Clustering the Portuguese Population Regarding Adoption and Intention to use UAM

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Master in Management

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BUSINESS
SCHOOL

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The present Thesis was written as the final Master's thesis of the Master in Management at ISCTE business school, a journey that started in September of 2019 and is rapidly coming to an end.

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Resumo

Com a crescente utilização dos transportes públicos, os meios que existem atualmente tornam-se insuficientes e incapazes de satisfazer as necessidades da população, surgindo a urgência de desenvolver um novo meio de mobilidade. Recorrendo ao investimento em tecnologias como a automatização, surge um conceito que envolve circulação no espaço aéreo das cidades, Mobilidade Aérea Urbana, que pode ser utilizada para transporte tanto de passageiros como de mercadorias, e demonstra ser uma opção mais sustentável para responder às necessidades de mobilidade dos cidadãos. O presente estudo procura apurar na população portuguesa, que grupos estarão mais recetivos a abraçar esta nova forma de mobilidade, através dos níveis de aceitação e intenção de uso dos veículos aéreos. A recolha de dados é feita recorrendo a um inquérito online, onde inquiridos são apresentados a vários fatores que podem impactar na forma como estes podem vir a aceitar ou utilizar a tecnologia quando esta for implementada, fatores determinantes como segurança, hábitos de mobilidade, o impacto ambiental, ou possíveis benefícios ou desvantagens da sua aplicação. O inquérito foi distribuído em Portugal e foram obtidas 485 respostas, os dados recolhidos foram aplicados de forma a desenvolver uma análise de clusters, antecedida de uma análise de componentes principais para garantir uma divisão dos grupos mais concreta, e também análises não paramétricas. Este estudo pretende entender que grupos, dentro da população portuguesa, estarão mais abertos a receber a UAM como um meio de transporte fiável e que fatores são determinantes para a aceitação desta tecnologia.

Palavras-chave: Mobilidade Aérea Urbana; Veículos Aéreos; Aceitação; Intenção de uso; Fatores Determinantes.

Abstract

With the growing use of public transport, the means that currently exist become insufficient and incapable of meeting the needs of the population, giving rise to the urgent need to develop a new means of mobility. From the investment in technologies such as automation, a concept emerges that involves circulation in the airspace of cities, Urban Air Mobility which can be used for both passenger and freight transport and proves to be a more sustainable option to respond to mobility needs of citizens. This study seeks to find out in the Portuguese population which groups will be more receptiveto embrace this new form of mobility, through the levels of acceptance and intention to use air vehicles.Data collection is done using an online survey, where respondents are presented with various factors that may impact how they will accept or use the technology when it is implemented, determining factorssuch as safety, mobility habits, environmental impact, or possible benefits or disadvantages of its application. The survey was distributed in Portugal and valid 485 responses were obtained, the collected datawas applied in order to develop a cluster analysis, preceded by a principal component analysis to ensurea more concrete division of groups, and also non-parametric analyses. This study intends to understandwhich groups within the Portuguese population will be more open to receiving UAM as a reliable meansof transport and which factors are nuclear to the acceptance of this technology.

Keywords: Urban Air Mobility; Air Vehicles; Acceptance; Intention to use; Determining Factors.

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Glossary

AV – Air Vehicles

ICT – Information and Communication Technologies

MaaS – Mobility as a Service

UAM – Urban Air Mobility

VTOL - Vertical Take-off and Landing Aircraft

1. Introduction

One of the major concerns in our present time is the world population growth which does not seem to be stopping any time soon. Nowadays we are around 7 Billion but we may reach over 9 Billion inhabitants in 2040 with Africa being the continent with more people reaching 2 Billion followed by India and China with over 1 Billion (PopulationPyramid, 2019).

To meet the growing numbers in the population, good transport infrastructures are needed, the large urban and even suburban areas are getting increasingly more populated, impeding seamless mobility. Public transportation can be an option, but it is hard to predict if and when it is available, especially when the demand peaks during rush hours, causing great discomfort on the users and jamming the roads with thousands of vehicles, causing big commute times affecting the lives of everyone. More than 20% of Europeans commute at least 90 minutes daily, with the UK being the country where the commute times are greater and the German being the more effective taking the least time commuting (sdworx, 2018). Adding to that, the maintenance costs are large, and in most countries, the public transport systems are outdated in need of investment; Just is the case in the United States, as the Federal Transit Administration identified investment needs in the order of $90 billion to modernize the public transport infrastructure and assets (Skoutelas, 2018).

To overcome this problem organizations have been developing more flexible and innovative ways to offer mobility options that suit better people's needs, e.g. shared mobility services (i.e. Uber, Zipcar). The "using instead of owning" way of thinking is gaining more recognition and people are starting to adopt this mobility model since especially in urban areas there is an increasing mobility need due to traffic congestions, and the shared solutions are more personalized, bringing a more comfortable and environmentally friendly transport mode (Schikosky, 2020).

The urgency in finding proper ways of ensuring sustainable and more responsive transportation systems is leading companies to invest in the transport sector, and one technology that seems to be fast-growing is automation (Kyriakidis et al., 2015). Self-driving vehicles bring numerous advantages for drivers, not only in saving travel time but also in reducing emissions and road accidents, increasing safety for pedestrians and other road users (Haboucha et al., 2017).

The emergence and subsequent use of autonomous vehicles can have a large impact on the number of road accidents and the costs adjacent to them since the main causes are usually associated with the human component in driving and not problems with the vehicle itself. Recent technological advances are making what was a futuristic idea a fast-approaching reality, and its use will alter the meaning of driving a vehicle as we know it, instead of utilizing only the roads as a way of transporting people, taking advantage of automation to use the third dimension, through self-driving air vehicles.

Operating an autonomous aircraft will change two fundamental aspects of its driving. The first, as mentioned above, concerns the automation of vehicles, where there may be cases in which automation is partial i.e. semi-autonomous vehicles, or fully autonomous vehicles, which do not require any operator to go from point "A" to a point "B". The second aspect refers to the place where the vehicles will transit, transport will not only be carried out on land but also in the air, using self-drivingaircraft for airspace circulation (Ahmed et al., 2020). In this context, the use of urban air mobility (UAM) and Air vehicles (AVs) is advancing and, the concept of utilizing a flying vehicle able to take-off and land vertically (VTOL) is under development (Rothfeld, 2019). Several companies want this technology to be on the market as soon as possible, such as the Volvo group's Terrafugia, Uber's "UberAir" project (Holden & Goel, 2016; Uber, 2019), and other multinational companies, which have spentmillions of dollars on R&D.

The acceptance of new technologies has always met barriers in the various fields where it sprouts. The transportation sector is no different. Bekiaris et al. (1997) (as cited in Konig & Neumayr, 2017) were the first to study the possibility of “automatic driving” and found that drivers tend to appreciate driving assistance systems, but when it comes to fully automated driving they rejected the idea. There are factors that may come as barriers to accepting automation as a nuclear part of a transportation system and may pose a problem to Air Vehicles (AVs) and Urban Air Mobility (UAM). Some factors can be related to the usage of the vehicle itself, like safety in travel and the fear of system failure. On the other hand, we have driver-oriented barriers which arise from internal factors such as gender, age, or cultural background. These barriers may be harder to atone since they can vary from user to user (Konig & Neumayr, 2017).

Therefore, before the introduction of this mode in the transportation system, it is imperative to understand what is the citizen’s opinion regarding the use of this technology, its operation, and required infrastructure, since there are many aspects to consider, ranging from system-oriented factors to human factors that can influence the adoption of this new means of transport. This paper aims to identify segments of potential users according to their embracement of Air Vehicles (AVs) and use of Urban Air Mobility (UAM) and subsequently understand which groups are prone to adopt this technology. The insights of this work could provide useful information for governments, local authorities, and companies that want to invest in UAM in the future. A sample of 485 responses gathered mainly from the Metropolitan Areas of Lisbon and Porto, was used for the cluster analysis.

The remaining of this dissertation is organized as follows: a second section where the literature on UAM and adjacent subjects such as AVs, automation, and mobility is reviewed with some of the latest study findings. The third section mentions the methods and how the data was collected and processed inorder to find results, which were then discussed in the fourth section, in the fourth section the sample and datacollected were characterized, and the information crossed with results from previous studies as well.

The next and final section (fifth) impales the conclusions of the study.

2. Literature Review

Technological advances in transport mobility have provided the population with an increasing number of alternatives to privately owned vehicles and recurrent means of transport, such as buses or subways. These alternatives seek to reduce the traffic within cities, but also reduce the number of emissions and their impact on the environment (Baptista et al., 2014). In this set of transportation modes, we find transport alternatives such as car-sharing services and others that seek to innovate and make the mobilization of the population within urban spaces more efficient and less impactful on the environment.

In addition to shared mobility services, the concept of autonomous vehicles is also increasingly a reality, showing to be safer and more comfortable for passenger transport compared to other non-autonomous vehicles. The level of automation can be varied, from level 0 (without automation) to level 5 where the vehicle is fully autonomous and does not require any human control to achieve its normal operation (Zhang et al., 2019). With the insertion of the concept of automation, there is also the concept of transport of passengers and goods in the airspace of cities, developed by NASA and called "urban air mobility "(UAM), which encompasses the use of autonomous aerial vehicles to transport people, these vehicles can circulate both on land and in the air, taking advantage of the third dimension, something that until now had never been explored**.**

The population in the world is increasingly growing in cities and large metropolitan areas, it is expected that by 2050 about 70% of humanity will be living in urban areas, and the public transport modes are growing incapable of accommodating the also growing number of citizens, causing problems like more traffic congestion and parking difficulties especially in central areas of the urban space, other problems arise as well such as longer commuting times, the high infrastructure maintenance costs, and most important the accidents and environmental impacts. There is a need to create an innovative means of circulation capable of providing the population with a safe, sustainable mode of transport that will take advantage of airspace in cities, and benefit the environment by reducing emissions of gases and other polluting agents.

Companies such as NASA and Airbus are developing programs to integrate the use of urban airspace into their mobility plans by integrating vehicles that are capable of intra-city travel as a way of meeting the growing needs of mobility and shared mobility (Airbus, 2018). Uber, with its "Uber Air" project, wants to launch a shared air mobility services program, with autonomous electric vehicles and without the need for human intervention, the project is expected to be marketed by 2023 in The United Studies and Australia (Uber, 2019).

Urban Air Mobility (UAM) is a concept developed by NASA to create a safer and more efficient way to travel in highly dense urban areas, utilizing the airspace to conduct all the operations in the metropolitan area, with automated AVs that may or may not require a pilot.

As the population is increasingly growing, government and other public entities must find an alternative to the insufficient public transportation, and promote the UAM system as a more environment-friendly and innovative solution.

Safety of the vehicles needs to be a priority, to ensure the safety of the passengers. The UAM vehicles can be piloted autonomously, eliminating the need for a pilot on board, enhancing the safety of the aircraft, which can be controlled by a command center (Ehang, 2020).

2.1 VTOL

Similar to automated vehicles the VTOLs will be powered by electric propulsion, and be capable of performing vertical landing and take-off, equipped with advanced navigation and communication capabilities.

Many companies have started developing and testing prototypes for what will be their aircraft when the implementation of urban air mobility starts in crowded urban areas. Even though the certain future commercialization of these aircraft is not happening in the next couple of years, many parameters need to exist for it to be able to penetrate the market when the time comes, these are barriers that are imposed in other vehicles as well but will be of major importance for the VTOLs, they are safety, noise, emissions and vehicle performance (Holden & Goal, 2016).

To engage the public in adopting air vehicles (VTOLs) as a viable option for shared mobility is imperative that people view it as a safe way of traveling. One way of improving the safety of VTOLs is implementing digital systems that include pilot aids and will be of most importance to reduce pilot error incidents and consequently crashes, making use of automation and sophisticated communication and navigation systems will be a key component to guarantee in-flight safety (Holden & Goal, 2016).

Regarding the noise concerns, they are towards the people living in close proximity to where the VTOLs will circulate, and it’s important not to disturb the communities living in those areas. The VTOLs will be operating quite often, and people tend to oppose the usage of vehicles in certain locations due to the noise. The noise generated has been identified as a critical factor in the development of this technology (Eissfeldt, 2020).

There are noise goals that have to be met, and restrict the level of decibels emitted by the vehicles´ engines. There is regulation for noise around airports and helicopters, but for VTOLs they need to be more restricted, meaning it should be able to blend with the existing background urban noise.

As it was mentioned before the noise levels generated by vehicles that will circulate in urban airspace is identified as a critical factor in the development of this technology, and measures must be developed to mitigate this risk, either by reducing the decibels produced by vehicles, or even restrictions on noise levels. The movement in urban airspace, as the name implies, will be made over the homes of citizens who will be exposed to noisy emissions from autonomous air vehicles (VTOLs), affecting their quality of life. One way to combat this factor will be to promote the involvement of the population in solving this problem and to understand the level of tolerance that exists in the different communities (Eissfeldt, 2020). By creating a source of information in real-time, where the community can withdraw information, but also contribute to it, increasing their involvement regarding the problem with noise emissions. The use of smartphones to capture noise through microphones can be an adaptable solution, where the majority of the population would have access and a way to contribute to the study. To optimize and control sound emissions by autonomous aerial vehicles, it is important to first understand the level of tolerance in communities, and from there develop maps and routes according to the information given by the public.

Another big concern of the general public is the emissions of greenhouse gas, and the transport sector is one of the largest contributors in the world, in 2018 27.9% of Europe 28 greenhouse gas emissions came from the transport sector (European Environment Agency, 2020). The greenhouse gas emissions in the transport mode are expected to have increased by 32% in 2030 when compared to 1990 levels. However, the VTOLs can generate an appealing solution to this problem, since they are fully electric and create zero in-flight carbon emissions being a more ecologically and sustainable mode of transport (Holden & Goal, 2016). The environmental impact will be important for the communities to accept the Air transport offerings, so having a minimal impact is a positive measure, and VOLTs may create the solutions everyone seeks for a more sustainable way for traveling inside the urban areas.

2.2 Automation and Automated Vehicles

Wickens and Hollands (2000) defined automation as the use of machines or systems to do a task that would otherwise be done by a person. There are cases where automation is minimal, as is the case in automatic vehicle windows, but there are also cases where the level of automation is very high, such as in airplanes, or in this case in air vehicles, which will be an essential part of urban air mobility systems.

The use of navigation systems for autonomous or even semi-autonomous vehicles will make it possible to identify the shortest routes, using not only land routes but also air routes or a combination of both. These attributes allow us to estimate that travel times, especially within cities or suburban areas, will be drastically reduced, since the vehicle's (airborne) navigation system can avoid the areas of greatest congestion. However, the adoption of new technologies is usually a time-consuming process, which involves establishing a relationship of trust with users and understanding their preferences and opinions regarding autonomous vehicles. Trust is a determining factor in acceptance and can dictate the acceptance and intention of using AVs (Winter et al., 2020).

There will be innovative people, who will want to adopt the technology with little or no resistance, and later some "early adopters" will also adopt, thus boosting the adoption by the other groups (Pettigrew et al., 2019). It is not only the technological factor that will affect the will or intention to use aerial vehicles but also the emotional aspect, so it is important to understand which factors, in a holistic way will influence the decision-making process regarding the intention to use these vehicles (Winter et al., 2020).

The affective part of the human being plays an important role in making decisions, especially if they are made with little information available, such as the case with air vehicles or "air taxis". Many potential users are unaware of or unfamiliar with high levels of automation, and certain emotions may be predictors in the acceptance of "air taxis" and urban air mobility systems.

Several benefits come from adopting automation into our daily life, that includes transportation, for instance, people who were unable to travel privately like young or older people and people with disabilities could have more autonomy and not depend on others to have the same level of mobility. Most of the casualties on road accidents, around 90%, were caused by human error situations, with automated vehicles those numbers will be reduced drastically if not eliminated (Begg, 2014). However, there are some setbacks that may cause barriers to implementing fully-automated vehicles, the level of engagement on the driving task is one of them, since the driver does not have to be so attentive to the road he or she may not be able to react in a situation where manual control is required, like dense fog or snow, and even very congested urban areas. Another issue is the attribution of guilt in case of an accident, who is to blame? The driver, or the vehicle itself? An efficient legal system needs to be created to regulate these situations when more automated vehicles start to travel on the road.

Another barrier opposed to autonomous vehicles and driving them is their acceptance, using a self-driving car is not the same as driving the car manually, the driver gives up the control, which is feared by many individuals (Brell et al., 2019). Anything that people do not understand or do not know how to work with, causes some discomfort. Personal data sharing is still a drawback since fewer people are willing to share it.

This technology is very appealing and represents a way to improve both comforts, as well as safety and mobilization of people, autonomous vehicles must be able to penetrate the market, and for this, it is important to quantify and analyze the perception of the public and its expectations regarding the acceptance and subsequent adoption of this means of transport and the vehicles concerned. It is important to inform the population of the benefits that come from its use, but also of the risks because only with an informed population it is possible to achieve the desired level of acceptance. By increasing people's awareness of the improvements that this technology can bring to their daily lives, it will be easier to move from the acceptance phase to the acquisition phase of autonomous air vehicles, and subsequent implementation of mobility in urban airspace (Eker et al., 2020).

2.3 MaaS

The concept of mobility as a service (MaaS) arises with technological advances, and with the integration of information and communication technologies in urban mobility, as a way to responsibly and effectively use the available resources allocated to the transport sector.

MaaS will act as a source of accessibility to intermodal or multimodal mobility solutions, while the suppliers ("Maas Suppliers") of these solutions will manage the platforms where the various modes of transport are inserted (Schikofsky et al., 2020). This program focuses on the individual mobility needs of each user, making it important to know what factors can drive the acceptance of this service, something that is not yet well known. It is an integrated multimodal platform, a view that allows the use of more than one means of transport in the transport chain, available on a single platform, accessible through a single account and payment method.

Through the use of ICT, MaaS uses algorithms focusing on individual preferences, to manage the passenger's path, with the entire process developed only in an application with easy access. The passenger can certainly use the transport chains that currently exist, however it will have to be herself or himself managing his route and the means he will use, without access to an integrated source of solutions, a source that encompasses not only the modes of transport but also the payment system.

The Maas service may not be the most suitable for short trips, or to passengers who only need to travel in one or two different modes of transport, but for multimodal trips, where there are many changes of transportation means and many costs associated with transport, having access to an integrated platform facilitates the passenger in choosing the indicated route and consequent means, as well as in the payment of these, needing only to have a personal account, where he draws his route and makes the payment, all in an app on mobile or through the web.

Schikofsky, et al. (2020), through qualitative data collection, noted that multiple factors affect the motivation to use MaaS services, not just perceived utility or ease of access or use, but it was also found that factors such as flexibility in route choice, time savings in planning, and greater efficiency are associated with innovative multimodal mobility systems. Sharing an identity with a group (MaaS users) can also have positive implications, as it supports the connection between individuals living a community life. Availability and trust, as well as internet coverage and possession of a smartphone, are requirements to take advantage of MaaS services, which restricts potential users.

Other sources also appear that may affect the motivation or intent of use, such as environmental and ecological issues, because MaaS is not always associated with electric vehicles, and also the concern of users with data privacy and its security. However, the latter has not been pointed out as a factor that can significantly impact the decision-making of the population concerning adopting or not these innovative mobility services, according to the authors.

2.4 Own Vehicle vs Shared Vehicle

When autonomous vehicles are implemented, many will be the resulting benefits, such as accident prevention, the allocation of mobility to people unable to drive, the reduction of gas emissions, and several unlisted, on the other hand, there are also fewer positive aspects, especially in the case of non-air mobility, as there may be increased congestion as more people will be able to drive, and people who are employed can also see their jobs disappear in the face of technological development. However, these benefits or risks will only be felt when the technology is adopted by the majority of the population, something that will depend on the speed in the acceptance of automation by drivers.

A deadlock in the implementation of MaaS is the fact that many prefer to have their own vehicle instead of using shared mobility services. The change from a private vehicle to the shared vehicles should be supported by the government, which can facilitate this transition through incentives (e.g. tax incentives), or with the creation of educational programs to the general public on the nature and advantages and disadvantages of the use of autonomous vehicles, and also of autonomous air vehicles, because as mentioned above, providing accurate and credible information on this new technology increases the intention to use these vehicles (Pettigrew et al., 2018).

However, and at an early stage of the implementation of autonomous and air vehicles, manufacturers will choose the model that will be more monetarily productive (Pettigrew et al., 2019), and focus on the older age groups most likely to quickly adopt new technologies, young people or men with greater monetary power, rather than focusing on the people who will benefit the most, namely the people who are unable to drive a vehicle.

2.5 Determining factors

Eker et al. (2019) conducted a study where the adoption of flying cars was analyzed, through the analysis of factors that can affect the intention of buying and using vehicles, and unsurprisingly, it wasconcluded that the perception of risks and benefits, as well as the factors that influence the operationalization of this means of transport, constitute a very significant impact on the decision- making of individuals regarding the adoption of flying cars to make trips, regardless of distance and cost.

Some characteristics can vary from individuals to individuals, or from urban to rural environment, so it is necessary to analyze the specific characteristics of the population, in order to determine concretely the perception of the general public. This will facilitate the creation of regulations, and roads and can even help vehicle manufacturers to design a strategy more focused on specific groups of consumers.

Last year NASA developed a market study to find out which barriers could exist to the implementation of passenger air transport systems and also freight, this study was conducted in 15 different cities in the United States (NASA, 2019). The results showed that about half of the respondents would be open or agreed to the adoption of UAM (Urban Air Mobility) systems for the transport of goods and passengers, however, there are some conflict areas, which raise concern to the representative population in the study, areas such as safety, pollution, and environmental impact, privacy, and cybersecurity of user data, are examples of these concerns. Additionally, Al Haddad et al.,(2020) identified that demographic factors are also influencing the intention to use the UAM. Market analyses show that younger individuals, or older individuals, but with greater economic power are the groups most likely to adopt this new technology, belonging to the group of innovators or early users (Pettigrew et al., 2019).

When we talk about safety, we are including the safety of the vehicle itself, which encompasses thorough maintenance routines, but also safety during the journey itself. In a study conducted by the Deloitte Analytics Institute (2017), regarding the use of automation in passenger transport, about 90% of respondents said they would feel safer if they knew they could take control of the vehicle at any time, or if there was a pilot in the vehicle to mitigate the risk of an accident, but it would represent an additional cost, with another agent being the cost and putting barriers to some segments of the population. The fact the population sometimes shows some aversion to adopting new technologies may be a difficult or at least retarding factor to the implementation of the UAM, but if it was possible to show the benefits that we can draw from automation and the positive social impact it can bring, it would perhaps lead to a higher level of perception of its usefulness.

Another factor pointed out is the loss of jobs, many jobs depend on a driver to operate the vehicle on its route, with the implementation of the UAM and the use of autonomous vehicles these jobs will be made superfluous and many individuals may end up without employment, however, the technological direction we take indicates that automation will continue to be developed and the need for operators to operate with machinery, equipment and new transport modes will decrease more and more. We are able to see this phenomenon in the industry in general, where gradually more posts are replaced by machines, to mitigate human error from the production process.

As for environmental benefits and risks, decongestion and reduced traffic in urban areas should facilitate the reduction of the amount of CO2 emissions by vehicles, as there were fewer vehicles with engines running, however in the study by Al Haddad et al. (2020) respondents were concerned about noise and visual pollution in urban centers, since vehicles will circulate in the airspace directly above the city.

It is difficult to make a concise and thorough study of the attitude of the population towards the use of urban airspace and autonomous vehicles, so it is important to collect as much information as possible for when the time comes and the implementation of the technology is imminent, consumers are informed and know the risks and benefits that come from its use. Knowing the population and having them well informed will be vital for the successful implementation of urban air mobility systems.

3. Methodology

3.1. Survey design

An online survey was retrieved from Lencastre (2020) the study's survey had all the relevant items and information to carry on to the present research along with the previous 200 responses already gathered. The online survey was once more shared and more responses were obtained. It is designed with an average duration of 15 minutes, and a total of 49 items. The survey was structured in 12 topics to collect information on the respondents´ views on the adoption of new technologies, automation, their attitudes towards AVs and UAVs, their mobility and driving behavior, their environmental concerns, and their sociodemographic characteristics. Specifically, these topics are organized as follows:

Trust in Automation: in this section, respondents were asked to give their opinion towards automated technologies on driver assistance systems (e.g: cruise control, braking assistance, etc.). Respondents were also asked if they ever used driverless vehicles and/or if they knew anyone who had.

Adoption of new technology: respondents were asked to place themselves in the adopter category that better represents them, from 1 – Laggards (very skeptical of change) to 5 – Innovator (very venturesome and interested in new ideas). Using the same scale, questions to address the shared mobility systems, like ride-hailing, car-sharing, etc. were also added. The next topic was introduced by asking whether respondents knew what Automated Air Vehicles are.

Air Vehicles: Introduction to Autonomous Air Vehicles in a short but objective text, to explain and inform the respondents about what an Air Vehicle is and what it can be used for in our society.

Expected Benefits: in this section, respondents were asked about how they did feel towards the possible benefits of introducing the Urban Air Mobility systems in our society. A 7-point Likert from 1 - Strongly Disagree to 7 - Strongly Agree was used.

Cyber Security: Using the same previous scale, respondents were asked about their feelings towards Cybersecurity practices in order to protect future users from digital attacks.

Safety**:** Regarding safety, respondents were asked how safe they would be in a society that uses Air Vehicles, using different sentences and scenarios to obtain more trustworthy information. The same Likert scale of agreement was used.

Intention to use: in this topic, the main goal was to determine if the respondents are likely to use Air Vehicles in the future, using sentences based on the previous topics to see if they could be barriers to using Air vehicles. They were also asked what they would use Air Vehicles for (e.g. trips to work or college, leisure activities, social activities and, healthcare services).

Public Embracement: To understand the participant's embracement, which is composed of intention to use and acceptance of UAM and Air Vehicles, it is important to know the respondent's acceptance of the transportation mean. Therefore, they were asked about (1) their level of acceptance, (2) the Air Vehicles utility and (3) their feelings about. Sentences were answered using the 7-point Likert scale from 1 - Strongly Disagree to 7 - Strongly Agree.

Mobility Behaviour: The respondents were asked how long they spent on their daily trips from/to work or college, and which means of transportation they use to. They also were invited to rank the satisfaction level regarding their trips, encompassing work, leisure, and social activities (from 1 – Totally Dissatisfied to 7 – Totally Satisfied).

Driving Behaviour: This group of questions is important to understand the respondents' driving habits, and also to know the percentage of respondents that actually drive and/or own a vehicle. The last item refers to car crashes and their severity, to understand the difference and possible impact on the embracement of Air Vehicles between a driver who never had an accident and a driver who had.

Environmental Concerns*:* in this topic, the main goal is to understand the level of concern of each respondent on environmental issues, and if they are willing to pay more in benefit of our planet.

Demographics: Respondents were asked to report their gender, age, education background, current employment situation, annual net household income, and the country where they live. They also reported whether they had children.

3.2. Sample characterization

The research sample was obtained through the distribution of an online survey on social media. The target population was Portugal Inhabitants with age above the minimum legal age of driving (18 years old), from both Portugal's metropolitan areas and rural areas. In order to guarantee that the sample was representative of the Portuguese population, with participants from all age groups and different geographical areas, a non-probability sampling method was chosen, the quota sampling method, which strata were defined by region and quotas were computed proportionally to the population distribution.

An extensive effort was put into the continuous distribution of the survey online and a direct approach method was also used through Linkedin, to avoid bias underlying the social media collecting method. For example, people more knowledgeable about the subject, like those linked with areas of expertise such as the automobile and the aeronautical industries were directly contacted as well as professionals from other areas of work

Along with the survey, there was also a small text giving an introductory explanation about Urban Air Mobility and Air vehicles, trying to catch the attention of the participants and motivate them to want to know more about the subject, in order not to abandon the survey. The survey was conducted between July and November 2020. Out of 882 total responses, 485 were considered valid as they properly have fulfilled the quota strata.

Table 3.1 - Distribution of respondents' Socio-Demographic Characteristics

	N	Valid %
Gender		
Male	278	57.3
Female	207	42.7
Age Group		
18 to 24	128	26.4
25 to 34	130	26.8
35 to 44	76	15.7
45 to 54	75	15.5
55 to 64	70	14.4
65 + years	6	1.2
Children		
Yes	194	40
No	291	60
Education		
Primary or Secondary School	1	0.2
High School	40	8.2
Apprentieship with graduation	20	4.1
Bahelors' Dregree	220	45.4
Masters' Degree	187	38.6
PhD	15	3.1
Prefer not to say	2	0.4
Monthly Net Income		
500€ or less	8	1.6
500€ to less than 1000€	51	10.5
1000€ to less than 2000€	111	22.9
2000€ to less than 3000€	120	24.7
3000€ to less than 4000€	66	13.6
4000€ to less than 5000€	47	9.7
6000€ to less than 7000€	17	3.5
More than 7000€	10	2.1
Prefer not to say	55	11.3
Current Employment Situtation		
Employed - Ful I time	301	62.1
Self—em ployed	43	8.9
Retired	8	1.6
Student (u niversity or college)	83	17.1
CurrentIy unemployed	21	4.3
Other	22	4.5
Prefer not to say	7	1.4
Place of Residence		
Megacity	4	0.8
City with over 1 million and less than 10 million	142	29.3
City with less than 1 million habitants	161	33.2
Smal I town	142	29.3
ViIIage	4	0.8
Remote location	32	6.6

Respondents are not equally distributed regarding gender, having a predominance of male (57.3%) compared to female respondents. Regarding the distribution by age group, the majority of respondents

(53.2%) are under 35 years old, with the predominant age group being 25 to 34 years old. The remaining age groups have a percentage of respondents around 15%, except for the age group of 65 and over, where only 1.2% of responses were obtained. A large percentage of respondents do not have children (60%), which was expected given the youngest are the most present age groups in this study.

The majority of respondents (about 58%) have a higher degree of education, and 38.6% have a master's level, which indicates that, in general, the sample is composed of an educated population. For the monthly income of respondents, 24.7% receives between 2000€ and 3000€, and almost 50% of respondents have monthly salaries between 1000€ and 3000€.

Most of the participants have a full-time job accounting for more than 62% of the sample, 17.1% are still studying, and just 4.3% are unemployed.

Regarding the local of residence, about one third (33.2%) live in cities with less than 1 million inhabitants. The number of respondents living in cities with more than 1 million inhabitants or in small towns is the same, with 29.3% responses each.

In terms of mobility habits, almost 95% of the respondents have a driving license and 78.6% have a vehicle for their own use, that is, most respondents have the possibility of freely circulating on the public roads without resorting to public transportation, and almost 60% take advantage of it. Only 30.9% of the total sample have a monthly public transport pass.

3.3. Segmentation approach

Before conducting the cluster analysis, a Principal Component Analysis (PCA) was applied to reduce the number of items of the Public Embracement section which were used as base variables for the segmentation analysis.

The Cluster analysis was employed to segment the sample based on the respondents' similarities or dissimilarities, meaning that the respondents that fit the same group or cluster are expected to have similar characteristics that differentiate them from the rest of the clusters. The cluster method aggregates the individuals according to a set of variables, the segmentation base, which are in our study the components of the public embracement section, as mentioned above.

To perform the cluster analysis two different approaches were employed to increase the legitimacy of the chosen solution, the hierarchical Ward, and non-hierarchical K-means methods. Firstly, the hierarchical Ward method with Squared Euclidean distance measure was applied, for the purpose of deciding the number of clusters to use in the K-means method. The latter method was conducted to improve the accuracy of allocating each individual within the clusters. Finally, the chosen clusters were labeled using their characterization in terms of the segmentation base variables. Then, they are also characterized using other variables, such as Safety, Expected Benefits, and Intention to Use of Air Vehicles. Although the groups are not independent, parametric and non-parametric hypothesis tests were conducted only to support this characterization.

4. Segmentation results and discussion

4.1. Public Embracement components

The PCA was conducted in order to reduce the 16 variables of Public Acceptance of Air Vehicles into a smaller set of variables (PCs). From the set of 16, two variables were excluded from the analysis: (1) "Air Vehicles are an acceptable means of transport", because it had almost no correlation with the other chosen variables, and had a very low commonality value, (2) "I am concerned that Air Vehicles will become a transport mode only for the rich" because it generated a one-variable PC. The chosen PCA had a value of 0.819 in the KMO and of 0.0 in Bartlett´s test, suggesting a high correlation between the data. The solution was obtained with varimax rotation and explains 73.4% of the total variance. It is composed of five components, named: "Use purpose", "Benefits", "Healthcare or Emergency", "Ambient Concerns"and "Risks and Concerns". Table 4.2 presents the items per PC and their respective loadings. These dimensions were then used as a basis to perform the cluster analysis, and more than one solution was found. From the hierarchical Ward method, five to seven cluster solutions were obtained and analyzed. Sufficient differences between clusters were identified to favor and opt for the six clusters solution, which was used as the initial solution for the non-hierarchical K-means analysis. The K-means allows for more precise distribution of the respondents in the cluster division.

Table 4.1- Distribution of Base Variables's descriptive statistics

	Mean	Std. Deviation
UAVs will increase the quality of life	5.31	1.249
UAVs will improve transport accessibility	4.84	1.512
I would not feel comfortable living in a city that adopts UAVs	3.19	1.556
I am concerned that UAVs will increase visual pollution	4.82	1.575
I am concerned that UAVs will increase noise pollution	4.94	1.555
UAVs will be beneficial for the society	5.01	1.113
UAVs will be risky to the public	3.90	1.353
Moving with UAVs will be as safe as with airplanes	4.28	1.466
UAVs should be used to transfer people from to work or school	4.44	1.655
UAVs should be used to transfer people for leisure	4.81	1.503
UAVs should be used to transfer people for social activities	4.83	1.471
UAVs should be used to transfer people from to healthcare services	6.02	1.080

UAVs should be used to transfer goods to people	5.32	1.467
UAVs should be used to respond to emergency cases	6.25	1.033

Table 4.2 - PCA results: loadings for the Public Acceptance items per PC

	Items	**PC**				
		Purpose	**Benefits**	**Social needs**	**Environment**	**Concerns**
Use purpose	**UAVs should be used to transfer people for leisure**	0.885				
	UAVs should be used to transfer people for social activities	0.884				
	UAVs should be used to transfer people from/to work or school	0.698				
	UAVs should be used to transfer goods to people	0.648				
Benefits	**UAVs will improve transport accessibility**		0.818			
	UAVs will increase the quality of life		0.733			
	Moving with UAVs will be as safe as with airplanes		0.637			
	UAVs will be beneficial for the society		0.597			
Healthcare or Emergency	**UAVs should be used to respond to emergency cases**			0.881		
	UAVs should be used to transfer people from/to healthcare services			0.873		
Ambient	**I am concerned that UAVs will increase noise pollution**				0.904	
	I am concerned that UAVs will increase visual pollution				0.86	
	I wouldn't feel comfortable living in a city that adopts UAVs					0.818

Risks and Concerns	**UAVs will be risky to the public**					0.806

4.2. Cluster Profile Analysis

The cluster analysis resulted in a final solution of six clusters with different levels of adoption and intention to use levels, which together amount to the level of embracement regarding the use of Air Vehicles, each distinctive in size and other characteristics(Annex E). Figure 4.1 and Table 4.3 show the distribution of mean scores of the embracement components per cluster. Table 4.4 presents the distribution of levels of UAM adopters per cluster.

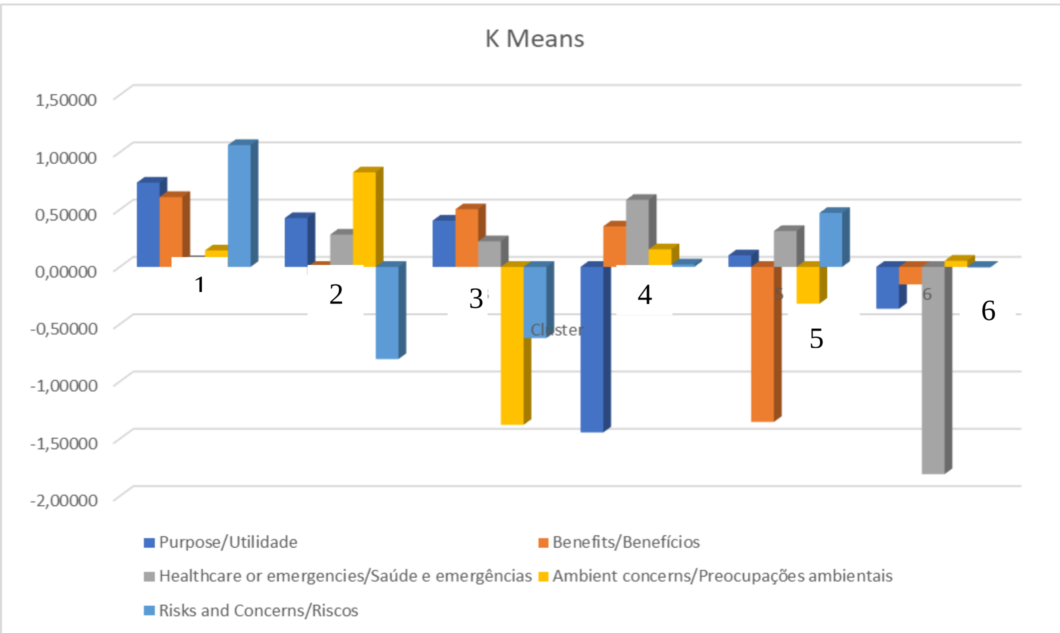

Figure 4.1. Mean scores of Principal Components per cluster

Table 2.3 - Mean scores of Embracement components per cluster

Cluster Groups	Purpose	Benefits	Healthcare or Emergencies	Ambient concerns	Risks and Concerns
Open-minded	0.7353	0.6096	0.0506	0.1440	1.0631
Pollution sensitive	0.4260	-0.0709	0.2820	0.8249	-0.8040
First Movers	0.4038	0.5026	0.2232	-1.3777	-0.6212

Emergency Supporters	-1.4444	0.3535	0.5848	0.1534	0.0216
Skpetics	0.1005	-1.3527	0.3133	-0.3211	0.4707
Deniers	-0.3652	-0.1525	-1.8083	0.05372	-0.0056

Table 4.4 - Distribution of UAM adopters per cluster

Cluster Groups	Open-minded	Pollution sensitive	First-movers	Emergency supporters	Skeptics	Deniers
Laggards	8.0%	4.7%	2.9%	9.6%	20.5%	14.9%
Late Majority	34.5%	32.7%	17.6%	32.5%	35.6%	28.4%
Early Majority	26.4%	35.5%	30.9%	39.8%	23.3%	37.3%
Early Adopters	16.1%	19.6%	35.3%	10.8%	12.3%	11.9%
Innovators	14.9%	7.5%	13.2%	7.2%	8.2%	7.5%
Cluster Size (Sample)	**17.9%**	**22.1%**	**14%**	**17.1%**	**15.1%**	**13.8%**

Cluster 1 counts for 17.9% of the sample and has an average positive mean in every component, meaning the participants of Cluster 1 are very open to both using and accepting AVs. They understand the possibilities of their use and the associated benefits but they are also aware of the risks they might present to people. Therefore, the participants of Cluster1 were named “***Open-minded***”. This group entails the highest percentage of expressed innovators (14.9%) but also has a relevant percentage of expressed laggards (8%), regarding UAM adoption. The participants belonging to this cluster compared to the others use less often shared mobility services, with almost 58% of them stating that they rarely use those services (Annex C).

Cluster 2 comprises 22.1% of respondents. Unlike the rest of the clusters, the members of Cluster 2 indicate a significantly higher consideration for the environment and seem worried about the potential visual and noise pollution caused by using UAVs. For this reason, this cluster was named “***Pollution sensitive***”. It is the cluster with more female participants (26.1% of the sample) and involves many young people, as almost 60% of the members belong to the age groups of 18 to 24 and 25 to 34 years old (Annex D).

Cluster 3 entails 14% of the total sample and its members have a higher appreciation of the benefits that UAM could bring to society for commuting, emergency and health situations. However, they are not worried about noise and visual pollution. It mostly entails male participants (72.1%) with 25% of the cluster members belonging to the age group of 55 to 64 years old with a relatively high level of monthly net household income. All the factors point out to a group with high levels of technological acceptance, as more than 35% of the cluster members consider themselves to be early adopters of UAM and more than 13% innovators, earning the title of the "***First Movers***". The fact that most participants are men and the age group is generally older might be an important factor in making the cluster the most prone to embrace UAVs, because it is known that men engage earlier to new technologies and adjust easier to technological changes, Al Haddad et al., (2020).

Cluster 4 contains 17.1% of the respondents. Its members expressed that they would only accept the use of UAVs for emergency or health cases, without demonstrating trust in the usefulness of this technology for more purposes. Therefore, they are named the "***Emergency Supporters***" citizens. This group is constituted mostly of young people (65%), with a lower average monthly income, this group has the highest percentage of people with income lower or equal to 500€(3.6%). The members of cluster 4 do not demonstrate a strong intention to use UAVs early with the percentage of laggards surpassing the innovators by 2.4 percentual points.

Cluster 5 represents 15.1% of the sample. Besides seeing some use in emergency and healthcare for Air Vehicles, these cluster members do not think the benefits for general use will overcome the risks for the society, meaning they are not convinced about the benefits of implementing this technology in the transportation sector. Thus, the participants in this cluster were named "***Skeptics***". This cluster has the highest percentage of Laggards, representing more than 20% of its participants. This group has more respondents earning high monthly income with 13.6% earning 6000€ or more.

Members of cluster 6 express a group of "***Deniers***" because they have demonstrated a negative average value across all factors variables. They do not even find Air Vehicles useful for emergency and health situations. Most of the representatives of cluster 6 are young people (55.2%) who regard themselves as late majority when it comes to adopting Urban Air Vehicles.

To detail, the cluster characterization, the average values for Safety (Table 4.5), Intention to Use (Table 4.6), and Expected Benefits (Table 4.7) items were used. There are some similarities among some clusters that should be noted: they present high means in several of the following item variables, suggesting that group members have higher intention to use and higher perception of expected benefits. Clusters are also characterized in terms of socio-demographics.

Table 4.5 - Average values of Safety variables per cluster

Cluster Groups	Open Minded	Pollution Sensitive	First Movers	Emergency Supporters	Skeptics	Deniers
More concerned with the operation over urban than suburban areas	5.43	5.21	4.79	5.19	5.23	4.58
Concerned about the performance under poor weather conditions	6.02	5.73	5.43	6.04	5.82	5.51
I'm concerned that the first AV available will be unsafe	5.85	5.43	5.12	5.55	5.75	5.28
I'm concerned that the first AV unsafe e vehicle collisions	5.76	4.61	4.38	5.25	5.55	5.16
In order for me to feel safe talk to an operator at any time	5.77	5.79	5.46	5.73	5.67	5.34
Expect an operator on the ground to be able to take control of the vehicle at any time	5.78	5.39	5.50	5.47	5.49	5.46
Expect an operator on the ground to be able to take control of the vehicle in case of emergency	6.15	6.30	6.26	6.22	6.04	5.52

The participants from Cluster 1, the "***Open Minded***", value safety and consider it an important factor in UAV acceptance and use. Despite being open to the application of UAM, it is interesting that they have the highest average in the concerns analyzed. Specifically, besides having the possibility for an operator on the ground to take control of the vehicle at any moment, they also emphasize the importance of the performance of the vehicle under poor weather conditions. They accept the use of UAVs for any purpose, demonstrating in general high levels of acceptance and intention to use in all the stated purposes but in comparison to the other clusters, they have the highest acceptance level for the use of UAVs to execute leisure trips. They also expect the implementation of UAM to enhance the reduction of the travel times and facilitate trips that serve the activities of policemen and ambulances.

However, they are not sure about how safe UAVs as a mode will be. The age groups more present in this first cluster both with 25.3% are members with 25 to 34 and 55 to 64 years old, and 42.5% of its members have a bachelor’s degree. Regarding the monthly net income, 43.7% earn between 2000 and 4000 euros.

The “***Pollution Sensitive***” are the participants who are more concerned with the noise and visual pollution that may occur due to the implementation of this new mode of transportation. They do not firmly believe that Air Vehicles will make transportation easier to move for the population in general but think their use for healthcare services or leisure and social activities is appropriate. This cluster gives more importance when compared to others, in having an operator available to give control to the aircraft in case of emergency. The reduction of road congestion and travel times seem to be the benefits expected from the implementation of UAM, besides helping the police and healthcare agents. Regarding the age distribution, 60% of members are between 18 and 34 years old, and only 7.5% are between 55 and 64 years old. More than 85% have either a bachelor's or a master's degree. Roughly 30% earn a monthly net income from 500 to 2000 euros whereas 28% from 2000 to 3000 euros.

Table 4.6 - Average values of Intention to use variables per cluster

Cluster Groups	Open Minded	Pollution Sensitive	First Movers	Emergency Supporters	Skeptics	Deniers
Trips from to work or college	4.91	4.31	4.85	3.18	3.49	3.54
Trips to leisure activities	5.64	5.46	5.46	4.01	4.75	4.40
Trips to social activities	5.54	5.36	5.69	3.82	4.67	4.36
Trips to healthcare services	5.97	6.08	6.09	5.65	5.47	4.52

The members of the “***First Movers***” cluster are concerned with safety, as they feel it would be important to be able to talk and give manual control to operators on the ground in case of an emergency. However, they are not too much concerned with the first AV being unsafe. Aside from using UAVs for healthcare services, these participants also see themselves using this mode of transport for social activities, not so much for work or college purposes. They expect UAM to highly reduce road congestion and travel times and in general, they appreciate the most the expected benefits that UAM could provide to society (average benefits value on a Likert scale = 5.9/7). Regarding the financial possessions, the members of the “First Movers” have a generally higher monthly income when compared to most other clusters. However, there are 41.2% that earn from 1000 euros to 3000 euros, although 17% earn between 4000 euros and 5000 euros. Regarding the age distribution, 44.1% of this cluster's participants belong to the 45 to 64 years old age range, and the younger age groups have the lowest percentage. Most of the cluster members have either a bachelor's or master's degree.

The "***Emergency Supporters***" individuals, as described above, are members of the fourth cluster as they tend to accept the use of AVs if it is only used for healthcare services. Despite the strict attitude towards the utilization of UAVs in society, these members do not demonstrate negative behavior on the expected benefits of UAM. Compared to the other clusters, they are the most concerned with the circulation of UAVs under bad weather conditions and they strongly expect to have the chance to contact an operator to take control of the vehicle in case of an emergency. Most of the members of this cluster are young participants (65% have between 18 and 34 years old), more than 90% either have a bachelor's or master's degree. Regarding the monthly net income, 54.2% of the group members earn less than 3000 euros. Finally, a characteristic of this cluster is that 10% of its members do not have a driving license as opposed to the other clusters for which the lowest respective percentage is 5% for cluster 6, the Deniers.

Table 4.7 - Average values of Expected Benefits variables

Cluster Groups	Open Minded	Pollution Sensitive	First Movers	Emergency Supporters	Skeptics	Deniers
The use of Air Vehicles will reduce road congestion	5.71	5.77	6.03	5.28	4.58	4.,78
The use of Air Vehicles will reduce accident on roads	5.46	5.44	5.4	4.98	4.22	4.66
Air Vehicles will significantly reduce travel time	5.82	6.12	6.15	5.67	5.29	5.15
Air vehicles will offer a safe and fast mean of transportation	5.09	5.14	5.60	4.77	3.85	4.22
Air vehicles will make it easier for people	5.29	5.01	5.60	4.87	4.05	4.49
Air vehicles will make it easier for ambulances and police	5.83	6.16	6.15	5.67	5.48	5.16

Members of the fifth cluster, the "***Skeptics***", are not convinced that the usage of Air Vehicles will bring many benefits to society, except for their use in an emergency or police-related situations, because they could act faster. This group is the most skeptical on the expected benefits of UAM for society and they have a moderate attitude towards the risky aspects that would concern the society. It can be noted that performance under poor weather conditions and UAV safety upon their introduction to mobility are two aspects that concern this cluster more than the others. 54.8% of the fifth cluster members are between 18 and 34 years old, and 19.2% belong to the age group of 45-54. Regarding to the monthly net income, 46.5% reported they earn approximately 1000€-3000€. However, the "Skeptics" have the highest percentage of participants with the highest monthly net income with 13.6% earning more than 6000 euros. Regarding to the education level, about 80% have either a bachelor's or master's degree. Finally, it is noteworthy that 30% of the Skeptics did not own or lease a car the time they participated in the survey and 70% commuted within 30 minutes.

The sixth and last cluster, the "***Deniers***", is among the groups with the least levels of adoption or intention to use the Air Vehicles, even in emergency and healthcare situations. As for expected benefits, they think it might facilitate the job of police and ambulances. However, they do not regard the UAVs as safe or faster than other existing means of transport. Regarding the socioeconomic characteristics of this cluster, 55.2% of this cluster's members are between 18 and 34 years old, and there are no members older than 65 years old. Regarding the monthly net income distribution, 67.2% earn more than 1000 euros and less than 3000 euros and, only 4.5% earn more than 4000 euros. When it comes to educational levels, 86.9% have either bachelor's or master's degrees. In this group, there is also a high percentage of members (24%) who do not have access to a car (own or lease one) and commute fast compared to the other clusters (66.3%).

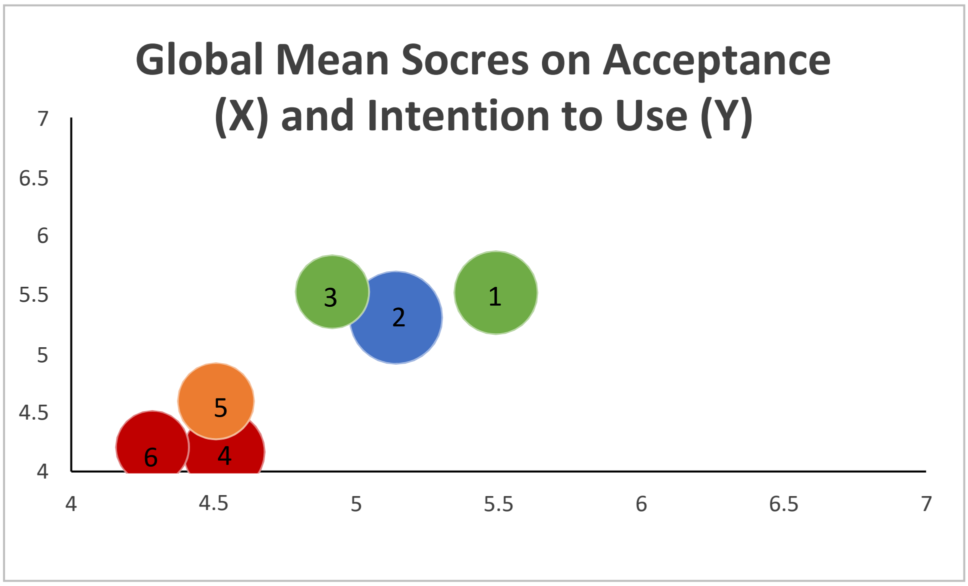

Figure 4.2 - Clusters distribution (average values) by Acceptance and Intention to Use of Air Vehicles

Figure 4.2 shows the levels of embracement regarding UAM and Air Vehicles per cluster. It presents, on a scale from 1 (Strongly Disagree) to 7 (Strongly Agree), the average values for each cluster in the items of Acceptance (x-axis) and Intention to Use (y-axis). The average of the acceptance items was computed using the 14 variables of Acceptance, and the average values for Intention to Use the items from Intention to Use of the survey were used. All average values are higher than 4, meaning that all the clusters have a global mean on Acceptance and Intention to use above the average point of the scale which is very positive in terms of how the groups see and feel about Air Vehicles.

The “Open Minded” (Cluster 1) members have the highest average on Acceptance (5.49) meaning they are those individuals that more easily accept the implementation of Air Vehicles. On the other hand, the “First Movers” (Cluster 3) are most prone to use these vehicles (Intention to Use average is 5.52) although they also have a high average of Acceptance. These two cluster groups correspond to the population segments that will not pose barriers to the implementation of UAM and AVs as a new and innovative mode of transport. Therefore, “Open Minded” and “First Movers” will not need many incentives to embrace UAM. However, “Emergency Supporters” (Cluster 4), “Skeptics” (Cluster 5) and “Deniers” (Cluster 6) will be the segments that require the most measures and incentives to increase their levels of Acceptance and Intention to Use. Public entities such as governments or private companies that will manufacture AV and others involved in the legal and other phases of the implementation process should focus on the population segments that pose barriers in accepting and using AV, such as the “Skeptics” and the “Deniers” and “Emergency Supporters”.

The population segments that will be the Innovators or First Adopters, will most likely have a big role in turning the rest of the population on board with UAM, and their feedback and word-to-mouth communication will have an impact on the levels of Embracement of the rest (Pettigrew at al., 2019).

4.3 Mobility Habits by Cluster group

Almost a third (31.1%) of the participants spend on average 15 to 30 minutes commuting daily, however almost the same can be said to less than 15 minutes with 28% of the answers. Only 6.4% spend more than 1 hour on daily trips.

Table 4.8 - Time spent on daily trips by Cluster group

Cluster Groups	Open Minded	Pollution Sensitive	First Movers	Emergency Tolerant	Skeptics	Deniers	Total Sample

Less than 15 minutes	33.3%	24.3%	23.5%	32.5%	24.7%	31.3%	**28.2%**
15-30 minutes	25.3%	29.0%	33.8%	27.7%	39.7%	34.3%	**31.1%**
30-45 minutes	21.8%	25.2%	20.6%	25.3%	12.3%	19.4%	**21.2%**
45-60 minutes	14.9%	13.1%	14.7%	10.8%	15.1%	9.0%	**13%**
Over 1 hour	4.6%	8.4%	7.4%	3,60%	8.2%	6.0%	**6.4%**

Regarding the mobility habits of the sample group, it was observed that many participants often dismiss the use of shared mobility services since 14.8% never used it or it is not available for their use, 28% rarely use them, and 18.6% only use it once a month. A small percentage compared to the participants who use the mobility services more than once a week or once a week, with 6.6% and 9.5%, respectively.

Table 4.9 -.Frequency of usage of Shared mobility services

	Percentage
More than once a week	6.6
Once a week	9.5
Every two weeks	12.8
Once a month	18.6
Every couple of months	9.7
I rarely use these services	28
Never used it/Not available in my residence area	14.8

A factor that impacts the use of these environmentally friendly services is the crushing number of privately owned vehicles in the Portuguese population, in our study almost 80% of the participants currently own a vehicle for their own use, and roughly 60% of them use it every day.

The most used mean of transportation is by far the car, the “First Movers” being those that use it the most with almost 80%. On the other hand, about 64% of “Deniers” use the car on their daily trips. The motorcycle and the subway are the most used means of transportation after the car. Both the shared bicycle and shared car services are the less used transportation methods (Annex C).

Most of the participants from the various cluster groups never used or do not have access to the variety sharing transportation services. The "Open Minded" are the most satisfied with the car-sharing services, with almost 20% claiming to be satisfied with the service. On the other hand, the "Deniers" have the biggest percentage of somewhat dissatisfied participants (4.5%).

When it comes to carpooling services, the less satisfied group was the "Skeptics" with only 5.5% reporting feeling satisfied with it. Most of the members of this cluster group as well as in the remaining groups have never used carpooling services or do not have access to it in their residence. The "First Movers" showed a considerably higher percentage of totally satisfied consumers (7.4%).

In the Motorcycle sharing services is also verified that most of the participants have never used or do not have access to the services. Once again the "Skeptics" were the group less prone to take advantage of this mean of transportation, with a low cumulative percentage of only 10.1% between satisfied and totally satisfied consumers, compared to the "Open Minded" or "First movers" with 22.9% and 22%, respectively.

Compared to the previously shared transportation services, the shared bicycle services have more users with roughly 50% in every cluster group having used it at least once. The "Pollution Sensitives" are the most satisfied users with 30% being satisfied, and 9.3% totally satisfied. The "Deniers" and the "Skeptics" are the clusters groups with more members being neither satisfied nor dissatisfied.

In a similar fashion to the bicycle shared services, the scooter shared services are used more often as a mobility option, with the "First Movers" being the members who use them more, followed by the "Open Minded". The "Skeptics" had the biggest percentage of somewhat dissatisfied consumers with 6.8%.

4.4 Cluster implications

In order to have a successful implementation of Urban Air Vehicles and Urban Air Mobility transportation, governments, local authorities and social entities will most likely have an important role in encouraging the population to embrace a more environmentally friendly transportation mode (Holden & Goal, 2016). According to our results, it is expected that certain population segments will adopt UAVs sooner than others. This dissertation aims to identify those groups to facilitate the development of strategies to implement UAM in Portugal, guiding stakeholders to the right path. The identified segments are expected to also have an impact on the broader acceptance of UAVs since they will theoretically be the first to experience this new and more advanced mode of transport, so their opinion will be spread and influence the rest of the population segments to either accept or reject Air Vehicles. Therefore, word-of-mouth communication can be beneficial to UAM.

Many interesting insights arose from the cluster analysis, although the knowledge of automated vehicles and automated air vehicles was not high, with only 48.9% of the sample knowing what an Air Vehicles is, there were still differentiation characteristics found among the sample. However, most of the sample are educated people with superior degrees so in some population segments with lower levels of education and not as well represented in this study, the knowledge of this technology might be lower. Two opposite clusters were identified. One, the “First Movers”, with high levels of acceptance, and with most participants regarding themselves as Early Adopters or Innovators in the adoption category classes. On the other hand, the “Deniers”, a segment of the population that does not believe that AVs and UAM will bring any sort of benefits to society, and most of them are either Laggards or Late Majority in the adoption category classes. The rest of the clusters lacked those highly defining characteristics; however, they can be distinguished and be put closer to the “First Movers” or “Deniers”, in terms of their levels of embracement to UAVs.

The first and third clusters, labeled as “Open-minded” and “First Movers” respectively, entail the most innovative people from the study. Both have the most participants from the age groups of 25 to 34, which are young people with some financial possessions, they also have participants of the age group of 54-65. These participants no longer have to worry about their children, therefore have more time and also money to spend on themselves since when they were young they did not have a chance to take advantage of technological developments as nowadays the younger people do. The Portuguese population, especially older age groups, are very fond of air transport since it has always been a part of the country’s history and culture. Adding to that, the Portuguese coastal area is very long and has several aerodromes across it, thus it does not come as a surprise that older people are one of the population segments that are most likely to adopt and use AVs and accept Urban Air Mobility as an innovative and safe mode of transport. Regions with aeronautic activity might be more receptive to UAM and its residents might be more willing to use UAVs early after their introduction in the mobility systems.

Especially in the third cluster, the “First Movers”, there is a big difference in gender distribution, with men counting for 72% of the participants in the cluster. This is a differentiator factor since men are known to better or at least more easily accept technological change, and not care as much for the environment as their female counterparts, and that can be observed since the “First Movers” are also the ones that have the least concern with the environment. On the other hand, the “Pollution Sensitive” cluster is the only one with a bigger percentage of female participants.

“Emergency Supporters”, “Skeptics” and, “Deniers” are the most adverse groups to the use of UAVs as a means of transport and they all share a few similarities in their demographic distribution. For example, all these clusters have a predominant incidence of younger respondents, the only exception is the respondents in the age group of 45 to 54 which represent 19.2% of the Skeptics. When compared to the cluster with a higher level of embracement, the monetary capacity of these participants is also inferior, especially in the “Deniers” cluster where 37% have a monthly income of 1000€ to 2000€, and according to Eker et al. (2020) people with lower income levels are less willing to pay for the use of AVs or UAM. However, the “Skeptics” group has respondents with higher income, those are respondents of the age group of 45 to 54 years. Most of the participants in these clusters regard themselves as either Late Majority or even Laggards when it comes to adopting Air Vehicles, yet those in the “Open-Minded” and “First Movers” (higher adoption) regard themselves more as Early Adopters or Innovators.

It was also found that when it comes to gender, men are more prone to embrace Air Vehicles than women since they tend to have a more positive take on embracing new technologies. About 47% of female respondents considered themselves as Early Majority, and 27.1% Late Majority, however, 38% of men also categorized themselves as Early Majority but another 32.1% said to be Early Adopter. Also, the percentage of Innovators adopting new technologies is higher for men as shown in table 4.10. Similar results were found across various studies (Al Haddad et al., 2020; Konig and Neumayr, 2017).

Findings show that not all age groups feel the same way regarding the adoption and use of UAVs. Despite the age differences not being the most important factor, since there are respondents of all age groups in the cluster with higher levels of embracement, people in the younger age group of 25 to 34 years old, and in the age group of 55 to 64 years old showed higher levels of acceptance towards AVs and UAM.

Previous research (Fu et al., 2019) also found that the penetration rates for UAVs will be higher in those age groups mentioned above. The level of income, despite many studies showing it as an important factor and most times participants with higher levels of income, tend to be more willing to accept and adopt new technologies. That was not entirely the case in this study, since the “Skeptics” arethe ones with higher levels of monthly net income, although they are not the ones considered to have atendency to adopt air vehicles easily.

There are some factors that will have an impact on how society will feel about UAVs and autonomous driving, namely safety which according to Panagiotopoulos and Dimitrakopoulos (2018) is the most important one. Al Haddad et al. (2020) also stated safety as the most important factor in adoption, followed by cost in second and trip duration in third. Safety regards not only the safety of the rider itself but of the vehicle and the conditions in which it will operate. Across all clusters, even those who do not seem willing to accept or use AVs, most respondents either stated to agree or strongly agree to be concerned with using an AV in bad weather conditions. Having the possibility to transfer manual control or even talk to an operator on the ground could be one method to increase trust among possible users and thus increasing the levels of acceptance and intention to use, results show that more than 60% of the respondents agree or strongly agree with this statement.

Begg (2014), who carried a study on autonomous driving with London based transport professional residents, found that 20% of the respondents expect level 4 automated vehicles (cars do not need to have a driver to operate) to be common in the UK; however, 29.8% answered “never” to the same question. In the study of Kyriakidis et al. (2015) a year later, the participants expected fully autonomous cars to be on public roads by 2030 (median response), this could mean that people are getting more used to driver assistance tools based on automation, like cruise control or ABS (Automatic Brake Systems). According to our results, the clusters with most participants who find driver assistance useful and reliable are also the ones with the higher levels of acceptance of Air Vehicles. Konig and Neumayr (2017) associate usage of driver assistance technology in cars with higher levels of embracement of autonomous vehicles.

With the implementation of UAM, the noise and visual pollution levels will probably raise due to the circulation of Air Vehicles. However, according to our study, the cluster with higher levels of embracement has the participants who are less concerned with visual and noise pollution with 36.8% of “First Movers” responding disagree to both questions. Urban pollution, especially noise pollution will be a big barrier to implementing UAM. It is a problem that should be tackled early and get the population to participate in finding a solution to the problem.

Table 4.10 - Distribution of Class regarding Adoption of New Technologies by gender

Gender	Laggards	Late Majority	Early Majority	Early Adopters	Innovators
Female	1.00%	27.10%	47.30%	17.90%	6.80%
Male	1.80%	14.40%	37.90%	32.10%	13.70%

5. Conclusions and Further Research

5.1. Conclusion

The purpose of this study was to determine which groups, within the Portuguese population, were more prone to embrace AVs and UAM as a form of public mobility for their daily use. To achieve that goal an online survey was shared and 485 valid responses were obtained.

In order to find groups, a cluster analysis was made using the Kmeans method based on five variables obtained from a PCA applied on14 different items of the public embracement (section H) section of the online survey, those variables refer to; (1) purpose for UAM; (2) benefits for society; (3) healthcare or emergencies use; (4) environment and pollution concerns; (5) risks and concerns from UAM use. From the cluster analysis, six different groups were found, (1) Open-minded; (2) Pollution Sensitive; (3) First-movers; (4)Emergency Supporters; (5) Skeptics; (6) Deniers. Cluster groups were then characterized based on different variable sections, such as safety, intention to use, expected benefits and, their mobility habits.

The results found in this study also point out the importance of analyzing the characteristics and the perception of the population over UAM to understand how to act towards a successful implementation of UAVs in Portugal in the sense that citizens will both accept the use of UAVs and use them for their mobility needs. The survey showed the low levels of knowledge on UAM of the Portuguese population, this means it is imperative to provide them with pertinent and significant information on the benefits of adopting AVs and UAM. Doing this beforehand might be a crucial factor for having a successful market implementation, since it was also identified in several other studies related to Air Vehicles and Driverless Vehicles, that ignorance and lack of knowledge only contribute to the nonacceptance of new technologies. Another important outcome is to take advantage of the population segments that show higher levels of acceptance, the "First Movers" and the "Open-Minded", who can be very helpful to bring the rest of the population in conformity with UAM.

The population segments who tend to be more positive towards Air Mobility and theoretically will be the first to take on the role of users are either young people in the age group of 25 to 34 years old. These people are more independent financially than compared to their younger counterparts, and older people especially in the age range of 54 to 65 who also have financial independence and especially more free time and a desire to experiment with new technologies, something they were not able to do as young people because this kind of developments was not possible in that time. In this study, men tend to be more flexible towards accepting this technology, a fact that seems to reoccur in other studies(Al Haddad et al., 2020; Hohenberger et al., 2016).

The information gathered in this research will give some light to Governments, Policymakers, and industrial manufactures on how to approach the market in the early stages of developing and implementing UAM in the main urban centers in Portugal, namely Lisbon and Porto.

5.2. Limitations

From the beginning of the study, it was known that some limitations were going to impact the results obtained on the research. Firstly the sample was collected via online. Although a big effort was made in order to fulfill the quotas by region, it is not proper to consider it representative of the entire Portuguese population. It was difficult to engage with participants from elder age groups, mainly participants 65 or more years old, which could bias the sample. In contrast, respondents with higher levels of education were prone to answer the survey as 84% of the sample has a higher degree of education (bachelors´ or masters´ degree). This was an issue as only 26.1% of the Portuguese population has a superior degree (Pordata, 2019). Theoretically, the participants in this study were more knowledgeable regarding technological innovations since they had easier access to trustworthy information, from their institutions. However, there is still a big percentage of the populations that are not well represented in this study, which could be a possibility for future researchers to engage and compare possible results.

A second limitation is the scope of this study, since it is aimed at the Portuguese population, and should not be directly used to define other nations' perceptions regarding Air Vehicles or the use of Urban Air Mobility as a mode of transportation. It only can be instructive on how to conduct this research, or how to make the transitions to other cultures.

5.3. Future Research

Regarding future research possibilities, it is important to keep studying the population more thoroughly, in order to fully understand the divergencies in the different population segments, and how to educate all on the benefits that this technology can bring to everyday lives. Other studies (S. Pettigrew et al., 2019) address the importance of driverless vehicles to benefit people who are unable to drive, the elderly, and the disabled. These people often depend on family, friends, or professionals to have mobility. Having the chance to have more independence in transport could be a changing point in their lives. In Portugal, there are no studies regarding the impact of driverless vehicles in these population segments, and analyzing its benefits for these people should be an important step to improve acceptance and adoption, in every age group.

Another way to help ensuring that UAV will be embraced is to promote the usage of shared mobility services as they are a path to create a smoother and more sustainable form of commuting for the general population who uses public transport daily. However, it is not easy to change the culture and the mindset of the people overnight. The younger generations, from 18 to 34 years old tend to use more these transport modes, because they seem to be more open to trying it, and have not been using a private vehicle for as long as the older population.

More campaigns should be made to encourage not just young people, but everyone to embrace the usage of shared mobility services because it would be helpful in many ways such as reducing the numbers of polluting gases released into our atmosphere, reducing the congestion on roads shortening travels times and, it is also a pathway to involve people with newer ways of commuting like the UAM.

Informing people, and helping them understand the benefits for the day to day life of using these services, could be one way of changing how the general population sees their commuting options, and begin to open up to newer, safer, and more sustainable forms of mobility creating a global change in the Portuguese perception of mobility.

Portugal, as a small country in terms of territory, is a pilot for a variety of technologicaldevelopment. Lisbon could be a proper city to try and implement UAM in Europe since it is a large citywith uneven terrain, perfect to try out the Air Vehicles, but not too large to require enormous amounts of investments. Studies should be made on the Lisbon area to pinpoint possible infrastructure sites for vertical landing and take-off operations, and from there develop a network of operations for the Air Vehicles (VOLTs), and experiment with this technology in Portugalperception of mobility.

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Annexes

Annex A – Online Survey

Dear participant,

My name is Tomás Ferreira and I would like to invite you to participate in a survey designed for my master thesis. Thank you very much in advance for your contribution to this research.

The objective of the survey is to assess people's perceptions towards air vehicles and their intention to use them for their mobility needs.

It should take around 15 minutes to complete this questionnaire. There are no right or wrong replies, we are interested in your opinion.

In case of any concerns, please do not hesitate to contact me via email: tlmfa@iscte-iul.pt

Thank you very much for your support. Tomás Ferreira

Please click "Next" to continue.

Section A: Trust in Automation

Automation is the technology by which a process or procedure is performed with minimum human assistance.

A1. Please select the options that best describe your opinion regarding the following sentences

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree	I don't know what is this / Never used it
I believe that driver assistance systems are useful (e.g.: automatic emergency braking, blindspot detection, cruise control, lane keeping assistance, etc.)	☐	☐	☐	☐	☐	☐	☐	☐
I believe that driver assistance systems are reliable (e.g.: automatic emergency braking, blindspot detection, cruise control, lane keeping assistance, etc.)	☐	☐	☐	☐	☐	☐	☐	☐
I am satisfied with the driver assistance systems I have used (e.g.: automatic emergency braking, blindspot detection, cruise control, lane keeping assistance, etc.)	☐	☐	☐	☐	☐	☐	☐	☐
When an automated technology gives me problems I usually stop trusting it	☐	☐	☐	☐	☐	☐	☐	☐

A2. Have you ever used a driverless vehicle? (e.g. car, bus, tram, metro)

- Yes ☐
- No ☐
- I dont what this is ☐

A3. Do know you someone who used a driverless vehicle?

- Yes ☐
- No ☐

A4. Please select the options that best describe your experience regarding the following sentences

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
I felt comfortable	☐	☐	☐	☐	☐	☐	☐
I was stressed	☐	☐	☐	☐	☐	☐	☐
I felt safe	☐	☐	☐	☐	☐	☐	☐
I felt anxious	☐	☐	☐	☐	☐	☐	☐
I was scared	☐	☐	☐	☐	☐	☐	☐

A5. Please select the options that best describe their experience regarding the following sentences

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree	I don't know
He or she felt comfortable	☐	☐	☐	☐	☐	☐	☐	☐
He or she felt stressed	☐	☐	☐	☐	☐	☐	☐	☐
He or she felt safe	☐	☐	☐	☐	☐	☐	☐	☐
He or she felt anxious	☐	☐	☐	☐	☐	☐	☐	☐
He or she was scared	☐	☐	☐	☐	☐	☐	☐	☐

Section B: Adoption of a new technology

B1. Regarding the adoption of a new technology, which adopter category represents you?

- ☐ Innovator - These are people who want to be the first to try the innovation. They are venturesome and interested in new ideas. These people are very willing to take risks, and are often the first to develop new ideas
- ☐ Early Adopter - These are people who represent opinion leaders. They enjoy leadership roles, and embrace change opportunities. They are already aware of the need to change and so are very comfortable adopting new ideas
- ☐ Early Majority - These people are rarely leaders, but they do adopt new ideas before the average person. That said, they typically need to see evidence that the innovation works before they are willing to adopt it.
- ☐ Late Majority - These people are skeptical of change, and will only adopt an innovation after it has been tried by the majority
- ☐ Laggard - These people are bound by tradition and very conservative. They are very skeptical of change.

B2. Regarding the adoption of a new shared mobility innovations, which adopter category represents you?

	Innovator	Early Adopter	Early Majority	Late Majority	Laggard	I don't know what this is / Not available in my city
Ride-hailing services (e.g. Uber, Bolt, etc)	☐	☐	☐	☐	☐	☐
Car-sharing services (e.g. DriveNow, car2go, etc.)	☐	☐	☐	☐	☐	☐
Carpooling services (e.g. BlaBlaCar, etc.)	☐	☐	☐	☐	☐	☐
Motorcycle-sharing services (e.g. eCooltra, Acciona, etc.)	☐	☐	☐	☐	☐	☐
Bicycle-sharing services (e.g. Jump, Gira, etc.)	☐	☐	☐	☐	☐	☐
Scooter-sharing services (e.g. Lime, Hive, etc.)	☐	☐	☐	☐	☐	☐

B3. How much satisfied are you with the following shared mobility services?

	Totally Dissatisfied	Dissatisfied	Somewhat Dissatisfied	Neither Satisfied nor Dissatisfied	Somewhat Satisfied	Satisfied	Totally Satisfied	Never used it / Not available in my city
Ride-hailing services (e.g. Uber, Bolt, etc)	☐	☐	☐	☐	☐	☐	☐	☐

	Totally Dissatisfied	Dissatisfied	Somewhat Dissatisfied	Neither Satisfied nor Dissatisfied	Somewhat Satisfied	Satisfied	Totally Satisfied	Never used it / Not available in my city
Car-sharing services (e.g. DriveNow, car2go, etc.)	☐	☐	☐	☐	☐	☐	☐	☐
Carpooling services (e.g. BlaBlaCar, etc.)	☐	☐	☐	☐	☐	☐	☐	☐
Motorcycle-sharing services (e.g. eCooltra, Acciona, etc.)	☐	☐	☐	☐	☐	☐	☐	☐
Bicycle-sharing services (e.g. Jump, Gira, etc.)	☐	☐	☐	☐	☐	☐	☐	☐
Scooter-sharing services (e.g. Lime, Hive, etc.)	☐	☐	☐	☐	☐	☐	☐	☐

B4. On average, how frenquently do you use shared mobility services?

- More than once a week ☐
- Once a week ☐
- Every two weeks ☐
- Once a month ☐
- Every couple of months ☐
- I rarely use these services ☐

B5. For which purposes do you use shared mobility services?

- For daily trips from/to work or college ☐
- For leisure activities ☐
- For social activities ☐

B6. Do you know what an Autonomous Air Vehicle is?

- Yes ☐
- No ☐

Section C: Air Vehicles

Let me introduce you to a new transport mode: Autonomous Air Vehicles. These vehicles will fly above the cities. Bellow you can find a short description of this new air mobility concept. *(Source: Airbus)*

Moving with Air Vehicles means that:

You reserve your Air Vehicle via smartphone app

You can use it whenever you require the service

You can pick-up a vehicle and drop-off from/to a nearby location

You travel at a speed that is 3 times higher than the speed of conventional road cars

You can have the entire Air Vehicle for yourself or for your travel group (max. 4 passengers)

No pilot is needed, the Air Vehicle is autonomous

The Air Vehicle is fully electric and has a range of 50 kilometers

Section D: Expected Benefits

D1. Based on this information, please select how much you agree with the following statements that express the expected benefits of introducing this new transport mode in mobility systems

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
The use of Air Vehicles will reduce road congestion	☐	☐	☐	☐	☐	☐	☐
The use of Air Vehicles will reduce accident on roads	☐	☐	☐	☐	☐	☐	☐
The use of Air Vehicles will make my travel time more productive	☐	☐	☐	☐	☐	☐	☐
Air Vehicles will significantly reduce travel time	☐	☐	☐	☐	☐	☐	☐
The use of Air Vehicles will facilitate the connection of remote areas to bigger cities and multimodal nodes such as ports and airports.	☐	☐	☐	☐	☐	☐	☐
The use of Air Vehicles will release more free space in the urban environment for other facilities such as parks and pedestrian zones.	☐	☐	☐	☐	☐	☐	☐
Air vehicles will produce lower CO2 emissions	☐	☐	☐	☐	☐	☐	☐
Air vehicles will offer a safe and fast mean of transportation	☐	☐	☐	☐	☐	☐	☐
Air vehicles will offer a less stressful mobility experience	☐	☐	☐	☐	☐	☐	☐
Air vehicles will make it easier for people with reduced mobility to move (e.g. elderly, children, disabled people).	☐	☐	☐	☐	☐	☐	☐

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
Air vehicles will make it easier ambulances and police to move fast to emergency cases	☐	☐	☐	☐	☐	☐	☐
Air vehicles will increase the trips people will make	☐	☐	☐	☐	☐	☐	☐

Section E: Cyber security

Cybersecurity is the practice of protecting systems, networks, and programs from digital attacks.

E1. Please select the options that best describe your opinion regarding the following sentences

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
I make sure that my data are kept private whenever I use the internet	☐	☐	☐	☐	☐	☐	☐
I'm concerned that my data is kept resilient to common cyber security threats whenever I use internet	☐	☐	☐	☐	☐	☐	☐
I'm concerned that others can keep track of my location	☐	☐	☐	☐	☐	☐	☐
I am concerned that Air Vehicles will use my personal information for other purposes without my authorization	☐	☐	☐	☐	☐	☐	☐
I am concerned that Air Vehicles will share my personal information with other entities without my authorization	☐	☐	☐	☐	☐	☐	☐
I'm concerned that someone can take control of the Air Vehicle and cause a terrorist attack	☐	☐	☐	☐	☐	☐	☐

Section F: Safety

F1. Please select the options that best describe your opinion regarding the following sentences

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
I'm more concerned with the operation of Air Vehicles over urban areas than suburban areas	☐	☐	☐	☐	☐	☐	☐
I'm concerned about the performance of Air Vehicles under poor weather conditions	☐	☐	☐	☐	☐	☐	☐
I'm concerned that the first Air Vehicles available will be unsafe due to technological issues of the vehicle	☐	☐	☐	☐	☐	☐	☐
I'm concerned that the first Air Vehicles available will be unsafe due to possible vehicle collisions in the air above cities	☐	☐	☐	☐	☐	☐	☐

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
In order for me to feel safe, I would expect to be able to talk to an operator on ground at any time.	☐	☐	☐	☐	☐	☐	☐
In order for me to feel safe, I would expect an operator on ground to be able to take control of the vehicle at any time.	☐	☐	☐	☐	☐	☐	☐
In order for me to feel safe, I would expect an operator on ground to be able to take control of the vehicle in case of emergency.	☐	☐	☐	☐	☐	☐	☐

Section G: Intention to use an Air Vehicle

G1. Taking all of this into account, which group do you think you belong when adopting Air Vehicles for your mobility?

- Innovator - These are people who want to be the first to try the innovation. They are venturesome and interested in new ideas. These people are very willing to take risks, and are often the first to develop new ideas ☐
- Early Adopter - These are people who represent opinion leaders. They enjoy leadership roles, and embrace change opportunities. They are already aware of the need to change and so are very comfortable adopting new ideas ☐
- Early Majority - These people are rarely leaders, but they do adopt new ideas before the average person. That said, they typically need to see evidence that the innovation works before they are willing to adopt it. ☐
- Late Majority - These people are skeptical of change, and will only adopt an innovation after it has been tried by the majority ☐
- Laggard - These people are bound by tradition and very conservative. They are very skeptical of change and are the hardest group to bring on board ☐
- I'll never adopt this transport mode ☐

G2. Imagine that we are in 2030 and you have to travel 30km (ex.: Sintra to Lisbon in Portugal, Kifisia to Glyfada in Greece, Bonn to Cologne in Germany, Paris centre to Paris Orly airport in France). Considering the following characteristics, which mode of transport would you choose?

	Air Vehicle	Shared mobility services
Air Vehicles - 17 minutes (door-to-door) with a price of 25€ | Shared mobility services - 30 minutes (door-to-door) with a price of 21€	☐	☐

G3. Please select the options that best describe your opinion regarding the following sentences

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
My safety concerns could prevent me from using an Air Vehicle	☐	☐	☐	☐	☐	☐	☐
My cybersecurity concerns could prevent me from using an Air Vehicle	☐	☐	☐	☐	☐	☐	☐
My fear to fly could prevent me from using an Air Vehicle	☐	☐	☐	☐	☐	☐	☐

G4. Would you use an Air Vehicle for:

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
Trips from/to work or college							
Trips to leisure activities							
Trips to social activities							
Trips to healthcare services (e.g. Hospitals)							

Section H: Public embracement

As a citizen (not necessarily as an user) please choose the answer that suits best your acceptance towards this new mean of transportation

H1. As a citizen (not necessarily a user) please choose the answer that suits best your acceptance towards this new mean of transportation:

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
Air Vehicles are an acceptable means of transport							
Air Vehicles will increase the quality of life in the cities that offer this transport mode							
Air Vehicles will improve transport accessibility for all citizens							
I am concerned that the Air Vehicles will become a transport mode only for the rich							
I wouldn't feel comfortable living in a city that adopts this transport mode							
I am concerned that Air Vehicles will increase visual pollution							
I am concerned that Air Vehicles will increase noise pollution							
Air Vehicles will be beneficial for the society							
Air Vehicles will be risky to the public							
Moving with Air Vehicles will be as safe as with airplanes							

H2. Air Vehicles should be use to:

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
Transfer people from/to work or school							
Transfer people for leisure							
Transfer people for social activities							

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
Transfer people from/to healthcare services (e.g. Hospitals)	☐	☐	☐	☐	☐	☐	☐
Transfer goods to people	☐	☐	☐	☐	☐	☐	☐
Respond to emergency cases (e.g ambulances, police units, etc.)	☐	☐	☐	☐	☐	☐	☐

H3. Air Vehicles make me feel...

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
Stressed	☐	☐	☐	☐	☐	☐	☐
Safe	☐	☐	☐	☐	☐	☐	☐
Anxious	☐	☐	☐	☐	☐	☐	☐
Comfortable	☐	☐	☐	☐	☐	☐	☐
Scared	☐	☐	☐	☐	☐	☐	☐

H4. In the list bellow you can find some usual sounds that we hear on our daily lives. ***Please rank the sounds on the right, being the first one the most annoying and last one the least annoying.***

- Busy restaurant ☐☐
- Ambulance siren ☐☐
- Freeway traffic ☐☐
- Car horn ☐☐
- Baby crying ☐☐
- Vaccum cleaner ☐☐

Section I: Mobility Behaviour and Well-being

I1. On average, how long do you spend per day on your daily trips from/to work or college?

- Less than 15 minutes ☐
- 15-30 minutes ☐
- 30-45 minutes ☐
- 45-60 minutes ☐
- Over 1 hour ☐

I2. Do you walk in your daily trips from/to work or college?

- No ☐
- Yes, along with other means of transportation ☐
- Yes, my commuting consists of walking exclusively ☐

I3. Do you have a public transport monthly pass?

- Yes ☐
- No ☐

I4. In your daily trips from/to work or college, how many means of transportation do you use?

- Only one mean of transportation ☐
- A combination of means of transportation ☐

I5. Which mean of transportation do you use in your daily trips from/to work or college?

- Car ☐
- Motorcycle ☐
- Bus ☐
- Ferry ☐
- Train ☐
- Tram ☐
- Taxi ☐
- Subway ☐
- Shared-mobility car (e.g. DriveNow, Uber) ☐
- Shared-mobility motorcycle (e.g. eCooltra) ☐
- Shared-mobility bicyles (e.g. Jump) ☐
- Other ☐

Other

I6. What means of transportation do you use in your daily trips from/to work or college?

- Car ☐

- Motorcycle ☐
- Bicycle ☐
- Bus ☐
- Ferry ☐
- Train ☐
- Tram ☐
- Metro ☐
- Taxi ☐
- Shared car ☐
- Shared motorcycle ☐
- Shared bicycle ☐
- Walking ☐
- Other ☐

Other

I7. How much satisfied are you with your...

	Totally Dissatisfied	Dissatisfied	Somewhat Dissatisfied	Neither Satisfied nor Dissatisfied	Somewhat Satisfied	Satisfied	Totally Satisfied
Trips from/to work or college	☐	☐	☐	☐	☐	☐	☐
Trips to leisure activities	☐	☐	☐	☐	☐	☐	☐
Trips to social activities	☐	☐	☐	☐	☐	☐	☐
Trips to healthcare services (e.g. Hospitals)	☐	☐	☐	☐	☐	☐	☐

Section J: Driving Behaviour

J1. Do you have a driver's license?

- Yes ☐
- No ☐

J2. Do you currently own or lease a vehicle?

- Yes ☐
- No ☐

J3. How often do you drive or use a vehicle?

- Everyday ☐
- Couple of times a week ☐
- Once every two weeks ☐
- Once a month ☐
- Every couple of months ☐
- I don't drive ☐

J4. Do you have free parking near your home?

- Yes ☐
- No ☐

J5. Do you have free parking at your work/college?

- Yes ☐
- No ☐

J6. Please select the options that best describe your opinion regarding the following sentences

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
I prefer not to have the responsibility of driving	☐	☐	☐	☐	☐	☐	☐
I feel safer driving myself rather than others driving me	☐	☐	☐	☐	☐	☐	☐
I always drive close to the speed limit	☐	☐	☐	☐	☐	☐	☐
I always obey the traffic code when in urban environments	☐	☐	☐	☐	☐	☐	☐
I consider myself more as a defensive driver than an aggresive one	☐	☐	☐	☐	☐	☐	☐
Comparing to other transport modes, I feel safer in a car	☐	☐	☐	☐	☐	☐	☐
I don't drive whenever I drink alcohol	☐	☐	☐	☐	☐	☐	☐

J7. As a driver, have you ever been involved in a car crash?

- Yes ☐
- No ☐

J8. What was the severity level?

- No injuries ☐
- Minor injuries ☐
- Major injuries ☐

Section K: Environmental Concerns

K1. Please select the options that best describe your opinion regarding the following setences

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
Overall, I am concerned about global warming	☐	☐	☐	☐	☐	☐	☐
I'm capable of changing my behaviour based on environmental concerns	☐	☐	☐	☐	☐	☐	☐
I am willing to spend a bit more to buy a product that is more environmentally friendly	☐	☐	☐	☐	☐	☐	☐
It is acceptable for an industrial society such as ours to cause some pollutions	☐	☐	☐	☐	☐	☐	☐
When I choose a mode of transport I am conscious about my CO2 emissions	☐	☐	☐	☐	☐	☐	☐

Section L: Demographics

L1. What is your gender?

- Female ☐
- Male ☐
- Prefer not to say ☐

L2. What age range do you fit in?

- 18 to 24 ☐
- 25 to 34 ☐
- 35 to 44 ☐
- 45 to 54 ☐
- 55 to 64 ☐
- 65 or older ☐
- Prefer not to say ☐

L3. Do you have children?

- Yes ☐
- No ☐

L4. What is your educational background (including ongoing education)?

- School without graduation ☐
- Primary or secondary school ☐
- High school ☐
- Apprenticeship with graduation ☐
- Bachelor's degree ☐
- Masters' degree ☐
- PhD ☐
- Prefer not to say ☐

L5. What is your household net monthly income in Euros (roughly)?
Please include all types of income, including monthly wage, salary, income from self-imployment, pension, child allowance, housing benefit or social assistance, and other income after deducting taxes and social security contributions for all household members.

- Up to 500€ ☐
- 500€ to less than 1000€ ☐
- 1000€ to less than 2000€ ☐
- 2000€ to less than 3000€ ☐
- 3000€ to less than 4000€ ☐
- 4000€ to less than 5000€ ☐
- 6000€ to less than 7000€ ☐
- More than 7000€ ☐
- Prefer not to say ☐

L6. What is your current employment situation?

- Employed - Full time ☐
- Employed - Part time (11 to less than 35hours/week) ☐
- Self-employed ☐
- Apprenticeship ☐
- Pupil (including pre-school) ☐
- Student (university or college) ☐
- Currently unemployed ☐
- Temporary leave (e.g. maternity leave, paternity leave) ☐
- Housewife or househusband ☐
- Retired ☐
- Military or civil service ☐
- Voluntary service ☐
- Prefer not to say ☐
- Other ☐

Other

L7. In which country do you live?

- Afghanistan ☐
- Albania ☐
- Algeria ☐
- Andorra ☐
- Angola ☐
- Antigua and Barbuda ☐
- Argentina ☐
- Armenia ☐
- Australia ☐
- Austria ☐

United Arab Emirates ☐
United Kingdom ☐
United States of America ☐
Uruguay ☐
Uzbekistan ☐
Vanuatu ☐
Venezuela ☐
Vietnam ☐
Yemen ☐
Zambia ☐
Zimbabwe ☐

L8. How would you describe the place you live in?

Megacity (a city with over 10 million habitants) ☐
City with over 1 million and less than 10 million habitants ☐
City with less than 1 million habitants ☐
Small town ☐
Village ☐
Remote location (country side) ☐

L9. Would you like to comment on this questionnaire? Please leave us suggestions here.

Thank you very much. Your contribution will be extremely valuable to this study!

If you have any questions or would like to get informed about the final results of this project, please feel free to contact me through email: tlmfa@iscte-iul.pt

Annex B – Principal Components Analysis and Ward Method Cluster

PCA Analysis

Corrolation Matrix

Correlation Matrix

		Public embracement - Air Vehicles will increase the quality of life	Public embracement - Air Vehicles will improve transport accessibility	Public concerns - I am concerned that Air Vehicles will increase visual pollution	Public concerns - I am concerned that Air Vehicles will increase noise pollution	Public concerns - Air Vehicles will be beneficial for the society	Public embracement - Moving with Air Vehicles will be as safe as with airplanes	Public embracement -Transfer people from to work or school	Public embracement - Transfer people for leisure	Public embracement - Transfer people for social activities	Public embracement - Transfer people from to healthcare services	Public embracement - Transfer goods to people	Public embracement - Respond to emergency cases	Public concerns - Air Vehicles will be risky to the public	Public concerns - I wouldnt feel comfortable living in a city that adopts
Correlation	Public embracement - Air Vehicles will increase the quality of life	1,000	,627	-,254	-,166	,632	,383	,406	,400	,430	,332	,315	,332	-,388	-,446
	Public embracement - Air Vehicles will improve transport accessibility	,627	1,000	-,183	-,138	,486	,339	,375	,315	,379	,235	,254	,218	-,237	-,268
	Public concerns - I am concerned that Air Vehicles will increase visual pollution	-,254	-,183	1,000	,661	-,298	-,132	-,155	-,137	-,138	-,068	-,039	-,044	,353	,382
	Public concerns - I am concerned that Air Vehicles will increase noise pollution	-,166	-,138	,661	1,000	-,220	-,106	-,163	-,163	-,152	-,059	,020	-,019	,381	,259
	Public concerns - Air Vehicles will be beneficial for the society	,632	,486	-,298	-,220	1,000	,408	,429	,461	,471	,374	,367	,375	-,346	-,397
	Public embracement - Moving with Air Vehicles will be as safe as with airplanes	,383	,339	-,132	-,106	,408	1,000	,394	,319	,333	,160	,149	,154	-,303	-,215
	Public embracement - Transfer people from to work or school	,406	,375	-,155	-,163	,429	,394	1,000	,601	,630	,144	,367	,160	-,251	-,255
	Public embracement - Transfer people for leisure	,400	,315	-,137	-,163	,461	,319	,601	1,000	,881	,257	,458	,230	-,276	-,249
	Public embracement - Transfer people for social activities	,430	,379	-,138	-,152	,471	,333	,630	,881	1,000	,255	,486	,236	-,266	-,279
	Public embracement - Transfer people from to healthcare services	,332	,235	-,068	-,059	,374	,160	,144	,257	,255	1,000	,216	,684	-,202	-,199
	Public embracement - Transfer goods to people	,315	,254	-,039	,020	,367	,149	,367	,458	,486	,216	1,000	,273	-,130	-,184
	Public embracement - Respond to emergency cases	,332	,218	-,044	-,019	,375	,154	,160	,230	,236	,684	,273	1,000	-,163	-,223
	Public concerns - Air Vehicles will be risky to the public	-,388	-,237	,353	,381	-,346	-,303	-,251	-,276	-,266	-,202	-,130	-,163	1,000	,548
	Public concerns - I wouldnt feel comfortable living in a city that adopts	-,446	-,268	,382	,259	-,397	-,215	-,255	-,249	-,279	-,199	-,184	-,223	,548	1,000

KMO and Bartlett’s test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,819
Bartlett's Test of Sphericity	Approx. Chi-Square	3113,427
	df	91
	Sig.	,000

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5,078	36,268	36,268	5,078	36,268	36,268	2,771	19,792	19,792
2	1,855	13,251	49,520	1,855	13,251	49,520	2,328	16,626	36,417
3	1,459	10,424	59,943	1,459	10,424	59,943	1,841	13,151	49,568
4	1,051	7,504	67,448	1,051	7,504	67,448	1,735	12,395	61,964
5	,828	5,912	73,360	,828	5,912	73,360	1,595	11,396	73,360
6	,785	5,608	78,968						
7	,596	4,257	83,224						
8	,485	3,467	86,691						
9	,451	3,219	89,911						
10	,401	2,864	92,775						
11	,307	2,195	94,970						
12	,306	2,182	97,152						
13	,285	2,035	99,187						
14	,114	,813	100,000						

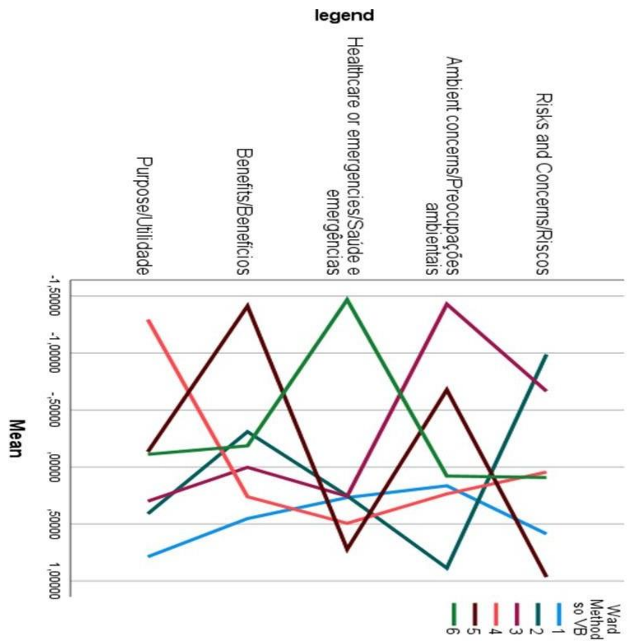
Ward Method Cluster solutions

Ward Method

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	84	17,3	17,3	17,3
	2	71	14,6	14,6	32,0
	3	66	13,6	13,6	45,6
	4	101	20,8	20,8	66,4
	5	30	6,2	6,2	72,6
	6	95	19,6	19,6	92,2
	7	38	7,8	7,8	100,0
	Total	485	100,0	100,0	

Ward Method

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	122	25,2	25,2	25,2
	2	71	14,6	14,6	39,8
	3	66	13,6	13,6	53,4
	4	101	20,8	20,8	74,2
	5	30	6,2	6,2	80,4
	6	95	19,6	19,6	100,0
	Total	485	100,0	100,0	



Best suited solution, with 6 clusters

Ward Method

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	122	25,2	25,2	25,2
	2	71	14,6	14,6	39,8
	3	96	19,8	19,8	59,6
	4	101	20,8	20,8	80,4
	5	95	19,6	19,6	100,0
	Total	485	100,0	100,0	

Ward Method

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	193	39,8	39,8	39,8
	2	96	19,8	19,8	59,6
	3	101	20,8	20,8	80,4
	4	95	19,6	19,6	100,0
	Total	485	100,0	100,0	

Ward Method

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	289	59,6	59,6	59,6
	2	101	20,8	20,8	80,4
	3	95	19,6	19,6	100,0
	Total	485	100,0	100,0	

Annex C – Mobility Habits per Cluster and Age

Cluster

		Mobility technologies embracement- On average how frenquently do you use						
		More than once a week	Once a week	Every two weeks	Once a month	Every couple of months	I rarely use these services	Total
Cluster Number of Case	1	6.9%	8.0%	3.4%	14.9%	9.2%	57.5%	100.0%
	2	5.6%	8.4%	16.8%	25.2%	8.4%	35.5%	100.0%
	3	11.8%	11.8%	13.2%	16.2%	8.8%	38.2%	100.0%
	4	4.8%	12.0%	16.9%	16.9%	8.4%	41.0%	100.0%
	5	8.2%	8.2%	15.1%	24.7%	6.8%	37.0%	100.0%
	6	3.0%	9.0%	10.4%	10.4%	17.9%	49.3%	100.0%
Total		6.6%	9.5%	12.8%	18.6%	9.7%	42.9%	100.0%

Satisfaction with different Mobility Options

Car sharing

		Mobility technologies embracement - **Car sharing** services							
		Dissatisfied	Somewhat dissatisfied	Neither satisfied nor dissatisfied	Somewhat satisfied	Satisfied	Totally satisfied	Never used it / Not available in my city	Total
Cluster Number of Case	1	1.1%	1.1%	6.9%	6.9%	19.5%	4.6%	59.8%	100.0%
	2		2.8%	9.3%	7.5%	16.8%	5.6%	57.9%	100.0%
	3		1.5%	10.3%	8.8%	14.7%	5.9%	58.8%	100.0%

	4		1.2%	15.7%	8.4%	7.2%	2.4%	65.1%	100.0%
	5		1.4%	15.1%	8.2%	13.7%	4.1%	57.5%	100.0%
	6	1.5%	4.5%	6.0%	9.0%	10.4%	4.5%	64.2%	100.0%
Total		0.4%	2.1%	10.5%	8.0%	14.0%	4.5%	60.4%	100.0%

Carpooling Services

	Mobility technologies embracement - **Carpooling services**								Total
	Totally dissatisfied	Dissatisfied	Somewhat dissatisfied	Neither satisfied nor dissatisfied	Somewhat satisfied	Satisfied	Totally satisfied	Never used it / Not available in my city	
Cluster Number of Case			1.1%	12.6%	3.4%	11.5%	4.6%	66.7%	100.0%
	0.9%	0.9%	2.8%	8.4%	2.8%	10.3%	0.9%	72.9%	100.0%
				13.2%	8.8%	5.9%	7.4%	64.7%	100.0%
				15.7%	3.6%	12.0%	2.4%	66.3%	100.0%
			2.7%	20.5%	1.4%	5.5%		69.9%	100.0%
			4.5%	7.5%	7.5%	10.4%	1.5%	68.7%	100.0%
Total	0.2%	0.2%	1.9%	12.8%	4.3%	9.5%	2.7%	68.5%	100.0%

Motorcycle sharing

		Mobility technologies embracement - **Motorcycle sharing services**							
		Totally dissatisfied	Somewhat dissatisfied	Neither satisfied nor dissatisfied	Somewhat satisfied	Satisfied	Totally satisfied	Never used it / Not available in my city	Total
Cluster Number of Case	1		1.1%	10.3%	3.4%	14.9%	8.0%	62.1%	100.0%

	2	1.9%	0.9%	6.5%	5.6%	15.0%	3.7%	66.4%	100.0%
	3		1.5%	10.3%	1.5%	13.2%	8.8%	64.7%	100.0%
	4			12.0%	2.4%	12.0%	6.0%	67.5%	100.0%
	5			13.7%	12.3%	6.8%	4.1%	63.0%	100.0%
	6			9.0%	13.4%	7.5%	4.5%	65.7%	100.0%
Total		0.4%	0.6%	10.1%	6.2%	12.0%	5.8%	64.9%	100.0%

Bicycle sharing

		Mobility technologies embracement - **Bicycle sharing** services								
		Totally dissatisfied	Dissatisfied	Somewhat dissatisfied	Neither satisfied nor dissatisfied	Somewhat satisfied	Satisfied	Totally satisfied	Never used it / Not available in my city	Total
Cluster Number of Case	1		1.1%		5.7%	8.0%	25.3%	5.7%	54.0%	100.0%
	2	0.9%	0.9%	1.9%	2.8%	7.5%	29.9%	9.3%	46.7%	100.0%
	3			1.5%	7.4%	7.4%	22.1%	10.3%	51.5%	100.0%
	4			2.4%	8.4%	7.2%	25.3%	9.6%	47.0%	100.0%
	5		1.4%	2.7%	12.3%	9.6%	19.2%	1.4%	53.4%	100.0%
	6			1.5%	11.9%	10.4%	22.4%	4.5%	49.3%	100.0%
Total		0.2%	0.6%	1.6%	7.6%	8.2%	24.5%	7.0%	50.1%	100.0%

Scooter sharing

		Mobility technologies embracement - **Scooter sharing** services								Total
		Totally dissatisfied	Dissatisfied	Somewhat dissatisfied	Neither satisfied nor dissatisfied	Somewhat satisfied	Satisfied	Totally satisfied	Never used it / Not availablein my city	
Cluster Number of Case	1		1.1%		4.6%	9.2%	26.4%	5.7%	52.9%	100.0%
	2		0.9%	3.7%	4.7%	6.5%	21.5%	5.6%	57.0%	100.0%
	3	1.5%		1.5%	10.3%	8.8%	22.1%	10.3%	45.6%	100.0%
	4		2.4%	2.4%	8.4%	10.8%	26.5%	4.8%	44.6%	100.0%
	5		1.4%	6.8%	12.3%	8.2%	12.3%	4.1%	54.8%	100.0%
	6		3.0%	1.5%	10.4%	9.0%	16.4%	1.5%	58.2%	100.0%
Total		0.2%	1.4%	2.7%	8.0%	8.7%	21.2%	5.4%	52.4%	100.0%

Age Group

		Mobility technologies embracement- On average how frenquently do you use					
		More than once a week	Once a week	Every two weeks	Once a month	Every couple of months	I rarely use these services
Socio-demographics What age range do you fit in?	18 to 24	7.0%	12.5%	14.1%	25.0%	7.8%	33.6%
	25 to 34	8.5%	14.6%	20.0%	18.5%	6.9%	31.5%
	35 to 44	9.2%	2.6%	7.9%	21.1%	10.5%	48.7%
	45 to 54	2.7%	6.7%	14.7%	12.0%	12.0%	52.0%
	55 to 64	4.3%	5.7%	1.4%	10.0%	15.7%	62.9%
	65 or older				33.3%		66.7%
Total		6.6%	9.5%	12.8%	18.6%	9.7%	42.9%

Adoption of UAV by Cluster

		Adoption UAVs					
		Laggards	Late Majority	Early Majority	Early Adopters	Innovators	Total
Cluster Number of Case	1	8.0%	34.5%	26.4%	16.1%	14.9%	100.0%
	2	4.7%	32.7%	35.5%	19.6%	7.5%	100.0%
	3	2.9%	17.6%	30.9%	35.3%	13.2%	100.0%
	4	9.6%	32.5%	39.8%	10.8%	7.2%	100.0%
	5	20.5%	35.6%	23.3%	12.3%	8.2%	100.0%
	6	14.9%	28.4%	37.3%	11.9%	7.5%	100.0%
Total		9.7%	30.7%	32.4%	17.5%	9.7%	100.0%

Annex D – Cluster distribution by age group

		Socio-demographics - What age range do you fit in						Total
		18 to 24	25 to 34	35 to 44	45 to 54	55 to 64	65 or older	
Cluster Number of Case	1	19.5%	25.3%	14.9%	12.6%	25.3%	2.3%	100.0%
	2	29.9%	29.9%	14.0%	18.7%	7.5%		100.0%
	3	19.1%	16.2%	19.1%	19.1%	25.0%	1.5%	100.0%
	4	36.1%	28.9%	10.8%	9.6%	12.0%	2.4%	100.0%
	5	30.1%	24.7%	16.4%	19.2%	8.2%	1.4%	100.0%
	6	20.9%	34.3%	20.9%	13.4%	10.4%		100.0%
Total		26.4%	26.8%	15.7%	15.5%	14.4%	1.2%	100.0%

Annex E – Cluster Socio-Demographic information

Gender distribution by Cluster group

		Socio-demographics - What is your gender		
		Female	Male	Total
Cluster Number of Case	1	46.0%	54.0%	100.0%

	2	50.5%	49.5%	100.0%
	3	27.9%	72.1%	100.0%
	4	45.8%	54.2%	100.0%
	5	37.0%	63.0%	100.0%
	6	43.3%	56.7%	100.0%
Total		42.7%	57.3%	100.0%

Monthly Income levels by Cluster group

		Socio-demographics - What is your household net monthly income									Total
		Up to 500€	500€ to less than 1000€	1000€ to less than 2000€	2000€ to less than 3000€	3000€ to less than 4000€	4000€ to less than 5000€	6000€ to less than 7000€	More than 7000€	Prefer not to say	
Cluster Number of Case	1	1.1%	13.8%	19.5%	27.6%	16.1%	6.9%	3.4%		11.5%	100.0%
	2	0.9%	13.1%	17.8%	28.0%	13.1%	9.3%	0.9%	2.8%	14.0%	100.0%
	3	1.5%	8.8%	25.0%	16.2%	20.6%	17.6%	4.4%	1.5%	4.4%	100.0%
	4	3.6%	9.6%	21.7%	19.3%	10.8%	13.3%	4.8%	1.2%	15.7%	100.0%
	5	1.4%	9.6%	20.5%	26.0%	11.0%	8.2%	6.8%	6.8%	9.6%	100.0%
	6	1.5%	6.0%	37.3%	29.9%	10.4%	3.0%	1.5%		10.4%	100.0%
Total		1.6%	10.5%	22.9%	24.7%	13.6%	9.7%	3.5%	2.1%	11.3%	100.0%

Category of Adoption of UAVs by Cluster group

		Adoption UAVs					
		Laggards	Late Majority	Early Majority	Early Adopters	Innovators	Total
Cluster Number of Case	1	8.0%	34.5%	26.4%	16.1%	14.9%	100.0%
	2	4.7%	32.7%	35.5%	19.6%	7.5%	100.0%
	3	2.9%	17.6%	30.9%	35.3%	13.2%	100.0%
	4	9.6%	32.5%	39.8%	10.8%	7.2%	100.0%
	5	20.5%	35.6%	23.3%	12.3%	8.2%	100.0%
	6	14.9%	28.4%	37.3%	11.9%	7.5%	100.0%
Total		9.7%	30.7%	32.4%	17.5%	9.7%	100.0%