than 1 hour)
	,224*	I like to drive
	,223*	I drove a gasoline car
	-,195**	Locomotive Capacities
	,248**	Ecology
	-,137*	Rest
	,134*	Happiness
	,239*	Purpose accomplished

People who relate to: Comfort		
- Nowadays consider that the cost of fuel is high. - Consider sense of panic when using an AV.	,222** ,141*	Cost of fuel has a high price In panic
People who relate to: Organize the time		
- Currently think that the maintenance cost and traffic are high. They also, consider that is tiring to drive with the manual gearbox and trips tend to be longer than 1 hour. - If buying the car of their dreams they would not experience lust.	,181* ,223* ,160* ,169* -,176**	Maintenance Cost is high Traffic is high It is tiring to drive with manual changes Usually the trips are long (more than 1 hour) Lust
People who relate to: Safety on Driving		
- In current driving, they consider that maintenance cost, frequency of maintenance, parking price, traffic and fuel price are all high and there is lake of parking space. - They tend to use DAS and see as benefit in an AV to be able to park anywhere without a driver and to have a system that calculates the fastest route to the destination. Also, ecology and safety are advantages in AV's. - When driving an AV, they would be anxious.	,196* ,186* ,288** ,253** ,200* ,232** ,242** , 167** ,145* ,216** ,169* ,155* ,140*	Maintenance Cost is high No need for recurring maintenance Parking is expensive There is a lack of parking The traffic is high Cost of fuel has a high price I use the aid systems I drove a car with automatic gearbox Anxious Can park anywhere without a driver System calculates the fast route to destination Ecology Safety
People who relate to: Environmentally Friendly Technologies		
- Today maintenance is recurrent and is tiring to drive with manual changes; - The AV can be advantageous and useful for the environment; - One of the advantages of the autonomous car is to be able to park anywhere;	,168* ,160* ,209*	No need for recurring maintenance It is tiring to drive with manual changes Can park anywhere

- Ecology, the existence of steering wheel and pedals are factors of choice for the purchase of an AV;	,390**	Ecological impact
	,182**	Steering wheel and pedals
People who relate to: Save money		
- Less tendency to drive very often; - Less inclined to consider locomotor skills as essential to driving an AV; - Power to park anywhere is one of the advantages of an AV; - One of the advantages of an AV is the advantage of contributing to the ecology; - Comfort and ecological impact are factors considered in the purchase of the AV; - Would feel vanity when acquiring the car of their dreams;	-,171*	I drive very often
	-,157*	Locomotive Capacities
	,198**	Can park anywhere without a driver
	,176**	Ecology
	,176**	Comfort
	,197**	Ecological impact
	-,167**	Vanity
People who relate to: Need to innovate		
- Consider that parking has a high price and have already driven a diesel car - Do not have the idea of feeling anxious when driving an AV; - They rather consider the feeling of luxurious if driving an AV; - Think that safety would be one of the advantages of driving an AV; - Type of car, design, ecological impact and that brand trust would be factors of choice for the purchase of an AV. - Consider that when they acquired the car of their dreams, they would feel feelings of a concrete goal;	,177*	Parking is expensive
	,168*	I drove a diesel car
	-,142*	Anxious
	,139*	Luxurious
	,152*	Safety
	,191**	Body Type
	,164*	Classic, modern and futuristic design
	,137*	Ecology (ecological impact)
	,157*	Confidence in the brand
	,152*	Purpose accomplished

**Correlation is significant at the 0.01 level (2-tailed).*
***Correlation is significant at the 0.05 level (2-tailed).*

4.4.2 By Thoughts of today's driving

The results of the correlations with mixed variables having as fixed variable the thoughts of the current driving it is ascertainable the plausibility of accepting the AV, see Table 56.

The ones most likely to use are those who agree with "AV is difficult to use", "Manual gearbox is tiring" and "I use DAS." The first ones, see this technology as useful in daily life and consider it modern and futurist, seen as advantages the ability of using the travel time to accomplish other tasks, the capability of the system to make decisions by itself and to calculate the fast way to reach the destination. The second ones, would feel happy using the AV and see it as safe, not considering a factor to the purchase the existence of pedals and steering wheel. The last ones would feel happy and luxurious when using an AV and see as benefit the ability of the car to park itself without human intervention.

The remaining variables are inconclusive regarding the adhesion of the technology, on these it is possible to verify some tendencies, mainly regarding the capacities necessary to use a car, advantages and factors of purchase. Two of these variables related to high maintenance cost and frequency tend to consider an AV easy to use. The variables studied mention the following:

- Concerning the competencies and capacities to use an AV
    - Ability to make decisions ("No frequent maintenance," "Parking price is high," "Parking is absent")
    - Low or no consumption of alcohol ("Traffic is high")
    - Absence of mental disorders ("Drive often")
    - Absence of cardiovascular disease ("I use DAS")
- Advantages of the AV
    - Less traffic ("No frequent maintenance")
    - Park anywhere with no driver ("Traffic is high," "I use DAS," "AV difficult to use")
    - Safety ("Manual gearbox is tiring")
    - Calculation of the fast route to destination ("I use DAS," "Long trips")
    - Decisions made by the system ("AV difficult to use")
    - Do not see as advantage the ability of the system to make decisions by itself ("Like to drive")
    - Use travel time to make other activities ("AV difficult to use")
    - Do not see as advantage the use of time to perform other activities ("Like to drive")
- Feelings using these type of car

  - Courageous (“Traffic is high”)
  - Happy (“Manual gearbox is tiring,” “I use DAS”)
  - Luxurious (“I use DAS”)
- Contribution factors to the purchase of an AV
  - Power and Pedals are not a factor (“Manual gearbox is tiring”)
  - Price is not a factor (“Long trips”)
  - Brand confidence (“Fuel is expensive,” “Like to drive”)
  - Power (“Like to drive”)
  - Comfort (“AV is difficult to use”)
  - Safety (“AV is difficult to use”)
  - Rest (“AV is difficult to use”)
  - Design (“AV is difficult to use”)

Table 56 - Correlation between variables by Thoughts of today’s driving.

People who relate to: Maintenance cost is high		
- Tend to have driven a diesel car	,247**	I drove a diesel car
- Do not consider the use of an Autonomous Vehicle as difficult	-,237**	Considers it difficult to use an AV
- Identify ecological impact as one factor to purchase this type of car	,163*	Ecology (ecological impact)
People who relate to: No need of frequent maintenance		
- As the people who relate to “Maintenance cost is high”, they tend to have driven a diesel car and do not consider difficult the use of an AV.	,244**	I drove a diesel car
	-,178*	Considers it difficult to use an AV
- They also tend to consider that the decision-making capacity is one of the necessary skills to drive this type of car	,169*	Decision Ability
	,158*	Less transit
- Tend to agree as an advantage the contribution to have less traffic		
People who relate to: Parking lot has a high price		
- Tend to have already driven a diesel car	,170*	I drove a diesel car
- consider the decision ability as a necessary competence to drive an AV	,167*	Decision Ability
- When owning the car of their dreams, vanity tends to be the emotion	,176*	Vanity
People who relate to: Parking lots are absent		
- Already drove a diesel car and one with automatic gearbox	,188*	I drove a diesel car
- As people who relate to “Parking lot has a high price” they also consider a necessary competence to drive an AV being able to make decisions and agree that vanity is the feeling when owning a dream car	,169*	I drove car with automatic gearbox
	,226**	Decision Ability
	,168*	Vanity
People who relate to: Traffic is high		

- When using an AV, they would feel brave	,164*	Courageous
- Consider that drivers with excessive consumption of alcohol should not drive an AV	,168*	Absence of excessive alcohol consumption
- The advantage if driving an AV would be the ability to park anywhere without a driver	,178*	Can park anywhere without a driver
People who relate to: Fuel is expensive		
- Already drove a diesel car and one with automatic gearbox, as the people that identifies with" Parking lots are absent"	,235*	I drove a diesel car
	,325*	I drove a car with automatic gearbox
- Tend to think that trust in the brand would be an important factor at the moment of purchase	,162*	Confidence in the brand
	,181*	Lust
- And agree that lust is associated to owning the dreams car		
People who relate to: Manual gearbox is tiring		
- Agree that when driving an AV, they would feel happy	,161*	Happy
- Safety is an advantage in these cars	,212**	Safety
- Pedals, steering wheel and power are not important factors to the decision of buying the car	-,221**	Power
	-,178*	Steering wheel and pedals
People who relate to: I use DAS		
- Have already drove a diesel car and do not drove an electric car	-,241**	I drove an electric car
- Would feel happy and luxurious when using an AV	,266*	I drove a diesel car
- One of the skills to drive an AV is the absence of serious cardio-vascular diseases	,232**	Happy
- Advantages of these cars would be the ability to park anywhere without driver and also the calculation of the fastest route to destination	,190*	Luxurious
	,161*	No serious cardiovascular disease
- - Emotion when driving the car of their dreams would be the vanity	,165*	Can park anywhere without a driver
	,177*	System calculates the fast route to destination
	,200*	Vanity
People who relate to: I drive often		
- Tend to have driven in gasoline-powered cars with manual and automatic gear gearbox	,365**	I drove a gasoline car
	,290*	I drove a car with a manual gearbox
- Consider as one of the essential skills to drive an AV is the absence of mental and behavioral disturbance	,328**	I drove a car with automatic gearbox
	,244**	Absence of mental and behavioral disorders
- When acquiring the dream car, the emotion felt tends to be vanity.	,175*	Vanity
- They also tend to consider that the decisions of the AV would not have much impact on personal values and ethic.	,205*	Impact in personal values and ethics
People who relate to: Usually the trips are long (more than 1 hour)		
- Currently tend to have driven an LPG car with automatic gearbox	,207*	I drove a car to LPG
- Calculation of the fastest route to the destination is seen as an advantage on AV's	,161*	I drove a car with an automatic gearbox

- To make the decision to buy an AV price is not a factor.	,173*	System calculates the fast route to destination
	-,201*	Price
People who relate to: I like driving		
- Have driven a gasoline car with manual and automatic gearbox	,292**	I drove a gasoline car
- Tend to disagree that the ability to perform other activities and the decision taken without driver intervention are advantages of the AV.	,202*	I drove a car with a manual gearbox
	,230**	I drove a car with automatic gearbox
- Power and confidence in the brand are considered a important factor to the decision of purchase of an AV	-,187*	Perform other activities while traveling
	-,205*	Decisions made by the car
- When acquiring the dream car, they would feel happy, with a sense of purpose achieved, lust, euphoria, enthusiasm, excitement	,263**	Power
	,196*	Confidence in the brand
	,212**	Happiness
	,184*	Purpose Completed
	,175*	Euphoria
	,182*	Enthusiasm
	,275**	Excitement
	,219**	Lust
People who relate to: AV is difficult to use		
- Tend to consider the car useful in day to day life, and consider as advantages to allow other tasks to be carried out during the journey, the	,239**	Useful in your day to day life
	,199**	Use travel time to engage in other activities
calculation of the fastest rout to destination by the system and the system ability to take	,160**	System calculates the fast route to destination
decisions without my intervention	,226**	Decisions without driver intervention
- Consider as key characteristics to the decision of buying this type of car, the comfort, rest, safety, price, design, classic,	,210**	Comfort
	,222**	Rest
- They tend to consider the AV as modern and futuristic,	,170*	Safety
- When acquiring the dream car, the feelings associated are euphoria, lust, and vanity	,166*	Price
	,168*	Classic, modern and futuristic design
	,135*	Euphoria
	,242**	Lust
	,136*	Vanity

**Correlation is significant at the 0.01 level (2-tailed).*
***Correlation is significant at the 0.05 level (2-tailed).*

4.4.3 By Benefits of AV

From these correlations, having as fixed variable one benefit of the AV, it is inconclusive if these would use this type of car.

However, from the results it is observable that most of these tend to agree that comfort, rest and safety are important characteristics when deciding to buy an AV. The price and type of the car were once pointed out as a characteristic for the purchase decision of the car, by those who relate to "Perform other activities while traveling" and "Can park anywhere without a driver." By contrary those who see as advantage the decisions being made only by the car, tend not to consider the confidence in the brand and the existence of pedals and steering wheel as factors when deciding to purchase an AV.

Table 57 - Correlation between variables by Benefits of AV

People who relate to: Can park anywhere without a driver		
- *Comfort, rest and the use of time to dedicate to other activities are advantages of the AV* - *The type of car is considered a purchase factor for the AV* - *It is noted that one of the advantages would be comfort, and that one of the emotions when having a dream car would be happiness*	,204** ,160* ,149* ,136* ,139* ,157*	Comfort Rest Use travel time to engage in other activities Body Type Comfort Happiness
People who relate to: Perform other activities while traveling		
- *Tend to consider on AV's an advantage the comfort, rest, security, use of time for other activities* - *One principal factor to the decision of purchase is the price.* - *Participants do not tend to consider social problems or impacts on issues of personal values and ethics.*	,204** ,400** ,203** ,165* ,140* ,170*	Comfort Rest Safety Price AV represents problem to values/ethics AV has impact in values/ethics
People who relate to: Is advantageous the calculation of the fastest route to the destination		
- *Tend to consider as an advantage of the AV comfort, rest, and safety, and less traffic*	,159* ,172* ,207** ,191**	Comfort Rest Safety Less traffic
People who relate to: Allows children, elderly and others with no driving ability to move		
- *Find advantageous in an AV the ability to rest.* - *When having the dreams car, they tend to feel enthusiastic*	,227** ,172*	Rest Enthusiasm

People who relate to: Decisions made by the car without driver intervention is advantageous

- *Comfort, rest, security, less traffic, use of travel time to perform other tasks are considered an advantage*
- *Trust in the brand and the existence of steering wheel and pedals are not considered essential factors when purchasing and AV*
- *Tend to consider a problem the impact on personal ethics and values when using the AV*

,170*	Comfort
,214**	Rest
,374**	Safety
,144*	Less traffic
,151*	Use Travel Time to engage in other activities
-,150*	Trust in the brand
-,184**	Steering wheel and pedals
,229**	AV represents problem to values/ethics
,175**	AV has impact in values/ethics

**Correlation is significant at the 0.01 level (2-tailed).*
***Correlation is significant at the 0.05 level (2-tailed).*

Chapter 5 - Conclusions and recommendations

5.1 Main conclusions

Comparing the quantitative and qualitative data, it is possible to infer that they mostly match and complement each other. For instance, in aspects such as the need of progress, need to experience and to obtain more information. According to the study, the opinion of the potential buyer may be explained partiallyby the lack of confidence on the automation system of the car, for example if it would happen to lose control of it. The lack of control on dangerous situations appears to be a critical issue, because when it comes to these cars, they are in fact totally dependent on technology, and the human factor is no longer considered.

The idea associated with the AV is that of this present evolution and future that considers the environmental issues, being related to social status. There are also those who have the notion that this will allow the increase of free time.

A controversial aspect is the knowledge about the technology these cars possess. In fact, when analyzing the quantitative data, our respondents claim to know about the technology used, however in the qualitative data it is verified that some say they do not know about it, or they need to experience or have more information about the car to be able to answer. And there are many questions and doubts regarding the car, some of these doubts are seen in quantitative data, where the predominance of response is the "maybe" or "neutral."

Prices are another relevant topic, once it is considered one of the most important factors to purchase a car, and prices are expected to be much higher than the budget of most consumers.

Results show that the progression of this type of technology is understood, however the need of information and experience is evoked, to accustom and trust on the radical change that would be provoked by this technology.

Table 58 – Short conclusions to the main question, research function and objectives of the study.

Main Question	
How the information and technologies currently available influence opinion about AVs?	
From the question about the usage made of the already available IA technology, on the most recent cars, such as DAS (Parking sensors, cruise control, GPS, and others), 31% of the of the respondents use them and 26% say that they do not use them, see *Table 24* and *Table 23*. These results indicate the latest available technology that has not yet been tested or approved by drivers. The lack of information concerning the AV arises some questions and doubts of whether the car is secure, trustful, useful and if it has some impact on ethic and values of each individual. This turns the acceptance of the car more difficult. If drivers do not trust the technology that helps them, it will be worse when the driver is not required to control the technology responsible for controlling the vehicle. Therefore, it is visible that some concern or mistrust in technology is shown in the answers given. This is also an early stage of this technology and is not yet available for the general market and there are still some secrets about the advances, much of which is due to competition between companies.	
Research Function	
Understand which information's and technologies affect most and least the consumer's acceptance of Autonomous Cars.	
Objectives of the study	***Conclusion***
Compare the ease and skills associated with the use of driving assistance systems with the av driving system.	AV are harder to use compared to the general technology and DAS.
Gauge if the subject is unknown in the sample.	Concept is known.
Gauge the feeling associated with the idea of using an av.	Curious, enthusiastic and anxious quite different feelings when compared to the purchase of the dream car
Check the situations that may change the daily life and the benefit or not in using the av.	Only half the sample sees some benefit using AV, mostly for parking without the driver, to drive people without driving capability, to calculate the fast route and to be able to take decisions without driver intervention.
Compare whether the prices currently advertised by brands match the expectations of potential consumers.	19,9% would not be willing to pay and the others 80% would be. The value stated does not cover the expected market price of the AV.
Assess the level of risk associated with av driving systems.	Unawareness and doubts regarding the operation of the system and the impacts of it. Although, population is receptive to the AV and even finding it partly safe.
Determine which features are most and least relevant / appreciated by the sample (and verify if AV's can meet these).	Most mentioned reasons for purchase are economy and sustainability, allow to do activities in the traffic (such as read, to watch films, series and documentaries and to

	learn new areas), comfort and ease of use. By contrary, least valued are design, DAS, extras and color.
Identify the opinion on current car driving (and compare it with the level of safety associated with the av)	Potential buyers of the car would be people with innovative profile and some financial standing, price is high there is lake of confidence in the system, and there is no need of an AV, since current cars with manual gearbox are enjoyable to drive and DAS are not used.

5.1.1 Compare whether the prices currently advertised by brands match the expectations of potential consumers.

This issue regarding autonomous cars leaves many uncertainties, since the brands keep as a secret the cost of production and the expected price of sale of the current prototypes of AV. However, it is possible to validate that AV's are expected to have higher prices due to the cost of the technologies, such as cameras, sensors and LIDAR radar, in which only the latter costs about € 62,250 (Schreurs and Steuwer 2015). For example, the Tesla 3 is partially autonomous that does not use a LIDAR radar and is already on market, it is the lowest price model and costs 48 900€ (Tesla Motors, 2019).

Results show that the sample drives often. In their opinion, they would be willing to pay for an AV a value between 15,000€ and 25,000€ (45,5%), having only 6,0% paying any value, and other 19,9% that would not be willing to pay.

Price is considered the main factor in the acquisition of a car and the sample considers that saving is one of the main personal characteristics, it can be verified that the acceptance and acquisition would be exceedingly difficult derived to the value of the AV.

In this scenario, where the price of the AV is higher than the maximum price set by consumers, they would choose ridesharing, carsharing or public transports as the preferable means of transport (97.2%) instead of owning a car.

5.1.2 Compare the ease and skills associated with the use of DAS with the AV driving system.

We can see that most of the sample has adopted the basic technologies in today's European society, the computer (99,1%), tablet (64, 4%) and smartphone (79,6%).

In relation to technologies in a car, the DAS, only 14,2% never tried any system and those who use are mostly the GPS (41,7%), Cruise Control (25,9%) and Parking Sensors (34,3%). In addition, a major part reviews themselves in innovations and considers that they are big adepts of technology with a lot of

ease of use in the technologies adopted (31,5%). Also, other 24,1%, have the same opinion but do not review themselves in innovations. In addition, no one dislikes or do not use technology. When analyzing the technology and ease of use, it is appreciated and used easily.

According to the study, the majority agrees that some capacities or competencies are needed to use an AV, those are to use technology with ease (76,9%), to own a driving license (45,4%), to be able to make decisions (41,7%), to be absent of mental and behavioral disorders (39,4%) and to be absent of excessive non-consumption of drugs and medicines with influence on driving (32,4%).

The AV is an evolved DAS that is considered by majority as easy or very easy to use (49,6%), although some say that it is average difficulty only 10,6% agree that it is hard or very hard to use.

With the study we notice that for the majority of the inquiries, AV is harder to use, when compared to the general technology and DAS. The last ones are considered by 94,9% of “relative ease” to “lot of ease”, on the other hand the AV is seen by 49,6% as “easy” to “very easy” to use.

5.1.3 Gauge if the subject is unknown in the sample.

AV’s were already known to 84,7% of the sample, which declares they had known through the internet and television, 53,7% and 14,8%. In addition to these means, were mentioned School, Websummit, Conversation, Home and Articles (“Others” 7,5%) (Table 27 and Table 28).

When analyzing the opinion of the sample on the topic it is observable some agree the AV is seen as being the future (27.0%) and innovative (7.6%) having however, some reticence about safety (13.3%), see Table 53. And there the sample needs additional information, mostly regarding the safety of the AV (36.1%), the way the system works (18.0%) and the possibility of human control (11.5%) (Table 54).

5.1.4 Gauge the feeling associated with the idea of using an AV.

Despite the concerns, most respondents said that they would use (35,2%) or considered it possible (42,6%) to use this type of car, and in most cases they say they feel curious (58,3%), enthusiastic (38,4%) and anxious (37,5%) when they consider acquiring this type of vehicle (Table 26 and Table 30). However, they are quite different sensations when compared to those who would say if they acquired the dream car, in which most described feeling happiness (74,1%), a sense of purpose achieved (62,5%) and enthusiasm (64,8%) (Table 40).
According to Kim, one of the purchase motives are the values, attitudes, interests and opinions (Kim et al., 2002). And by Attig, for an technology to be accepted the are some characteristics in individuals that should be considered such as affinity for technology, utilitarian use and hedonic motivation or some geekism (need to explore new technologies (Attig et al., 2017).

In sum, when observing the emotions described when acquiring and AV and the dream car, it leaves a doubt whether the AV would have a positive effect on emotions, such as a dream car would. Having that, and the opinions of Kim and Attig the acceptance of this car due to emotions and feelings may not be the most important.

5.1.5 Check the situations that may change the daily life and the benefit or not in using the AV.

In terms of benefits, and despite being enthusiastic about experimenting with these vehicles, 50% do not see them as advantageous, compared to those they already drive (Table 33). The other half thinks that these have some positive impacts, namely the reduction of driving-related stress, and that they are indeed useful (Table 38 and Table 32). Seeing as possible advantages of an AV, the possibility to park without a driver, allow people to drive without driving capability, calculation of the fastest route and the decisions without driver intervention (Table 35).
In sum, this duality of results does not allow us to conclude a predisposition for large-scale acceptance, even because many drivers see driving as a pleasure.

Regarding the ecological advantages, and in the light of recent events, it would be interesting to see how their opinions are related to the fact that these cars are electric. Since 63% see them as ecologically advantageous and the latest news and studies, they realize that the batteries used in electric cars are harmful to the environment, both from the point of view of the purchase of the raw material to build them and the way of recycling which still cannot be done (Egbue & Long, 2012).
We can therefore question ourselves even if this aspect is a negative point regarding the acquisition of these vehicles, since if in the future it is proved that the batteries are harmful to the environment, adhesion to this type of car could still decrease, given that 52,8% say that this point is important for the decision to purchase a car (Table 35).
Moreover, many see electric cars as unreliable for long distances, and may be points relevant to the advantages presented (Egbue & Long, 2012).
Although the biggest disadvantage found by the respondents was security, price and decision making (Table 38), considering public transport as more advantageous (Table 38).
However, while decision models are developing and constantly improving, the time for analysis and response of these cars should be better than for humans. On the other hand, there may be restrictions derived from the quality of data capture for the decision, since the hardware is not yet available for all the effects of time and clarity, which may be compromised during the night in situations of high cloudiness or heavy rain (Weisser, Schulenberg, Göllinger, & Schmidt, 2000).
In addition to these two issues, artificial intelligence introduces ethics that is also the cause of great doubts, since in an accident situation, it will opt for the smallest number of possible deaths, even if this means self-destruction (Bundesministerium für Bildung und Forschung, Federal Ministry of Education

and Research (BMBF), & Demographic Change Division; Human-Machine-Interaction, 2016; Lin, 2016)(Lin, 2016)[14](Lin 2016)(Lin 2016)(Lin 2016)

5.1.6 Assess the level of risk associated with AV driving systems.

Through the study we observed that more than half neither trust nor distrust the AV, but on the other hand more than a quarter considers it reliable. And most do not consider or consider at all, that there may be a problem in the ethics and personal values (37,0%), however a smaller but considerable part of the sample, has doubts as to whether or not it could represent a problem (33,8%). As for the impact of these problems on the values of each individual, there is the same opinion, that is, no impact or doubts on the subject.

However, they identify several problems particularly in relation to Freedom and Legislation, the most relevant being absence of decision, road code and data privacy. Others identified problems are reliability in a machine, decisions in case of collision and guilt in case of accident.

And although they refer to the system as being absent from ethical problems, close to 85% agree that the system will make different decisions than the driver would, but most cannot see if this would compromise their personal values.

However, the sample considers the AV as safe or neutral, about 35% and 30% respectively. And the sample considered negative for safety the limitations in the decision-making capabilities of the AV and the ignorance of the decisions, these may be the reason why AV doubts prevail.

In conclusion, it is concluded from the study that there is a lot of unawareness and doubts regarding the operation of the system and the impacts of the same, but these are receptive to the AV, not rejecting and even finding it partly safe.

Safety and reliability are one of the relevant points for choosing a car, according to Litman, Egbue and Long and Mohd Jawi, so long as there are many doubts the reception will be lower. To minimize this, it will be necessary to clarify the operation of the system, so that the population can more concretely identify the AV as safe or unsafe.

5.1.7 Determine which features are most and least relevant / appreciated by the sample (and verify if AVs can meet these).

For the purchase of an autonomous car the most mentioned reasons for purchase are the economy and sustainability, allow to do activities in the traffic, comfort and ease of use. The least valued features in cars in general are the design, the aid systems, the extras and the color.

Sustainability and reduction of the environmental impact besides being one of the main reasons for buying the autonomous car, is also identified by about 83% as a personal value. This study verifies that the activities that the sample would like to do if it had an autonomous car, would be to read, to watch films, series and documentaries and to learn new areas. Therefore, the inclusion of these activities

would be an added value for the acquisition of the car, since the possibility of carrying out activities is a reason for the acquisition identified with one of the main.

In some models these are already included, according to Bay, AV's are idealized to create an experience during travel time, having for example the Mercedes-Benz F 015 Luxury, and prototype of AV it includes some features such as video, music, internet, voice recognition and gestural recognition (Bay & Nysveen, 2016; Mercedes-Benz, 2018b).

5.1.8 Identify the opinion on current car driving (and compare it with the level of safety associated with the AV)

With this study it was observed that currently Portuguese drivers have short travel times and find driving a pleasant experience not considering it tiring, while most of them drives a manual gearbox car. And even claim they would not like to have an automatic gearbox car, which the AV has.

However, there are some problems such as the high price of gasoline, parking and maintenance and the absence of parking spaces. With the introduction of AV's, the parking problem can be minimized since they can park alone. On the other hand, there is no tendency to use DAS, which can be explained by two reasons, the absence of cars with these technologies or the lack of use when the car has them.

Putting together current opinion with uncertainty about the reliability and safety of the AV's, perhaps the potential buyers of the car would be people with innovative profile and some financial standing. Since few would be those who would invest in a car with a high price and do not feel full confidence of its system or need of it, since they do not consider the current cars a problem, once they enjoy driving a manual gearbox car and do not use DAS.

5.2 Limitations

During the present study some limitations and difficulties were found.

Firstly, difficulties in obtaining answers to the inquiry, derived from the date of beginning of the distribution that occurred with the school vacations of the population selected for the study.

Secondly, derived from the recent topic, there is a certain limitation in the available information, making more difficult the design of the inquiry and selection of the methodology to analyze the collected data. Therefore, redefining the variables would be an improvement as it would allow, to use variables that allow a better descriptive statistical analysis of the results. Thus, it would be possible to achieve a higher level of confidence in the conclusions of the research.

5.3 Future studies proposal

Continuing the autonomous cars theme, some possible studies would be to:

- Verify the extent to which the use of batteries as an energy source and the absence of pedals and steering wheel may compromise or not the purchase decision of the car.
- Verify the consistency of the data collected, would constitute a second phase and a future study proposal. Once, given the temporal limitation, the objective of the present study was reduced in a way that the initial intention was to evaluate and confirm the conclusions of the data obtained with the first objective, the present study.
- Extend the study to new samples outside ISCTE.
- Extend the study of automation to agricultural professional uses, patient transport, public transport and freight transport.
- Study the opinion and technologies that affect the opinion of the AV in a phase where consumers can experience the car, and

Other study proposal would be to study automation concerning other vehicles such as bicycles, boats, airplanes, motorbikes and drones.

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A – Appendix

Evolução da Tecnologia Automóvel

O presente questionário tem como intuito a elaboração de uma Dissertação para Mestrado. O estudo pretende conhecer o perfil de condutor do futuro, com base na análise de diferentes dimensões desta atividade, nomeadamente, na forma como vê e interage com a tecnologia.

O tempo previsto de resposta ao questionário é de 15 minutos no máximo.

Se durante o preenchimento tiver alguma dúvida ou necessidade de informação adicional, por favor contacte:

patricianobrega94@gmail.com

Muito obrigada pela sua colaboração!

*Obrigatório

Uma nota sobre a privacidade

Este questionário é anónimo.

O registo guardado das suas respostas ao questionário não contém nenhuma informação identificativa a seu respeito.

Consentimento informado *

Eu li e compreendi a informação acerca do objetivo e política de privacidade do questionário, e desejo voluntariamente responder ao questionário que se segue. Se concorda com a declaração prévia e deseja participar neste estudo, através da sua resposta a questionário, selecione "Concordo".

☐ Concordo

Dados Sociodemográficos

1. Idade *

2. Género *

☐ Feminino
☐ Masculino

3. Atividade *

- [ ] Docente
- [ ] Estudante
- [ ] Estudante/Trabalhador

4. Onde passa a maior parte do seu tempo? *

- [ ] Cidade Capital de Distrito
- [ ] Cidade
- [ ] Aldeia perto de Cidade
- [ ] Aldeia
- [ ] Vila
- [ ] Outra

5. Quais os dispositivos tecnológicos a que já aderiu? *

- [ ] Selecione todas as que possuiu.
- [ ] Telemóvel
- [ ] Tablet
- [ ] Telemóvel inteligente
- [ ] Computador
- [ ] TV Inteligente
- [ ] Eletrodomésticos inteligentes
- [ ] Outra

6. Qual é o seu nível de facilidade na utilização dos dispositivos tecnológicos acima indicados? *

- [ ] Tenho muita dificuldade.
- [ ] Não gosto, não uso, sou contra. Tenho algumas dificuldades.
- [ ] Uso apenas no trabalho porque sou obrigado.
- [ ] Uso com relativa facilidade e gosto de usar.
- [ ] Uso com relativa facilidade, mas não gosto de muito. Uso com facilidade vários dispositivos.
- [ ] Sou grande adepto e tenho muita facilidade.
- [ ] Sou grande adepto, tenho muita facilidade e revejo-me nas inovações.

7. A que se dedica nos tempos livres? *

Identifique quais as atividades que costuma realizar nos tempos livres.

Marcar tudo o que for aplicável.

- [ ] Ler
- [ ] Concertos
- [ ] Passear a pé
- [ ] Viajar pelo país
- [ ] Atividades na serra

- ☐ Atividades náuticas
- ☐ Aprender novas áreas
- ☐ Filmes, séries e documentários
- ☐ Atividades com amigos e familiares
- ☐ Outra

8. Quais as características que mais o definem/valoriza? *

Para cada elemento, diga qual o grau na qual valoriza as características, caso não saiba responder indique "Não sei".

	Não me identifico	Identifico-me pouco	Identifico-me	Identifico-me muito	É essencial para mim. Identifico-me por completo
Trabalho	☐	☐	☐	☐	☐
Família	☐	☐	☐	☐	☐
Conforto	☐	☐	☐	☐	☐
Organizar bem o tempo	☐	☐	☐	☐	☐
Segurança na condução	☐	☐	☐	☐	☐
Tecnologias amigas do ambiente	☐	☐	☐	☐	☐
Economizar	☐	☐	☐	☐	☐
Tenho necessidade de ser inovador	☐	☐	☐	☐	☐

Adoção de tecnologia automóvel

9. Possui Carta de Condução? *

- ☐ Sim
- ☐ Não Passe para a pergunta 18.

9.1 Identifique as cartas de condução que possui. *

- ☐ Marcar tudo o que for aplicável.
- ☐ Carro
- ☐ Mota
- ☐ Barco
- ☐ Outra

10. Possui carro próprio? *

- ☐ Sim
- ☐ Não
- ☐ Apenas os meus familiares
- ☐ Outra

11. Com que frequência conduz? *

- ☐ Não conduzo
- ☐ Conduzo durante a semana
- ☐ Conduzo no fim de semana
- ☐ Conduzo todos os dias
- ☐ Conduzo esporadicamente

12. Identifique os sistemas automáticos de auxilio do(s) carro(s) que conduz ou conduziu.*

Marcar tudo o que for aplicável.

- ☐ GPS
- ☐ Cruise Control
- ☐ Ajuda arranque
- ☐ Sensores de estacionamento
- ☐ Nunca utilizei nenhum sistema
- ☐ Travagem de emergência
- ☐ Retrovisor com visão de Ângulo Morto
- ☐ Outra

13. Na condução que faço atualmente, penso que... *

	Discordo fortemente	Discordo	Não concordo nem discordo	Concordo	Concordo fortemente
O Custo de Manutenção é elevado	☐	☐	☐	☐	☐
Há necessidade de manutenção recorrente	☐	☐	☐	☐	☐
O estacionamento tem preço elevado	☐	☐	☐	☐	☐
Há falta de estacionamento	☐	☐	☐	☐	☐
O Trânsito é elevado	☐	☐	☐	☐	☐
O combustível tem preço elevado	☐	☐	☐	☐	☐

É cansativo conduzir com mudanças Manuais	☐	☐	☐	☐	☐
Utilizo os sistemas automáticos de auxílio (sensores de estacioamento, cruise control, GPS, ...)	☐	☐	☐	☐	☐
Conduzo com muita frequência	☐	☐	☐	☐	☐
Geralmente as viagens são longas (mais de 1 hora)	☐	☐	☐	☐	☐
Gosto de conduzir	☐	☐	☐	☐	☐

14. Indique qual o seu grau de concordância com as seguintes afirmações. *

Para cada linha, indique o grau de valorização que atribui a cada uma das afirmações.

	Gostaria	Não Gostaria	Já conduzi	Conduzo atualmente
Conduzi(o) um carro elétrico	☐	☐	☐	☐
Conduzi(o) um carro a GPL	☐	☐	☐	☐
Conduzi(o) um carro a Gasolina	☐	☐	☐	☐
Conduzi(o) um carro a Gasóleo	☐	☐	☐	☐
Conduzi(o) um carro com caixa manual	☐	☐	☐	☐
Conduzi(o) um carro com caixa automática	☐	☐	☐	☐

15. Quais as características que menos valoriza num carro? *

Imagine que...

Amanhã não seria necessário ter de conduzir um carro para chegar ao seu destino! Apenas teria de se sentar e indicar o destino pretendido. Durante esse tempo poderia efetuar outras atividades como ler, ver um filme, estar numa reunião, etc... O sistema desse carro iria decidir as ações a tomar, como desviar, ultrapassar, travar, abrandar, virar, estacionar, selecionar a rota mais rápida para o destino selecionado por si, ... nesse carro não existiriam pedais ou volante. Intitule esse carro como "Carro Autónomo".

16. Já tinha ouvido falar no termo Carro Autónomo? *

☐ Sim
☐ Não Passe para a pergunta 20.

16.1 Onde ouviu falar pela primeira vez sobre o conceito de Carro Autónomo? *

- [ ] Internet
- [ ] Revistas/Jornais
- [ ] Televisão
- [ ] Redes Sociais
- [ ] Escola
- [ ] Outra

Sobre a condução autónoma

17. Imagina-se a utilizar um Carro Autónomo? *

- [ ] Sim
- [ ] Não
- [ ] Talvez

18. Como se sentiria ao utilizar um Carro Autónomo? *

Marcar tudo o que for aplicável.

- [ ] Amedrontado(a)
- [ ] Ansioso(a)
- [ ] Confuso(a)
- [ ] Curioso (a)
- [ ] Corajoso(a)
- [ ] Entusiasmado(a)
- [ ] Feliz
- [ ] Luxuoso(a)
- [ ] Em pânico
- [ ] Vaidoso(a)
- [ ] Outra

19. Considera difícil a utilização de um Carro Autónomo? *

Muito Difícil 1 2 3 4 5 Muito Fácil

20. Quais as competências ou capacidades que acha necessárias para utilizar um Carro Autónomo? *

Marcar tudo o que for aplicável.

- [ ] Facilidade de uso de tecnologias como tablets, computadores, smartphones, ... Capacidade de decisão
- [ ] Interação com grupos heterogéneos (diferentes valores, normas, países, ...)
- [ ] Ausência de doenças cardiovasculares graves
- [ ] Ausência de perturbações mentais e comportamentais

- ☐ Ausência de doenças neurológicas (sistema nervoso e periférico)
- ☐ Ausência de consumo de álcool em excesso
- ☐ Não consumo de Drogas e medicamentos com influência na condução
- ☐ Capacidades locomotoras
- ☐ Carta de condução
- ☐ Outra

21. Em que medida considera um Carro Autónomo como vantajoso/útil no seu dia a dia? *

Nada Vantajoso/útil 1 2 3 4 5 Muito Vantajoso/útil

22. Se soubesse que um Carro Autónomo iria ajudar a reduzir o consumo de petróleo e gases poluentes seria um ponto positivo para vir a adquirir um carro desses? *

- ☐ Sim
- ☐ Não
- ☐ Não sei

23. Na sua opinião, um Carro Autónomo teria impacto positivo na sua vida diária?*

- ☐ Sim
- ☐ Não
- ☐ Talvez

23.1 Justifique a sua resposta. *

---

24. Relativamente aos benefícios do Carro Autónomo, classifique as seguintes afirmações conforme as considere ou não vantajosas: *

	Muito Desvantajoso	Desvantajoso	Neutro	Vantajoso	Muito Vantajoso
Poder estacionar em qualquer lugar sem condutor	☐	☐	☐	☐	☐
Executar outras atividades durante a viagem	☐	☐	☐	☐	☐
O sistema calcula a rota mais rápida para o destino	☐	☐	☐	☐	☐
Permitir que crianças, idosos e outros sem capacidade de condução se desloquem	☐	☐	☐	☐	☐
Decisões tomadas pelo carro sem a minha intervenção	☐	☐	☐	☐	☐

25. Imaginando que utilizada um Carro Autónomo, que outras vantagens pensa que viria obter? *

Marcar tudo o que for aplicável.

- [ ] Conforto
- [ ] Ecologia
- [ ] Descansar
- [ ] Segurança
- [ ] Menos trânsito
- [ ] Utilizar o tempo de viagem para dedicar-se a outras atividades (por exemplo: reuniões)
- [ ] Nenhuma
- [ ] Outra

26. Quais as atividades às quais se gostaria de dedicar no futuro, caso possuísse um Carro Autónomo, que o libertasse do tempo passado a conduzir? *

Marcar tudo o que for aplicável.

- [ ] Ler
- [ ] Concertos
- [ ] Passear a pé
- [ ] Viajar pelo país
- [ ] Atividades na serra
- [ ] Atividades náuticas
- [ ] Aprender novas áreas
- [ ] Filmes, séries e documentários
- [ ] Atividades com amigos e familiares
- [ ] Outra

27. Imaginando que utilizava um Carro Autónomo, quais seriam as desvantagens que considera preocupantes? *

Marcar tudo o que for aplicável.

- [ ] Privacidade dos dados (os Carros iriam comunicar entre si, exemplo: rota, informações de trânsito, ..)
- [ ] Segurança (O Carro decide tudo por si)
- [ ] Trânsito
- [ ] Tomada de decisão limitada
- [ ] Autonomia (Veículos elétricos)
- [ ] Preço
- [ ] Nenhuma
- [ ] Outra

28. Se quisesse comprar um Carro Autónomo, quanto estaria disposto a pagar? *

- [ ] 10.000 a 15.000
- [ ] 15.000 a 20.000
- [ ] 20.000 a 25.000
- [ ] 30.000 a 40.000
- [ ] Não estaria disposto a pagar
- [ ] Qualquer valor
- [ ] Outra

29. Caso os Carros Autónomos venham a ter um preço elevado (acima dos 40 mil €), consideraria alguma das seguintes possibilidades como uma opção de deslocação no seu dia a dia? *

Marcar tudo o que for aplicável.

- [ ] Ridesharing (Uber, Cabify, Táxi, Blablacar...)
- [ ] Carsharing (Drive now, City Drive, ...)
- [ ] Transportes Públicos
- [ ] Outra:

30. Caso tenha de comprar um Carro Autónomo, quais seriam, na sua opinião, os fatores de escolha decisivos? *

Marcar tudo o que for aplicável.

- [ ] Tipo Carroçaria
- [ ] Preço
- [ ] Gasóleo
- [ ] Potência
- [ ] Conforto
- [ ] Design clássico, moderno, futurista Segurança
- [ ] Ecologia (Impacto ecológico)
- [ ] Sistema de decisão do Carro Autónomo
- [ ] Confiança na marca
- [ ] Volante e pedais
- [ ] Outra

31. Imagine que tinha adquirido o carro dos seus sonhos, que emoções sentiria? *

Marcar tudo o que for aplicável.

- [ ] Felicidade
- [ ] Objetivo concretizado
- [ ] Ansiedade
- [ ] Coragem
- [ ] Euforia
- [ ] Entusiasmo

- ☐ Excitação
- ☐ Luxúria
- ☐ Vaidade
- ☐ Outra

Decisões

32. Considera o sistema dos Carros Autónomos como sendo confiável? *

O sistema desse iria decidir as ações a tomar, como desviar, ultrapassar, travar, abrandar, virar, estacionar, selecionar a rota mais rápida para o destino, ...

- ☐ Sim
- ☐ Não
- ☐ Talvez

33. Em que medida, considera que as decisões tomadas pelos Carros Autónomos representam problemas e considerações preocupantes quanto aos valores/ética? *

Exemplo: Código de Estrada, Discriminação por idade, sexo ou genero.

Considero Completamente 1 2 3 4 5 Não considero Completamente

34. Em que medida, considera que as decisões tomadas pelo Carro podem ter impactos nos valores/ética? *

Considero Completamente 1 2 3 4 5 Não considero Completamente

35. Enumere as questões morais e éticas que, na sua opinião, associa à utilização dos Carros Autónomos, e que consideram serem preocupantes. *

Enumere o que considera impactar os seus valores. Indique "nenhuma", caso não considere questões éticas/valor associadas ao Carro Autónomo.

---

36. Indique em que medida considera os seguintes itens como tendo impacto na Condução Autónoma. *

	Concordo fortemente	Concordo	Não concordo nem discordo	Discordo	Discordo fortemente
Privacidade pode ser afetada	☐	☐	☐	☐	☐

Decisão do sistema poderá ser diferente da minha em certas situações	☐	☐	☐	☐	☐
Confio na decisão do sistema	☐	☐	☐	☐	☐
O sistema autónomo em nada compromete os meus valores	☐	☐	☐	☐	☐

37. Em que medida considera um Carro Autónomo seguro? *

- ☐ Nada seguro
- ☐ Pouco seguro
- ☐ Neutro
- ☐ Seguro
- ☐ Completamente seguro
- ☐ Não sei

37.1 Indique o motivo da sua resposta. *

---

38. Quais os motivos pelos quais compraria um Carro Autónomo?

Enumere as razões que o fariam comprar.

---

39. Se um amigo ou familiar próximo (pais, marido, mulher, ...) o aconselhasse a utilizar um Carro Autónomo, teria essa opinião em consideração?

- ☐ Sim
- ☐ Não
- ☐ Talvez

40. Descreva em poucas palavras o que pensa sobre o Carro Autónomo? *

---

41. Que questões tem sobre o Carro Autónomo?

Enumere as dúvidas ou pontos que gostaria de ver esclarecidos.

B – Appendix

Evolution of Automotive Technology

The purpose of this questionnaire is to prepare a Master's Dissertation. The study intends to know the driver profile of the future, based on the analysis of different dimensions of this activity, namely, in the way it sees and interacts with technology.

The estimated time for replying to the questionnaire is 15 minutes maximum.

If during the filling you have any questions or need additional information, please contact: patricianobrega94@gmail.com

Thank you for your cooperation!

*Obrigatório

A note about privacy

This questionnaire is anonymous.

The saved record of your responses to the questionnaire does not contain any identifying information about you.

1. Informed consent *

I have read and understood the information about the purpose and privacy policy of the questionnaire, and voluntarily wish to respond to the questionnaire that follows. If you agree to the prior statement and wish to participate in this study, through your questionnaire response, select "I Agree".

- [ ] Agree

Sociodemographic Data

1. Age *

2. Gender *

- [ ] Female
- [ ] Male

3. Activity *

- [ ] Teacher

- [ ] Student
- [ ] Student/Worker

4. Where do you spend most of your time? *

- [ ] City Capital District
- [ ] City
- [ ] Village near City
- [ ] Village
- [ ] Other

5. Which technological devices have you joined? *

Select all you have owned.

- [ ] Mobile Phone
- [ ] Tablet
- [ ] Smartphone
- [ ] Computer
- [ ] Smart Television
- [ ] Smart home appliances
- [ ] Other

6. What is your level of ease in using the above technological devices? *

- [ ] I have difficulties
- [ ] I do not like, do not use, I am against
- [ ] I have some difficulties
- [ ] I only use at work because I am forced to.
- [ ] I use it with relative ease and I like to use it.
- [ ] I use it with relative ease, but I do not like it very much
- [ ] Easily use multiple devices
- [ ] I am very adept and very easy
- [ ] I am a huge enthusiast, I have very easily, and I identify the innovations

7. What do you do with your free time? *

Identify what activities you do during your free time.

Select all that apply.

- [ ] Read
- [ ] Concerts
- [ ] Walk
- [ ] Travel the country
- [ ] Activities in the mountains

- ☐ Nautical activities
- ☐ Learning new areas
- ☐ Movies, series and documentaries
- ☐ Activities with friends and family
- ☐ Other

8. What are the characteristics that most define / value? *

For each element, say what degree you value the characteristics, if you do not know how to respond, indicate "I do not know".

	I do not identify	I identify few	I identify	I identify a lot	It is essential to me. I fully identify
Work	☐	☐	☐	☐	☐
Family	☐	☐	☐	☐	☐
Comfort	☐	☐	☐	☐	☐
Organize well time	☐	☐	☐	☐	☐
Secure Driving	☐	☐	☐	☐	☐
Environmentally Friendly	☐	☐	☐	☐	☐
Economize	☐	☐	☐	☐	☐
Need to be innovative	☐	☐	☐	☐	☐

Adoption of automotive technology

9. Do you have a driving license? *

- ☐ Yes
- ☐ No Go to question 18.

9.1 Identify the driving licenses owned. *

Select all that apply.

- ☐ Car
- ☐ Moto
- ☐ Boat
- ☐ Other

10. Do you own a car? *

- ☐ Yes
- ☐ No

- ☐ Only my family members
- ☐ Other

11. How often do you drive? *

- ☐ I drive during week
- ☐ I drive at the weekend
- ☐ I drive every day
- ☐ I drive sporadically

12. Identify the automatic assistance systems of the car (s) you drive or drive. *

Select all that apply.

- ☐ GPS
- ☐ Cruise Control
- ☐ Help start
- ☐ Parking sensors
- ☐ I have never used any system
- ☐ Emergency Braking
- ☐ Rear View with Dead Angle View
- ☐ Other:

13. In my driving today, I think ...* *

	Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree
Maintenance cost is high	☐	☐	☐	☐	☐
Need of recurrent maintance	☐	☐	☐	☐	☐
Parking is expensive	☐	☐	☐	☐	☐
There is lack of parking space	☐	☐	☐	☐	☐
Traffic is high	☐	☐	☐	☐	☐
Fuel has high price	☐	☐	☐	☐	☐
Is tiring to drive with manual gearbox	☐	☐	☐	☐	☐
Use the automatic assistance systems (parking sensors, cruise control, GPS, ...)	☐	☐	☐	☐	☐
I drive very often	☐	☐	☐	☐	☐

I Usually the trips are long (more than 1 hour)	☐	☐	☐	☐	☐
I like to drive	☐	☐	☐	☐	☐

14. Please indicate how closely you agree with the following statements *

For each row, indicate the degree of valuation that you attribute to each of the statements.

	I would like	I would not like	I drove	I drive
An electric powered car	☐	☐	☐	☐
An LPG powered car	☐	☐	☐	☐
A gasoline powered car	☐	☐	☐	☐
A diesel-powered car	☐	☐	☐	☐
A car with a manual gearbox	☐	☐	☐	☐
A car with an automatic gearbox	☐	☐	☐	☐

15. Which features do you least value in a car? *

_____

Imagine that...

Tomorrow you would not have to drive a car to get to your destination! He would just have to sit down and indicate the intended destination. During this time you could perform other activities such as reading, watching a movie, being in a meeting, etc ... The system of this car would decide the actions to take, such as diverting, overtaking, slowing, slowing, turning, parking, to the destination selected by you, in that car there would be no pedals or steering wheel.

Label this car as an "Autonomous Car".

16. Ever heard of the term Autonomous Car? *

- ☐ Yes
- ☐ No Go to question 20.

16.1 Where have you first hear about the concept of Autonomous Car? *

- ☐ Internet
- ☐ Journals/Magazines
- ☐ Television
- ☐ Social Networks
- ☐ School
- ☐ Other

About Autonomous Driving

17. Imagine yourself using an Autonomous Car?*

- ☐ Yes
- ☐ No
- ☐ Maybe

18. How would you feel when using an Autonomous Car? *

Select all that apply.

- ☐ Frightened
- ☐ Anxious
- ☐ Confused
- ☐ Curious
- ☐ Courageous
- ☐ Excited
- ☐ Happy
- ☐ Luxurious
- ☐ In panic
- ☐ Vain
- ☐ Other

19. Do you consider it difficult to use an Autonomous Car? *

Very hard 1 2 3 4 5 Very easy

20. What skills or abilities do you think you need to use an Autonomous Car? *

Select all that apply.

- ☐ Ease of use of technologies like tablets, computers, smartphones
- ☐ Decision-making ability
- ☐ Interaction with heterogeneous groups (different values, norms, countries, ...) No serious cardiovascular disease
- ☐ Absence of mental and behavioral disorders
- ☐ Absence of neurological diseases (nervous and peripheral system) Absence of excessive alcohol consumption
- ☐ Non-consumption of Drugs and medicines with influence on driving
- ☐ Locomotive capacities
- ☐ Driving license
- ☐ Other

21. To what extent do you consider an Autonomous Car to be advantageous / useful in your daily life? *

Nothing Advantageous/useful 1 2 3 4 5 Very Advantageous/useful

22. If you knew that an Autonomous Car would help reduce the consumption of oil and gaseous pollutants would it be a good thing to get a car like that?*

- ☐ Yes
- ☐ No
- ☐ Do not know

23. In your opinion, would an Independent Car have a positive impact on your daily life? *

- ☐ Yes
- ☐ No
- ☐ Maybe

23.1 Justify your answer. *

---

24. Regarding the benefits of the Autonomous Car, classify the following statements as to whether to consider them advantageous: *

	Very disadvantageous	Disadvantageous	Neutral	Advantageous	Very Advantageous
Can park anywhere without a driver	☐	☐	☐	☐	☐
Perform other activities while traveling	☐	☐	☐	☐	☐
The system calculates the fastest route to the destination	☐	☐	☐	☐	☐
Allow children, the elderly and others with no driving ability to drive	☐	☐	☐	☐	☐
Decisions made by the car without my intervention	☐	☐	☐	☐	☐

25. Imagining that he was using an Autonomous Car, what other advantages do you think he would get? *

Select all that apply.

- ☐ Comfort
- ☐ Ecology
- ☐ Rest
- ☐ Safety
- ☐ Less traffic
- ☐ Use travel time to engage in other activities (for example, meetings)
- ☐ None
- ☐ Other

26. What activities would you like to pursue in the future if you had a Autonomous Car during the travel time? *

- ☐ Read
- ☐ Concerts
- ☐ Walking
- ☐ Traveling by country
- ☐ Activities in the mountains
- ☐ Nautical activities
- ☐ Learn new areas
- ☐ Movies, series and documentaries
- ☐ Activities with friends and family
- ☐ Other

27. Imagining using an Autonomous Car, what would be the most troubling disadvantages? *

Select all that apply.

- ☐ Privacy of the data (the cars would communicate with each other, example: route, traffic information…)
- ☐ Safety (The Car decides everything for you) Traffic
- ☐ Limited decision-making Autonomy (Electric vehicles) Price
- ☐ None
- ☐ Other

28. If you wanted to buy an Autonomous Car, how much would you be willing to pay?*

- ☐ 10.000 to 15.000
- ☐ 15.000 to 20.000
- ☐ 20.000 to 25.000
- ☐ 30.000 to 40.000
- ☐ Would not be willing to pay
- ☐ Any amount
- ☐ Other

29. If Autonomous Cars are to have a high price (above € 40,000), would you consider any of the following possibilities as an option to travel in your daily life? *

Select all that apply.

- [ ] Ridesharing (Uber, Cabify, Táxi, Blablacar...)
- [ ] Carsharing (Drive now, City Drive, ...)
- [ ] Public Transport
- [ ] Other

30. If you must buy an Autonomous Car, what would be the decisive choice factors? *

Select all that apply.

- [ ] Type of Car
- [ ] Price
- [ ] Diesel fuel
- [ ] Power
- [ ] Comfort
- [ ] Classic, modern, futuristic design
- [ ] Safety
- [ ] Ecology (Ecological Impact)
- [ ] Autonomous car decision system
- [ ] Confidence in the brand
- [ ] Steering wheel and pedals
- [ ] Other

31. Imagine that you had acquired the car of your dreams, what emotions would you feel? *

Select all that apply.

- [ ] Happiness
- [ ] Purpose accomplished
- [ ] Anxiety
- [ ] Courage
- [ ] Euphoria
- [ ] Enthusiasm
- [ ] Excitement
- [ ] Lust
- [ ] Vanity
- [ ] Other

Decisions

32. Do you consider the Autonomous Car system to be reliable? *

The system of this would decide the actions to take, such as diverting, overtaking, locking, slowing, turning, parking, selecting the fastest route to the destination, ...

- ☐ Yes
- ☐ No
- ☐ Maybe

33. To what extent do you consider that the decisions made by the Autonomous Cars represent problems and worrying concerns about values / ethics? *

Example: Road Code, Discrimination by age, gender or gender.

I fully consider 1 2 3 4 5 I do not fully consider

34. To what extent do you consider that decisions made by the Car can have an impact on values / ethics? *

I fully consider 1 2 3 4 5 I do not fully consider

35. List the moral and ethical issues that, in your opinion, associate with the use of the Autonomous Cars, and which they consider to be of concern. *

List what you consider impacting your values. Indicate "none" if you do not consider ethical / value issues associated with the Independent Car.

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36. Indique em que medida considera os seguintes itens como tendo impacto na Condução Autónoma. *

	Strongly Agree	Agree	I do not agree or disagree	Disagree	Strongly Disagree
Privacy may be affected	☐	☐	☐	☐	☐
System decision may be different from mine in certain situations	☐	☐	☐	☐	☐
I trust the decisions of the system	☐	☐	☐	☐	☐
The autonomous system in no way compromises my values	☐	☐	☐	☐	☐

37. To what extent do you consider an Autonomous Car to be safe? *

- ☐ Nothing safe
- ☐ Little safe Neutral
- ☐ Safe
- ☐ Completely safe
- ☐ Do not know

37.1 State the reason for your response. *

38. What are the reasons why I would buy an Autonomous Car?

List the reasons that would make you buy.

39. If a friend or close relative (parents, husband, wife, ...) advised you to use an Autonomous Car, would you have that opinion in mind?

- ☐ Yes
- ☐ No
- ☐ Maybe

40. Describe in a few words what you think about the Autonomous Car? *

41. What questions do you have about the Autonomous Car?

List the doubts or points you would like to see clarified.