Bilkent University

Bilkent 06800, Ankara Turkey

GE 301: Science Technology and Society

Term Project - Spring 2022

18.04.2022

Instructor: Robin Ann Downey Section: 6

AirCar: A "Jetsons" Dream Coming True

Team Members	Student ID	Department
● Arda İçöz	21901443	Computer Science
● Ahmet Melih Gıcır	21703538	Mechanical Engineering
● Zeynep Selcen Öztunç	21902941	Computer Science
● Erdem Deniz Erdağ	21600951	Electrical and Electronics Engineering
● Onur Vural	21902330	Computer Science

List of Figures

List of Tables

1. Introduction

As a result of the increasing importance of sustainability around the world, the need to offer new solutions has emerged in transportation just like in many other areas. At this point, flying electric cars appear as an inevitable part of the new generation sustainable city concept. AirCar comes out as an example of this vision as it aims to create a sustainable transportation system by reducing carbon emissions, providing an artificial intelligence backed software to create the most optimal route, reducing the overall traffic in the city by easing the vehicle density on the roads and being a pioneer in the change of cities and the emergence of more green areas by reducing the dependence on traditional roads. In this paper, AirCar is examined by conducting interviews with the CEO, CSO and R&D Engineer of the company and making literature reviews about flying cars. AirCar is a product of recent technological developments which will lead in reducing carbon emission, reducing long traveling times and creating greener cities by providing a sustainable transportation method.

2. Theory

This project aims to analyze the technological progress of AirCar under the Responsible Research and Innovation Model. In this respect, RRI becomes fundamental to highlight the role of integrating technological development in parallel with public concerns and therefore answering to the needs of society. Inclusion, anticipation, reflexivity and responsiveness come out as the inseparable values to take sound, sustainable and informed steps toward RRI. Inclusion touches on the issue of integrating the views of many different stakeholders in order to gain a more detailed and diverse look at the matter of technological development [1]. Anticipation basically means regarding social and ethical impacts of the particular technological development, defining and accepting the possibility of the risks that may arise. Reflexivity defines taking the necessary measures so that the core values behind this technology can be properly inscribed to it and furthermore the possible impacts are taken into account where responsiveness becomes important to answer to the results of such possible impacts and possible risks. For the mentioned dimensions of RRI to properly function, strategizing for stakeholder engagement, widening existing assessments, focusing on the fundamental values, making many experiments for responsiveness, tracking RRI progress, aiming for shared value provide guidance. In the light of all mentioned premises of RRI, the technological progress of AirCar is evaluated in terms of analyzing its social outcomes of it, focusing on the measures of the technology that addresses the needs and concerns of society, determining any safety and privacy-related risks that flying cars may bring within and showing to what extent the company sticks on ethical matters and tries to minimize such risks and in what ways.

3. Background Research

Technology advancements are pushing the globe closer to a future in which flying cars soar through the skies. Flying cars is a concept that involves flying automobiles with completely autonomous flight and artificial intelligence technologies, as well as providing human resources and funding. The goal of flying cars is to save time spent in urban transportation while also lowering carbon emissions.

3.1 Technology

The transportation industry is one of the fastest growing industries today. Therefore, it is a subject open to evaluation on many issues. Two of the most important aspects when evaluating flying cars here are economy and efficiency.

3.1.1 Economy

Flying cars have aspects that need to be evaluated economically. First of all, in developing technology, flying cars are generally planned to be electric. This is one of the most important features for flying cars, because electric flying cars have a great advantage over fuel-powered ones [4]. The importance of these advantages is economic. As flying cars are made from fuel-powered engines, the costs will increase accordingly, as fuel will be more expensive than electricity [22]. The increase in these costs will have a great impact on two issues. First, higher costs will increase the driving costs of flying cars. Therefore, users might not use flying cars. Thus, flying by using fuel is more harmful to nature than using electric vehicles. For this reason, it is foreseen that it is not used by cars and will have a huge impact on sales and marketing [7]. Apart from these aspects, the main purpose of the emergence of flying cars is to transport users from one place to another faster. In fact, it is aimed to prevent problems such as traffic. Today, less than 1% of the 250 million cars are still electric [26].

Therefore, cars still have to use large amounts of fuel. One of the things that causes this high fuel is traffic. That's why cars burn much more fuel than normal, which both negatively affects the economy and environment. Flying cars are trying to be integrated into our lives to solve this problem. Getting from one place to another faster and safer is actually one of the most important problems of today. Flying cars will be able to go from one place to another much faster, as they are both electric and will not be affected by traffic. Another concern with flying cars is the driver. Today, the number of accidents is seen as quite high compared to it. A total of 983 thousand 808 traffic accidents occurred in Turkey in 2020 [27]. From this point of view, one of the most important factors for users is how the flying car will provide transportation. If a licensed pilot had to drive every flying car, it would be a colossal disaster in terms of cost. If it happens that way, no one will want to ride because of the expensive prices. Because of this, it is expected that the flying cars that will be presented to the market will be driven autonomously [28]. In these vehicles, it is envisaged that the users will travel from one place to another autonomously, not against their wishes.

3.1.2 Efficiency

Studies have shown that flying cars are more efficient than gasoline burning cars when going more than 21 miles [7]. Flying cars also minimize the traffic and the space that is used by cars in the cities. Its design enables longer ranges with less energy consumption [7]. They are designed to have a low drag coefficient with no downward force. Since they are transporting users from one place to another without getting into traffic, they actually get to places faster and less costly. In this way, it will be able to go from one point to another using less energy. The CEO of AirCar states that assuming that flying cars will be electric in general, they will actually accelerate the speed more since they have more torque. Because of this, it is much more efficient than using fuels.

In 2015, the development process and the efficiency of flying cars have significantly accelerated because of the breakthroughs in artificial intelligence, battery and avionics technologies. The CSO of AirCar explains them as:

> "The reason for the increase after 2015-2016 is the breakthrough in artificial intelligence. …a threshold has been crossed in technology, and it was predicted that with that threshold, autonomous flight and autonomous driving technologies could actually go further."

She goes on to mention the second and third breakthroughs:

> "The second technology is battery technology. It was a breakthrough in battery technology. Therefore, longer flight times have been achieved. The next breakthrough in battery technology is expected to be in 2024 or 2025, in which case costs will fall a lot and the market growth rate will increase… The third breakthrough is the development in avionics technology. With lighter materials, technologies have emerged that can both consume less energy during take-off and landing and increase flight time."

3.2 Policy Context

3.2.1 Stakeholders

When it comes to flying cars, there are stakeholders from various areas that are responsible for production, development, legalization and use of the project. Accordingly there are stakeholders that are parallel to the ones in modern car companies such. Battery and hardware production companies come out as examples in this respect. Furthermore, software and artificial intelligence companies are also responsible [7], [10], [11], [16]. National and International air organizations, flight companies, governments and local municipalities are the primary actors that form the legal basis and control for flying cars and therefore they come out as important representatives among many different policy stakeholders [25]. Besides transportation companies and governmental organizations may become stakeholders in terms of providing flying cars in the areas of use [10].

3.2.2 International Context

The global market for flying cars is growing rapidly, and it is estimated that there are at least 200 companies working on making flying cars. Key players in the market include AeroMobil, Joby, Airbus, Lilium and Volocopter. Some manufacturers have already surpassed the design stage and are planning to mass produce in 2023 or sooner [2]. There are a couple of reasons for the growth of this market, such as increasing population, growth in urbanization and surging the demand for environmentally friendly automobiles [3]. Restraining factors for the market growth include the high manufacturing cost of the flying cars and regulations for aviation licenses [21]. There are various applications of flying vehicles such as military, commercial and civil. Flying cars that are currently being developed around the world can be divided into two groups by their mode of operation; autonomous and piloted. The cars also differ in their seating capacity, it ranges between one and more than six passengers per vehicle [23].

3.2.3 Safety

Safety is a big potential issue for flying cars. Several things should be taken into account to ensure safety and security. In order to prevent accidents from happening, special training for pilots, (people who drive the flying cars) driving certificates and regular repair/service/upgrade procedures might be required. In the case of flying cars, it is planned to be autonomous, so safety issues concerning pilots can be disregarded [6]. One of the most critical questions regarding flying cars involve ground/ air transitions and the logistics of the flying cars. In the first uses of flying cars, they are planned to park and land on “ports”, specific areas designed based on the size of flying cars, so they cannot land anywhere they want to [8].

Poor weather conditions such as heavy rain, hurricanes and winds should also be taken into account. In these conditions, flying cars needs to be guaranteed that there is no problem during the flight in poor conditions. The future version of flying cars should have a system that enables them to connect with the GPS and network. Since the cars will go to the route which users want to reach via a network, people need to be sure that this communication is completely protected and cannot be reached by third parties. Any DDoS attack can directly disconnect the flying cars from the network, which can be corrected by a direct crash of the plane or by the pilot taking over the driving of the plane at that moment. In addition, in a different attack, control of the vehicle can be taken and thus very bad results can occur [9].

Another big problem for security is users' fear of heights. One of the important features of flying cars is that they go fast. However, how many feet they will do this and how fast they will go can scare the users, and these fears can turn into panic and harm the users. Thanks to the regulations made in recent years about everything flying thanks to the FAA, certain types of vehicles can only fly at certain distances. Therefore, flying cars are expected to rise to a height where users will not be affected much. Apart from that, it may pose a problem for users as speed. Naturally, it is desired to be fast, but users should not be affected by this speed as in airplanes.

3.2.4 Privacy & Ethics

Privacy is another essential aspect of social issues of this technology. In Mofolasayo's article about policy issues in flying car technology, he points out two crucial privacy problems [5]. Firstly, the problem is about the need of tracking the location of the vehicle. In case of any criminal act, the location of the flying car must be known in order to track the potential criminal. Because it is not possible to know when the crime will happen, the

location must be shared with the authorities all the time. Additionally, users of this flying car might violate the privacy of another's property. So, flying car locations cannot be hidden for both of these illegal acts. This situation is obliged to violate the privacy of the users. Second, transportation by flying cars bypasses baggage check (personal belongings) as there is no air border control. This can lead to many illegal acts, such as money laundering or illegal drug trafficking. In order to prevent such actions, passengers' belongings should be inspected. Again, this will violate the privacy of users. There are two important perspectives that come into play here. One of them is definitely flight safety. Flight safety is of vital importance to both users and flying car companies. Therefore, users should pay attention to what they bring with them when using flying cars, because malicious people can damage flying cars with what they bring. Therefore, before getting into flying cars, the things people carry with them should be checked [31]. Actually, this is considered ethical, but there may be things that users do not want to show and this may violate their privacy. Secondly, one of the most important factors is the GPS systems to be found in flying cars. GPS systems come to the fore in flying cars, especially in vehicles with autonomous driving features. Although these systems are useful, they do not offer the same things for users. Some important users may want their location not to be known, but thanks to these GPS systems, products can be tracked by companies. Using this system also makes the system vulnerable to attacks. In case of possible attacks, this information can be stolen and the location and location of the users can be learned [31]. In such cases, users' security breaches occur. People who want to harm the user can easily harm themselves by using this information.

3.2.5 User Feedback

User feedback is critical for developing, upgrading, and correcting faults in technology, especially for technologies with a well-established system. Froehlich et al. stated that companies are able to track and capture the information due to the feedback system they

developed for phones, and thanks to this, they had the experience perceived by the user. Thanks to the feedback system, it has had the chance to develop its technology according to user experience [37]. Therefore, the feedback system is extremely important for developed or newly developing technologies. Even if the newly developing technologies do not have any users, they can attract the attention of a certain group with the prototypes they make and predict how they will return in the future, or they can try to get feedback by directly checking this to the potential user.

3.3 Socio-Technology Context

When this technology is examined from a socio-technological point of view, the infrastructure, working principle of flying car technologies and how technology will enter people's lives in the future will be investigated. While more electric and hybrid cars have entered our lives and are still widespread, such emerging technologies will enter our lives in the future under the leadership of science.

3.2.1 Infrastructure

Since flying car technology is a newly developed technology that has not yet entered our lives fully, its infrastructure is still being established and even designed. As Solomon also mentioned in his article, the name of flying cars used in the current technology branch is e-VTOL (electric vertical takeoff and landing)[16]. Currently, companies that produce more than one car and aircraft engine have studies on this subject[17][18][19]. Some of them are companies such as Aston Martin, Airbus Samson Sky. Moreover, some conditions that require this technology to come into force will be allowed to reach the standards and be used within the framework of certain rules. In this regard, the U.S. The Department of Transportation (DOT) has certain criteria set by an FAA. It is very important for the

establishment of infrastructure, road and traffic systems that vehicles must comply with. Solomon briefly mentioned in his article that these systems will be "Air Traffic Management and Integration", and briefly stated that the industry and laws are currently in the test-learn phase [36].

3.2.2 Work Policy

How the flying car technology will enter our lives and in which areas it will serve people is another subject that needs to be investigated. As Cohen mentioned in his article, this technology will enter people's lives in the near future, primarily according to urgency and demand. In the long run, when all stakeholders are considered, it will be available to the public in emergency services, government and government vehicles, through mobile applications [35].

3.4 Sustainability

The topic of sustainability is critical, and it should be considered by everyone if the earth is to remain habitable for people and other living things in the future. According to statistics which Johansson et al. states, energy output grows by 2% every year, with fossil fuels providing 80% of the energy [14] . Furthermore, the impact of population and economic expansion are the most significant factors for the increase in energy demand. Due to the increasing need and demand for energy, it becomes difficult to create a sustainable environment on a permanent basis. Along with that, Chiras states that people entered a new age owing to agricultural and technological revolutions, and the answer to challenges such as mounting environmental concerns and global warming may go down in history as a new human revolution by making innovative sustainable developments [13]. At this point, firms like which develop flying car technology, and others play a critical role. The reason for this is that flying cars are electric vehicles that contribute significantly to the reduction of carbon

emissions. When comparing the emissions of autonomous vehicles to those of conventional automobiles, for example, Kasliwal et al. states that, the fact that autonomous vehicles emit 35% less carbon than normal cars is a crucial development for a sustainable future [4]. In this manner, Silvestre & Ţîrcă state that innovative technologies should be created for long-term sustainability [15]. The flying cars hope to lead the way in creating a more habitable and sustainable future for all living beings on the planet thanks to this cutting-edge battery and artificial intelligence technology. As mentioned in the news in the UNSW newsroom, flying cars are environmentally friendly technology. However, while this technology is being introduced, electrical energy must be produced with solar or wind energy [20]. In this way, a sustainable technology can be produced.

4. Method

Bilkent University has declared the 2021-2022 Academic Year as “Sustainability Year”. Therefore our primary goal was to find a company that is developing sustainable products or solutions. Because of these reasons, AirCar is the perfect option for our project with sustainability being their main concern. To conduct interviews, our group initially contacted the CSO of AirCar Company. Then, our group did interviews with CSO, CEO of AirCar and R&D Engineer. Then, transcripts of these interviews are coded via QDA Miner Lite program to group the content of these interviews into various themes. Finally, Information gathered from the interview is analyzed to be used in Background Research and Findings subtopics. As a following step, we made literature reviews to obtain academic articles as well as news concerning flying cars.

5. Findings

5.1 Technology

5.1.1 Economy

The main purpose of flying cars is to gain more importance than the traditional cars. Because traditional cars have not reached maturity in terms of economics and efficiency. So we can first calculate the consumption values of cars and flying cars. According to research, a normal user travels 30000 km per year by car. If we look at the averages, generally cars use 5.5 liters/100km of fuel. This corresponds to approximately 140 liters per month. Considering the fuel prices that vary from country to country, if we calculate it from 1.35 € per liter, there is a monthly cost of approximately 2300 € [30]. As part of airlines' standard highway driving test, the AirCar uses approximately 275 Watt-hours of energy per mile while traveling at an average speed of 50 miles per hour. These vehicles can comfortably seat two people [5]. Thus, the energy consumption of the AirCar is approximately 171 Wh per passenger mile on all journeys. The current prototype of AirCar uses about 120Wh per passenger mile. In this way, we can save 15% more energy compared to cars because flight paths are usually straight, even if the roads are not straight. Therefore, for 1 mile traveled by AirCar, normal cars need to use 61% more energy [5]. Worldwide traffic wastes an average of 97 hours each year [5]. AirCar, on the other hand, helps reduce carbon emissions while trying to reimburse consumers for the time spent on urban transport. These times create problems for the economy.

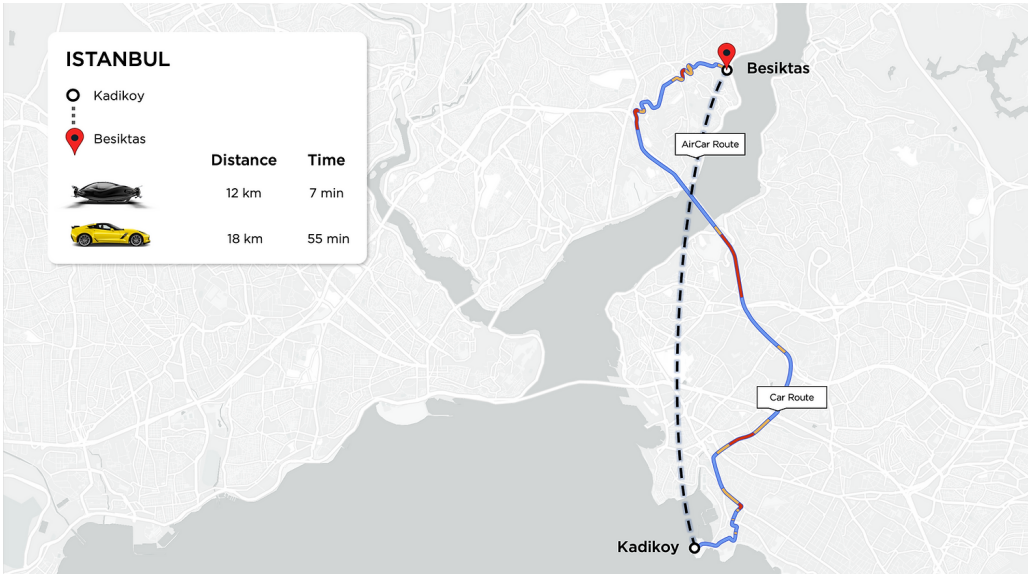

Figure 1: Route and Time Spent by using both types of vehicles in Istanbul.

5.1.2 Efficiency

The flying car uses a 400V lithium-ion based battery which provides a high charge/discharge performance [6]. The battery is made with flame retardant material which prevents a thermal runaway. It takes 30 minutes to charge it and it can go 50 to 80 kilometers on a single charge. It has 8 distributed motors which provide redundancy combined with silent propellers. The interior of the car is also designed to be the most efficient. It has screens displaying real-time flight data and passengers can access all the screens via voice commands. It has seating for two adults and the CEO of Aircar explains the reason behind this: “we preferred to build a two-person vehicle. Why? Because nearly seventy percent of them travel with one or two people. So I can target seventy percent of people in traffic”. So the seating capacity is chosen to be most efficient based on real-life data.

Just like the traffic management system in the railroads, there also needs to be an air management system and this management system is called Avionics. It combines sensory outputs such as machine vision, lidar and radar and to make a flight plan without a ground control connection. Sensor fusion systems enable improved autopilot performance using

artificial intelligence [6]. Artificial intelligence finds flight routes for all the cars so that they all can fly to their destination in the fastest route. The CSO of the AirCar explains the avionics system and how it can be managed however they want:

> “A system called “Air Traffic Management” is being developed. We can open as many lanes as we want, because the sky is already empty and we can remove the lanes we have opened. Zero investment cost.”

Also, CSO talked about how the management system works:

> “...flying cars will be flying between a hundred meters and four hundred meters… So, we're talking about a corridor, between 100-400 meters. A "management" system, which we call "traffic management", manages this corridor. Like when will your lights come on, which will be green, which will be red.”

She went on to say that it is like the tower system for planes: “Just as there are towers and radar systems for airplanes, this system, which is foreseen in the world and manages these short-haul flights, is being developed.”

5.2 Policy Context

5.2.1 Stakeholders

The results point out that various stakeholders from many areas are trying to be integrated into the innovation and design process. First of all, during the research and development stage the electrical and computer engineers work on the prototype itself to make sure that main features are coordinated with autonomous functions of AirCar. Softtech, a software development company that aims to provide innovative solutions to current issues, came out as the main supporter and funder of the project where AirCar is integrated to it. Apart from these apparent stakeholders, it is found out that many external stakeholders are interacting on this technological frame. R&D Engineer states that:

> “There are separate partners for battery technology. There are very different partners for shell technology, that is, for mechanical technology, which I have heard, seen and

> researched. It's very different for the engine. In other words, it's like a car, but we can think of it as a more comprehensive version of the car. It's like an airplane. For it, the scope and the partnership of the problem as a thing may be small related to the software partner, but it is very comprehensive in terms of hardware partnership."

In this respect it can be concluded that some stakeholders in AirCar are similar to those that are functioning in cars, but since it is like a more comprehensive version of the car, there are separate partners for battery technology, different partners for shell technology and mechanical technology. On top of this, R&D Engineer emphasizes that:

> "There is a general directorate of civil aviation in Turkey. We can say that it takes a stance in Turkey and according to the decisions of the FAA. We can say that those who are close to those two, that is, those who are scrutinized there. Or we can say that they give feedback there. When you work with them, they try to create an order, a regulation based on the feedback they get from other companies. They get it from you and the test reports they get from the companies I've mentioned."

The CEO of AirCar presents further details about the stakeholders in development and production by stating:

> "Nvidia has a lot of carbon fiber manufacturers, hardware and avionics manufacturers. Other than that, electric motor manufacturers. I'm not giving names there either. Because there are many. NASA, they work for the drawing of the airways… Also here are open source software systems working in artificial intelligence. We buy and use something from there as well."

Accordingly it is found out that in the project, Nvidia functions to manufacture lots of carbon fiber hardware, as other avionics manufacturers. Other than that, electric motor manufacturers are also responsible for this process. Aviation companies that work for the drawing of the airways take part to ensure that AirCar is aerodynamically acceptable. Also there are open source softwares, systems working in artificial intelligence where the company purchases software solutions. When it comes to policy stakeholders, the CEO talks about:

> "FAA, America's federal aviation agency for civil aviation. Also, EASA is the aviation institution of the European Union. They are also working on regulations. In

> some countries, local municipalities or the state directly pave the way for this. We're meeting with them too. These are the stakeholders in general."

In this respect, it is found out that on the regulations of flying cars many parts are taking steps for the future. Normally aviation in Turkey is dependent on the European Union, where they control various flying devices, from specialized drones to huge aircrafts. The European Union says that they can fly it, gives a certificate to the device, and afterwards the devices can fly with the rules of the airlines. As an example, the FAA, America's federal aviation agency for civil aviation, and the aviation institution of the European Union are working on regulations. For flying car projects in general, AirCar authorities have observed that local municipalities or the state directly pave the way for the legal applications and accordingly they wanted to show a similar approach and therefore arranged meetings with such local authorities. However the company authorities inform that the current negotiations with local authorities as policy stakeholders were much less efficient than expected in terms of constructing legal solutions. Municipalities, state, ministries, were not very supportive in this respect as expressed as:

> "It requires planning on a municipal and city basis. Where will they land, where will they take off, how will you charge them? Will the electricity you supply there be enough? Will it strain the mains? Or you're making a noise there. So, are you near a nursing home? Will people be disturbed? These are also important. Or are you flying over a restricted area, like flying over a military ground? We need to work together on these sides as well. I say it is necessary. If you ask if you can do it in Turkey, no we cannot do much. We try to reach the municipality, but they are not very available."

When it comes to user types and areas and stakeholders that may arise in such areas, CSO sheds light on the subject by stating:

> "First, we will start using the unmanned ones and extinguish the fires. We will do search and rescue with these, and they will be in two or three years. We will extinguish fires from 2024. They will be a flying ambulance. First, the necessary medical supplies will be transported to the hospital, and then they will be able to transport people. Between 2025 and 2030, there will be flying cars that carry cargo.

> I'm talking about something bigger, the one that carries material from port to ship or between two production facilities that carries material from ship to port. First they will become common and we will start to get used to these flying devices."

In the light of this information, it is found out that potential use areas were including humanless works such as collaborating with fire organizations to extinguish fires and operating with search and rescue organizations in two or three years. They agreed to get help from such stakeholders and accordingly AirCar is expected to extinguish fires beginning from 2024. In the following years, health organizations will join as stakeholders as well to use AirCar as a flying ambulance. First, the necessary medical supplies will be transported to the hospital, and then they will be able to transport people. Between 2025 and 2030, there will be flying cars that carry cargo and they are going to carry material from port to ship or between two production facilities which also includes transportation companies as stakeholders. The regular human users are expected to be people that have urgent duties where they will prefer AirCar instead of regular taxis and Uber's to escape from traffic and save time.

Table 1: Data Obtained from AirCar Authorities Concerning Stakeholders

Concerning Stakeholders in Development and Production of AirCar	"There are separate partners for battery technology. There are very different partners for shell technology, that is, for mechanical technology, which I have heard, seen and researched. It's very different for the engine. In other words, it's like a car, but we can think of it as a more comprehensive version of the car. It's like an airplane. For it, the scope and the partnership of the problem as a thing may be small related to the software partner, but it is very comprehensive in terms of hardware partnership." [R&D Engineer] "Nvidia has a lot of carbon fiber manufacturers, hardware and avionics manufacturers. Other than that, electric motor manufacturers. I'm not giving names there either. Because there are many. NASA, they work for the drawing of the airways… Also here are open source software systems working in artificial intelligence. We buy and use something from there as well." [CEO].
Concerning Policy Stakeholders	"There is a general directorate of civil aviation in Turkey. We can say that it takes a stance in Turkey and according to the decisions of the FAA. We can say that those who are close to those two, that is, those who are scrutinized there. Or we can say that they give feedback there. When you work with them, they try to create an order, a regulation based on the feedback they get from other companies. They get it from you and the test reports they get from the companies I've mentioned." [R&D Engineer] "FAA, America's federal aviation agency for civil aviation. Also, EASA is the aviation institution of the European Union. They are also working on regulations. In some countries, local municipalities or the state directly pave the way for this. We're meeting with them too. These are the stakeholders in general." [CEO].

Concerning Users and Organizations that Determine Functions of AirCar	“First, we will start using the unmanned ones and extinguish the fires. We will do search and rescue with these, and they will be in two or three years. We will extinguish fires from 2024. They will be a flying ambulance. First, the necessary medical supplies will be transported to the hospital, and then they will be able to transport people. Between 2025 and 2030, there will be flying cars that carry cargo. I'm talking about something bigger, the one that carries material from port to ship or between two production facilities that carries material from ship to port. First they will become common and we will start to get used to these flying devices.” [CSO]

5.2.2 International Context

The size of the global market for flying cars was $55.0 million in 2021, and it is expected to be valued at $215.54 million in 2025. Europe is expected to contribute $77.98 million to the market in 2025, being the highest contributor. Based on the product type, companies are developing flying cars and passenger drones. Currently, passenger drones hold the largest share in the market. There are various application types for flying vehicles, such as military, commercial and civil. Military segment holds the biggest share in the market. In fact, the U.S. Air Force is planning to use aircraft in various applications [29]. Commercial use of the vehicles are also on the rise, for example, Uber is planning to launch an air taxi service in the next couple of years [29].The vehicles that the companies are developing also vary in their mode of operation: they are either piloted or autonomous. The companies also develop vehicles that differ in their seating capacity, they either have 1, 2, 4 or more than 6 seats in a vehicle [33].There are different regions for the market such as North America, Europe, Asia-Pacific, Middle East-Africa and currently North America holds the biggest share with $27.63 million in 2021 [34].

The R&D engineer at AirCar explains some of the key companies developing flying vehicles:

> "In fact, there are few competitors at the moment… In Germany, for example, it goes up to two big companies: Lilium and Volocopter. There are two big companies in America: Joby and Archer. In the UK there is Vertical Aerospace. These are the biggest ones."

The other key players in the market are AeroMobil, Airbus, The Boeing Company and Volocopter. The R&D engineer also compares AirCar with the other companies that are developing flying vehicles around the world: "So we started in the same places, but they are ahead of us." He mentions that this is caused by the financial dimension of developing vehicles: "while software can only have a human and effort dimension, producing the tool we call hardware, of course, also has a financial dimension. Those who get the financial dimension first, that is, the fund, their investment progresses faster". R&D engineer also state that AirCar is more advantageous than other companies in some ways: "We have autonomous technologies that make us stand out. It was actually a great benefit for us that we started it earlier, we see that our software muscles and software autonomous perspective are more advanced than others."

5.2.3 Safety

As for safety, there are many aspects that are important for flying cars. These should be considered and studied in detail. The first thing that comes to mind from these perspectives is how flying cars will react in bad weather such as rain or fog. Such situations pose a great risk in terms of flight safety and also pose a great financial and moral risk for companies and users. Regarding this, the CEO of AirCar explained the situation in this way: "For example, there are storms, rain or lightning situations. Then what about these tools? Current technologies are developed under normal conditions, according to a certain wind rate

and a certain fog rate." Although flying cars are being prepared for such bad weather conditions, it carries a great risk for users and companies. First of all, since they are affected by the magnetic field, they are likely to lose power and fall in possible lightning and similar situations [17]. Secondly, even if it is put into use autonomously, it poses a risk in the event that GPS systems fail, as location information cannot be obtained. It was stated that flying cars should not be used in such risky situations, and it was also stated that the use of flying cars would be prevented depending on the weather conditions [9]. It was also stated that since it will provide transportation service from one point to another, it is necessary to correctly adjust the distance between these two points and the weather conditions in this area.

Another big problem is, of course, attacks. Possible attack situations pose a great risk to users. It is envisaged that those who use this tool will be the first to be in good financial standing. Therefore, these users can be easily attacked by malicious people while the users are using flying cars, because it is seen as the place where users are most vulnerable. The precautions taken against such troubles are of great importance for users as security. The R&D engineer of AirCar states:

> “The device will determine a location with an algorithm, based on historical GPS and location information, as well as IME information. And will safely go to point B when it leaves the point A.”

That means that an AirCar is not a car which is completely dependent on a GPS system. The future of flying by using historical GPS locations is a trustworthy feature for both Aricar and users. They also stated that they have developed some algorithms against GPS interruptions, sudden encounters or anything thrown from outside. The R&D engineer of AirCar explained one of them as follows:

> "Detect and run away. Or we call it sense and abort. What's this? A different drone attack can happen to you. It can happen with a different flying object attack. Or it can happen if a flying animal attacks you. Or it may appear directly in front of you and so

> on. We must first perceive these obstacles as the first example and show an active reaction against them."

Despite the fact that the flying car has a pre-drawn route, if something lands in front of it, it can get out of its orbit, get rid of the thing that will come in front of it, and enter its orbit again.

The last problem discussed was altitude and speed. Humans can be affected by the rapid altitude change and speed. Since passengers are alone in the air, there should be a precaution in case of these situations. Companies understand their fears and concerns and they work for it. The CSO stated that "What will happen? All this is being considered now. There should be a responsible human that can always communicate with the passengers in case of emergency." On this subject, she talked about the fact that there will be a consultant or psychologist who is an expert in the field who can communicate with the user from the microphone in the vehicle when necessary, in case of panic situations that the users may enter in the flying car. She explained that with the emergency button that the user will press, the user will contact this person and that he will at least help to overcome the panic situation in the most undamaged way.

5.2.4 Privacy & Ethics

According to the information obtained from the interview with the managers, at this level, it was concluded that secrecy is of great importance in ensuring confidentiality with GPS, but in line with the plans made, this would not pose a big problem. The CEO states that:

> "Flying also has a clear route. If the important person is being transported, the critical thing is this. By the way, you can follow planes, you know? Right now, most of the planes are being tracked right now. Where did it come from? Did it come to Istanbul? So we can already watch."

It means that the company monitors where the users will be at any time with GPS systems and that this information will not be shared but it can be followed since it has a clear route. It is predicted that flying cars will only serve one purpose, with their first introduction into our lives. This purpose is in the form of flying cars going and coming from one point to another. These two points will be chosen as there is usually traffic and commuting is highly demanded. For this reason, in the first place, since the place where the users will go will be known in advance, privacy will not be at the forefront with GPS. Apart from this, one of the most important details discussed is the damage that the things that the users carry on them while riding can cause. Flying cars will be affected by some magnetic devices, as well as malicious people can damage flying cars, which can lead to a bad situation for both the user and the flying car company. One of the studies carried out to prevent this is to have security at the flying car ports. Just like on airplanes, users first have to go into an X-RAY scanner to see if they have metal on them [6]. Afterwards, it should be checked by a responsible person and then taken in. As the passengers inside will be alone, they can also damage the flying cars inside. Apart from these, there is a protocol that users actually accept before getting on the flying cars. This protocol generally consists of legally placed items from places such as the FAA (Federal Aviation Administration) and was written to protect the rights of both sides [32]. One of the biggest reasons for writing this protocol is to protect the rights by minimizing the material and moral damages that both parties may face, because there are many areas where privacy and security must be ensured in flying cars. Therefore, making this agreement ethically is of great importance for both users and companies.

5.2.5 User Feedback

According to the information we obtained from the interview with the CSO, Aircar did not have a customer because it is a newly developing technology, but he gave some

information about how the technology design will be. For example, it was among the information we learned that people were getting feedback on how many people used the taxis and which routes they preferred, and they designed a vehicle accordingly, and the CSO said:

> "There are no potential users yet. We are trying to get feedback on where people might need such a service the most and where regulations will be allowed. It is also important in which areas it can be used first. There are studies on the city's tolerance for noise, its demographic structure, its approach to such a service and its intention to pay money. These vehicles are planned to be used in 175 cities in 2050. We receive such feedback. Another is about the design. For example, we can design two-person, four-person, eight-person vehicles. How many people take taxis? On average a driver and one passenger. We preferred to build a two-person vehicle. Why? Because nearly seventy percent of them travel with one or two people. So I can target seventy percent of people in traffic. Who is experiencing the problems and how are they experienced? And the vehicle takes shape with feedback such as what they can tolerate or not"

According to the information we gathered from here, feedback on how many people took the taxi was received, and the vehicle was designed accordingly. Finally, it was discovered by monitoring potential users that approximately 70% of people took a cab as 1-2 persons, and the vehicle design to utilize was determined based on this knowledge.

On the other hand, in our interview with the CEO, he stated the following about the feedback system and mechanism:

> "We currently do not have users. You are our potential users. Municipalities, state, ministries, they are not very supportive. I mean, of course, because Turkey's agenda is different. Now we call it a flying car. You already know how skeptical people are that TOGG will even happen. We continue on our way. We develop things that we like, that we know to be true, and that we predict people's usage habits. Of course, we read a lot of reports… So it's obvious what's going on."

In line with the information we have obtained from here, we can observe as an important finding that they do not have an active feedback system because they are having a new technology that is developing and they do not have active users, but they create a feedback system indirectly, by taking into account the habits and needs of people. On the other hand, it was observed that the necessary feedback and consultation system could not be fully

provided since Turkey currently has a very busy agenda other than the flying car, but as the CEO stated, people used to be skeptical and cynical in the same TOGG (Turkish Electric car brand).

Table 2: Data Obtained from about the User Feedback System

About the Feedback System	"There are no potential users yet. We are trying to get **feedback on where people might need such a service the most and where regulations will be allowed**. It is also important in which areas it can be used first. There are studies on the city's tolerance for noise, its demographic structure, its approach to such a service and its intention to pay money. These vehicles are planned to be used in 175 cities in 2050. We receive such feedback. Another is about the design. For example, **we can design two-person, four-person, eight-person vehicles. How many people take taxis? On average a driver and one passenger. We preferred to build a two-person vehicle**. Why? Because nearly seventy percent of them travel with one or two people. So I can target seventy percent of people in traffic. **Who is experiencing the problems and how are they experienced? And the vehicle takes shape with feedback such as what they can tolerate or not."** [CSO]
About the feedback system and the future of how the feedback is going to be happen in the future	"We currently do not have users. You are our potential users. Municipalities, state, ministries, they are not very supportive. I mean, of course, because Turkey's agenda is different. Now we call it a flying car. You already know how skeptical people are that TOGG will even happen. We continue on our way. We develop things that we like, that we know to be true, and that we predict people's usage habits. Of course, we read a lot of reports… So it's obvious what's going on." [CEO]

5.3 Socio Technology Context

In line with the interviews and the information obtained from the articles, how AirCar technology will take place in our lives in terms of socio-technology, how its infrastructure will be developed and the necessary steps are examined in this section.

5.2.1 Infrastructure and Superstructure

Current transportation methods, apart from planes, usually only have vertical mobility. However, when it comes to eVTOL (electric vertical take-off and landing) vehicles, horizontal movement is introduced to transportation. In a world where the infrastructure is built for non-eVTOL vehicles, mainstream usage of eVTOL vehicles will require the infrastructure to change and also thesewo vehicles themselves will influence the society to conduct a change in the infrastructure of cities. In the interview CSO mentioned this and states:

> "We are currently talking about devices that will fly from point A to point B. In the city the flying car will go to certain places, from point A to point B, the number of these points will increase. …When people start to buy their own flying cars, the stage of how technology will change society will come into play. Cities will start to grow upwards like in Singapore. In cities growing upwards, imagine a building. There is a park on the thirtieth floor of the building. In fact, each floor of the city will have a neighborhood, a park. There will be a hospital in another place or floor. So we're going to start building cities like this. At present, architects have already begun work on building cities like this. Therefore, there will be cities where we live with buildings that are close to 1000 floors. The flying car will be a device that will take you from that floor to the bottom, it will go between the cities. That's how we're going to start making cities."

Therefore, as a eVTOL vehicle, AirCar will also be a member in changing how society builds cities like the CSO mentioned above. In our findings, the most emphasized change in the cities is buildings. It is proposed that the widespread usage of AirCar (therefore eVTOL vehicles) will contribute to the design of cities.

Another issue related to infrastructure is the route which AirCar and flying cars will use. In the articles and interview with CSO the earned inference is that there is a system called "Air Traffic Management" system [35]. The CSO mentioned this system in her interview:

> "So, we're talking about a corridor, between 100-400 meters. A "management" system, which we call "traffic management", manages this corridor. Like when will your lights come on, which will be green, which will be red. For this, just as there are

> towers and radar systems for airplanes, this system, which is foreseen in the world and manages these short-haul flights, is being developed. Therefore, each country's own administration will be involved. Currently, this system is not fully installed. Everything we are talking about is being set up at the same time. In other words, charging centers, vehicles themselves, traffic management systems are currently being set up."

Not only the CSO but also the CEO of AirCar mentioned this and stated:

> "NASA. It works for the drawing of the airways. FAA, America's Federal Aviation Agency for civil aviation. Also, EASA is the aviation institution of the European Union. They are also working on regulations."

As it can be deduced from here, in line with the information given in the interviews, an air traffic system should be established, just like today's traffic system. In Solomon's article it also mentions how this technology will occur. In the article it states that "The FAA is in charge of regulating aviation safety, and it will have to put in place strict new rules and exercise regulatory oversight before flying cars can become a reality in the United States". As a result, institutions such as the FAA (Federal Aviation Administration) will play an important role in the creation and establishment of standards. It will play an important role in how infrastructure and technology will develop [36] .

In our findings, we are also informed about the current situation of infrastructure and superstructure development of cities. Currently, the increase in the charging situations is a positive aspect for AirCar, meaning that the vehicle can operate on different routes. However, major changes (including changes in the construction of buildings) require municipal and governmental legislation changes. The CEO mentioned this in an interview as:

> "If you ask if you can do it in Turkey, no we cannot do much. We try to reach the municipality… Nothing happens until you fly, unfortunately. But here we are doing our best and we will use it one day."

This situation, of course, is a negative aspect for AirCar in terms of infrastructure and communication with the state.

5.2.2 Work Policy

After the infrastructure and necessary legal regulations, how will AirCar enter our lives? Just as cars and electric cars entered people's lives and certain areas of use took shape over time, the same is true for AirCar. About this in an interview with the CSO:

> “First, we will start using the unmanned ones and extinguish the fires. We will do search and rescue with these, and they will be in two or three years. We will extinguish fires from 2024. …Between 2025 and 2030, there will be flying cars that carry cargo. Starting from 2030, we will start to see some flights that is touristic…These vehicles are planned to be used in 175 cities in 2050…Therefore, people will ask: ‘How should I build the houses and buildings that I will build new? Shall I redirect the city here then?’”

In this part of the interview, we found out about AirCar's near future and how this near future society will use this technology but in order for this technology to take place, the current gas-powered cars should be gradually put out of circulation, the CSO also conveyed in the following information:

> "In Europe gasoline vehicles have started to be banned in the city and their use will decrease considerably by 2030. In the city, the number gas stations will decrease and power stations will replace them, infrastructure is changing. Everything will be changing together, but it will be such a journey. Of course, we won't be connecting to jetsons like this all at once."

As a result, we have obtained information from interviews that these vehicles will be used as a fast transportation vehicle such as fire brigade, cargo and taxi in our lives and when the technology develops and the infrastructure becomes suitable for this, they will be made available to everyone.

Table 3 : Data obtained from interviews about Infrastructure, Superstructure and Work Policy of the AirCar

Current Work Policy of AirCar	“We are **currently** talking about devices that will fly from point A to point B. In the city the flying car will go to certain places, from point A to point B, the number of these points will increase.” [CSO]
Future of the AirCar in terms of how it will develop in America and around the world.	**“Towards the 2050s,** we will see a world where everyone starts to buy their own vehicles. It will be a **click sooner in America** because they have huge lands. Then it will spread all over the world. When people start to buy their own flying car, the stage of how technology will change society will come into play.” [CSO]
About the Superstructure of the AirCar in terms of How Cities will Develop	“Cities will start to grow upwards like in Singapore. In cities growing upwards, imagine a building. There is a park on the thirtieth floor of the building. In fact, each floor of the city will have a neighborhood, a park. There will be a hospital in another place or floor. So we're going to start building cities like this. At present, architects have already begun work on building cities like this. Therefore, there will be cities where we live with buildings that are close to 1000 floors. The flying car will be a device that will take you from that floor to the bottom, it will go between the cities. That's how we're going to start making cities.” [CSO]
About the Air Traffic Management System, Construction of Airways and Institutions related to Airways	“NASA. It works for the drawing of the airways. FAA, America's Federal Aviation Agency for civil aviation. Also, EASA is the aviation institution of the European Union. They are also working on regulations.” [CSO]
About the Infrastructure and Air Management Systems	“So, we're talking about a corridor, between 100-400 meters. A **"management"** system, which we call "traffic management", manages this corridor. Like when will your lights come on, which will be green, which will be red. For this, just as there are towers and radar systems for airplanes, this system, which is foreseen in the world and manages these short-haul flights, is being developed. Therefore, each country's own administration will be involved. Currently, this system is not fully installed. Everything we are talking about is being set up at the same time. In other words, charging centers, vehicles themselves, traffic management systems are currently being set up.” [CSO]

Near Future of the AirCar and its Work Policy	“First, we will start using the unmanned ones and **extinguish the fires**. We will do search and rescue with these, and they will be in two or three years. We will extinguish fires from 2024. …Between 2025 and 2030, there will be flying cars **that carry cargo**. Starting from 2030, we will start to see some flights that is touristic…These vehicles are **planned to be used in 175 cities in 2050**…Therefore, people will ask: ‘How should I build the houses and buildings that I will build new? Shall I redirect the city here then?’” [CSO]
Alteration of infrastructure from current technology to AirCar’s Technology	"In Europe gasoline vehicles have started to be banned in the city and **their use will decrease considerably by 2030**. In the city, the number gas stations will decrease and power stations will replace them, infrastructure is changing. Everything will be changing together, but it will be such a journey. **Of course, we won't be connecting to jetsons like this all at once**." [CSO]

5.4 Sustainability

The issue of sustainability has been discussed in line with the information obtained from interviews and other sources. The biggest difference of "AirCar" technology from currently common petrol, diesel and hybrid cars is that it runs entirely on electricity. In this direction, the biggest advantage of being electric is related to sustainability. With the development of battery technology, a big step was taken in the field of electric cars and the pioneer of this step was TESLA. Likewise, AirCar and similar companies are advancing in this direction. As CSO states that “Our first priority is that it is already electric”. This shows that the development of battery technology is very important in terms of sustainability. Another problem related to sustainability is about the production phase emission problem. The CSO mentioned this situation in the interview and states:

> “...there is an inevitable carbon emission in the production of those parts. Zero emissions is the wrong word anyway. We also use it because the industry uses it, but zero emission is the wrong word. There is also the matter of both the production and the filling of those batteries… It is very important to do the engineering at the optimum. The primary goal is to bring that battery as close to zero emissions as

> possible. It is very important to produce with the least amount of parts, that is, it is necessary to eliminate many unnecessary parts."

In addition, most of the time electricity is produced using fossil fuels and offered to AirCar-style companies. As a result, although the technology produced is seen as an environmentally friendly technology that works entirely with electricity, the methods used by the companies that provide electricity cannot make this technology a 100% environmentally friendly and sustainable resource. In the interview, the CEO mentioned this problem and stated:

> "So the question is, where does the electricity come from? It does not come out of the ground on its own. You can get it from the sun, you can get it from the wind, you can get it from the nuclear power plant. But most are not. Most of the electricity is produced from natural gas or coal, but there is a transition here. So there is an alternative to generating electricity…all the companies that I have founded as an entrepreneur, while we are making our products, are already based on sustainability. I can say that we are satisfied with this for now."

Incidentally, some of the newspapers on the internet also mentioned this problem the way the CEO mentioned. In the website UNSW News states if one wants to create a more sustainable technology and world, it is the appropriate method to produce this energy by using solar energy or dams while generating electricity [33]. The use of different alternative energy sources is very important when producing this technology. As the CEO mentioned, we encountered a similar example in the news in the UNSW newsroom. As Dr. Brown mentioned, "With growing research in the renewable energy sector, I think there's huge potential to consider other alternative energy sources, such as hydrogen, to power the flying cars in the future [20]." Therefore, alternative technology movements are extremely important in this manner. Briefly, as interviewers CEO and CSO mentioned the aim of AirCar is to avoid a complex design by using very few parts while designing the vehicle as well as less emissions as it is during the production phase of the vehicle.

Another issue related to sustainability is not just because the vehicle is electric. At the same time, these produced vehicles are made available for the common use of more than one user. In the interview the CEO mentioned this:

> "Sustainability doesn't just come from being electric. Sustainability also means making that product available to many people. Sharing is also critical here…Other people should also be able to use it so that we can use the device 60-70 percent…If we use them like this, we can actually introduce a completely sustainable technology that can make people's lives easier."

Just as it is trying to encourage people to use public transportation today, the same is true for AirCar technology. Therefore, it is very important in terms of sustainability that flying cars are open to common use. The CEO of the AirCar also mentioned about the common usage of technology "You will go to work, you will go to school. Wherever you are going, you will come back. It ends there. It shouldn't be sitting in your garage the rest of the time." Briefly, common usage of the AirCars will also serve an innovative and sustainable future.

Table 4: Data obtained from interviews about Sustainability

Priority of AirCar in terms of sustainability	"**Our first priority** is that it is already **electric.**" [CSO]
Inevitable carbon emission and production phase	"…there is an **inevitable carbon emission** in the production of those parts. **Zero emissions is the wrong word** anyway. We also use it because the industry uses it, but zero emission is the wrong word. There is also the matter of both the production and the filling of those batteries. So, the business revolves around marketing most of the time. It is very important to do the engineering at the optimum. **The primary goal is to bring that battery as close to zero emissions as possible.** It is very important to produce with the **least amount of parts**, that is, it is necessary to eliminate many unnecessary parts." [CSO]
About proper production and usage of electricity and CEO's Sustainability aim	"So the question is, **where does the electricity come from**? It does not come out of the ground on its own. You can get it from the sun, you can get it from the wind, you can get it from the nuclear power plant. But most are not. Most of the electricity is produced from natural gas or coal, but there is a transition here. So there is an alternative to generating electricity. We leave the electricity to those who supply us. They, too, are working across the state to produce electricity from natural resources within the scope of each country's own plans. It's not enough anymore. We cannot do such a thing. We

in companies	are not his company. Apart from that, all the companies that I have founded as an entrepreneur, while we are making our products, are already based on sustainability. I can say that we are satisfied with this for now." [CSO]
Common use of AirCar Technology and Sustainability	"Sustainability doesn't just come from being electric. Sustainability also means making that product available to many people. Sharing is also critical here. In other words, you will call from a mobile application and get on and off. You will go to work, you will go to school. Wherever you are going, you will come back. It ends there. It shouldn't be sitting in your garage the rest of the time. Other people should also be able to use it so that we can use the device 60-70 percent. This actually means serving more people with fewer pieces. It's like taxis anyway. If we use them like this, we can actually introduce a completely sustainable technology that can make people's lives easier." [CSO]
Alternative technology for production of electricity	"With growing research in the renewable energy sector, I think there's huge potential to consider other **alternative energy sources, such as hydrogen, to power the flying cars in the future**[33]." [Dr.Brown about Flying Cars and Alternative Technology]

6. Analysis and Conclusions

In the light of findings and their relation with the relevant background information, it can be deduced that AirCar is in line with the Responsible Research and Innovation (RRI) practices. As the concept of flying cars is totally new to the world and the use of this technology still has not been completely ready to function in today's standards, it becomes very important for this technology to be shaped with RRI. In this respect, core findings of AirCar, namely Technology, Policy Context, Socio-Technology Context and Sustainability are evaluated under the fundamental values of RRI.

For the case of technology, topics of economy and efficiency are the primary concerns here. Economically, AirCar consumes less electricity per mile, leading to a more environmentally friendly vehicle and also it is beneficial for the potential customers by making them spend less on recharging. Additionally, with its advanced artificial intelligence backed software, AirCar aims to find optimal courses for the specified destination. With all these findings, it can be said that AirCar satisfies the inclusion, reflexivity and responsiveness dimensions of RRI in technological context. These explained attributes of this vehicle show that AirCar has technical differences and advantages when compared with their competitors. By declaring the stakeholders properly, AirCar manages to understand the stakeholder interests and design a vehicle accordingly. Additionally, the process of customer-dependent design shows that the AirCar implemented these features, which are the requirements of reflexivity and responsiveness.

When it comes to policy context, it is found out that the company regards inclusion as the findings showed parallelism with the anticipation in background research in terms of highlighting the importance of successfully integrating various types of stakeholders. In case of AirCar, stakeholders that are functioning in this technology were including different areas

that are necessary for similar types of aero-vehicle technologies and furthermore AirCar authorities had awareness in terms of defining policy stakeholders and trying to include them as well although local municipalities showed much less cooperation then expected. In addition to that, it is found that AirCar authorities were in connection with stakeholders such as transportation organizations and governmental aid organizations where this shows the steps taken to include the stakeholders and thus to make this technology usable. In terms of International Context it caught attention that the authorities of AirCar were using the autonomous design of AirCar to compete properly in a field which shows reflexivity and responsiveness. For safety, the results demonstrate that authorities are taking the necessary measures to make sure that AirCar will not bring dangerous consequences to the user where not operating the vehicle in bad weather conditions, GPS and tracking the vehicle in case of emergency situations or accidents, operating the vehicle on altitudes that are suitable for humans come out as examples of this reflexivity and responsiveness. The findings under Privacy & Ethics showed that AirCar authorities were also in line with anticipation since they were regarding the social and ethical impacts of this technology by not sharing route/location data of users with third parties, providing a protocol for the user and finally although they had no users yet, the results pointed out that AirCar authorities were trying to predict what the potential users would want by applying similar concepts from other land and air vehicles, thus following reflexivity and awareness again. In this respect, the overall results in this section was confirming that the technological development in AirCar mostly included the necessities listed on background research and furthermore complied with RRI.

Considering the ecological problems, global warming, the innovative technology that AirCar company produces is environmentally friendly and sensitive to engineering ethics and it should not be forgotten that this technology is still under development.The predictions of the people we interviewed who dominate this issue are states that this technology will be

widespread and usable in 2050. In the remaining period ahead, stakeholders who contribute to the development of this technology must cooperate in order to produce a sustainable and environmentally friendly technology, therefore, including all of the various stakeholders can be an example to the inclusion which is one of the four dimensions of RRI. For instance, as mentioned before, the issue of electricity generation needs to be produced in a more environmentally friendly way using solar energy or dams, and companies and institutions that produce electricity need to be in contact with AirCar and similar companies and be in a constant state of return with each other. It is an extremely important point that all of these mentioned issues should be carried out in accordance with the RRI concept of inclusion. Within the framework of engineering ethics, the common concern of all stakeholders must be human health and a sustainable world. Considering these two elements which are basically sustainability and human health, possible risks may occur and these risks should be defined and accepted by all of the stakeholders especially by the engineers developing AirCar. Therefore, by defining and accepting those risks in the process of development of AirCar technology is called anticipation in terms of RRI. Although the AirCar company tries to produce an environmentally friendly design and technology, it is not enough for the continuity of this technology. As the CSO of AirCar mentioned in the interview, cities and buildings will be redesigned so that not only engineers but also architects and policy makers will be a part of this work, and cities and buildings will no longer grow in width but in length. The reason for this is that human beings cannot fit into the world by exploiting nature and the resources it offers one by one, and eventually finds itself at the center of the environmental problems it has created on its own.

Within the scope of RRI, it is very important to work together with the stakeholders for the progress and applicability of technology that has been produced by AirCar. In this

regard, stakeholders can continue on their way in a way that inspects and approves each other. By taking the necessary measurements via communication chain with each other, provide reflexivity to the process of development of Aircar. For instance, the work of the engineers working to prevent situations such as the Volkswagen emission scandal must be constantly monitored because after the battery part of the technology is taken care of, the rest is entirely based on a software process. Likewise, at this point, it is important that the data collected by Aircar engineers should be reliable and environmentally friendly.Furthermore, the data obtained should be constantly inspected primarily from Aircar and other various stakeholders such as the state, FAA, NASA etc. Finally by taking all of these necessities into account and looking for answers possible impacts called responsiveness. At this final stage of RRI, engineers and administration of Aircar and all of the inspector or superior stakeholders should come out with a result which answers the results of possible impact of this technology in terms of sustainability and future of the world. For instance, in the findings Dr.Browns offers that the production of electricity can be achieved by using alternative technology[33]. For example, hydrogen, dams and solar energy can be used in the production of electricity. Therefore, responsiveness contributes to the development of Aircar technology by finding remedies to possible risks.

When Socio-Technology is examined by considering the RRI, it is important that not only the engineers who develop AirCar technology, but also the architects, the FAA, Air Traffic Management systems that shape the infrastructure, and the governments should act in accordance with the developing technology in this process and communicate with each other, as an example of inclusion. As the CEO mentioned in the interviews, since the busy agenda of the country in which the views and assistance of the Turkish Government cannot be obtained properly, the inclusion phase may not show its efficiency fully. On the other hand, it

is also important how such new emerging technologies will create social and ethical situations in terms of anticipation. For example, the construction of tall buildings can lead to social class discrimination, and the CSO also stated in the interview, "This is the part that makes me the most unhappy. So far, it's always very exciting, futuristic. From here on out , my heart is a little tight. Because I think of it as a situation similar to the hunger games." Considering the reflexivity and responsiveness, the necessary measures to prevent this social and class discrimination should be discussed and taken by all stakeholders, and finally by looking for possible remedies should be fulfilled. Considering the reflexivity and responsiveness, as an example, in the interview CSO states that Aircar took the necessary observations and designed the vehicle design accordingly, and CSO used the following words about this subject, "...We preferred to build a two-person vehicle. Why? Because nearly seventy percent of them travel with one or two people. So I can target seventy percent of people in traffic." Again, in this regard, Aircar is shaping its technology and taking precautions by looking at the habits of potential stakeholders can be given as examples of reflexivity and responsiveness.

In conclusion, with its efficient software and being an electric-powered vehicle, AirCar can have a great impact on customers about their transportation preferences. In mainstream usage, AirCar can drastically reduce CO2 pollution produced by transportation vehicles by having a zero carbon emissions. With a built-in air traffic system, by communicating with other e-VTOL vehicles, it can provide a direct route to the destination, which will result in a very short traveling time. Also, with this system, it can transport its passengers safely by avoiding possible collisions with other vehicles. In an emergency situation, it is also prioritized to save its passengers and ensure a safe landing. AirCar can also be used in cargo transport or any other transportation that needs a fast method of delivery. Considering that there are lots of other companies that work on e-VTOL vehicles,

and with all of these areas of usage, it is almost certain that AirCar will find a dominant usage in transportation in the future. By following RRI practices AirCar becomes ready to be a part of the modern and sustainable transportation perspective.

7. References

[1] A. Kumar, M. Das, M. Raafid, R. Yash, H. R. Praneeth, and Vinod, “Design and development of a novel flying car for future transportation,” in 3RD INTERNATIONAL CONFERENCE ON FRONTIERS IN AUTOMOBILE AND MECHANICAL ENGINEERING (FAME 2020), 2020.

[2] “Flying car transportation system: Advances, techniques, and challenges GAOFENG PAN 1 , (senior member, IEEE), MOHAMED-SLIM ALOUINI 1 , (FELLOW, IEEE),” Edu.sa. [Online]. Available: https://repository.kaust.edu.sa/bitstream/handle/10754/663065/09345783.pdf;jsessionid=F1EAFB1D0398D3ECD2F14B30C7314A25?sequence=3. [Accessed: 04-Apr-2022].

[3] U. Eker, S. S. Ahmed, G. Fountas, and P. C. Anastasopoulos, “An exploratory investigation of public perceptions towards safety and security from the future use of flying cars in the United States,” *Analytic Methods in Accident Research*, vol. 23, p. 100103, 2019.

[4] A. Kasliwal et al., “Role of flying cars in sustainable mobility,” Nat. Commun., vol. 10, no. 1, p. 1555, 2019.

[5] yasins_ondokuzon, “AirCar, Softtech Teknolojisiyle Gökyüzünde,” Com.tr. [Online]. Available: https://softtech.com.tr/aircar-softtech-teknolojisiyle-gokyuzunde/. [Accessed: 04-Apr-2022].

[6] “AirCar,” AirCar. [Online]. Available: https://www.aircar.aero/. [Accessed: 04-Apr-2022].

[7] A. Bernhard, “The flying car is here – and it could change the world.”

[8] “When will flying cars really take off?,” euronews, 13-Sep-2021. [Online]. Available: https://www.euronews.com/green/2021/09/13/flying-cars-how-close-are-we. [Accessed: 04-Apr-2022].

[9] “Personal flying cars around the corner? Not yet,” Diplomaticourier.com. [Online]. Available: https://www.diplomaticourier.com/posts/personal-flying-cars-around-the-corner-not-yet. [Accessed: 04-Apr-2022].

[10] R. Mayes, “Flying cars: What, how, when, and why?,” Quillette, 18-Nov-2021. [Online]. Available: https://quillette.com/2021/11/18/flying-cars-what-how-when-and-why/. [Accessed: 04-Apr-2022].

[11] J. Partridge, “Flying cars will be a reality by 2030, says Hyundai’s Europe chief,” The guardian, The Guardian, 29-Jun-2021.

[12] A. Paul, “Flying cars seem cool, but they’re never going to happen for us regular folks,” Input, 08-Apr-2021. [Online]. Available: https://www.inputmag.com/culture/flying-cars-history-unrealistic-dreams. [Accessed: 04-Apr-2022].

[13] D. D. Chiras, Environmental Science, 10th ed. Jones & Bartlett, 2014.

[14] Global Energy Assessment Writing Team, Global energy assessment: Toward a sustainable future. Cambridge, England: Cambridge University Press, 2012.

[15] B. S. Silvestre and D. M. Ţîrcă, “Innovations for Sustainable Development: Moving Toward a Sustainable Future,” Journal of Cleaner Production, vol. 208, pp. 325–332, 2019.

[16] S. Cao, “A historic year for flying cars: 6 eVTOL companies dominating 2021,” Observer, Observer, 27-Dec-2021.

[17] BaykarTech, “Flying car,” BaykarTech. [Online]. Available: https://www.baykartech.com/en/fighting-car/. [Accessed: 04-Apr-2022].

[18] Z. Kleinman, “Flying car completes test flight between airports,” BBC News, BBC News, 29-Jun-2021.

[19] R. Glon, “14 awesome flying taxis and cars currently in development,” Digital Trends, 20-Mar-2021. [Online]. Available: https://www.digitaltrends.com/cars/all-the-flying-cars-and-taxis-currently-in-development/. [Accessed: 04-Apr-2022].

[20] z, “Flying cars could soon be ready for take off,” UNSW Newsroom, 22-Sep-2021. [Online]. Available: https://newsroom.unsw.edu.au/news/science-tech/flying-cars-could-soon-be-ready-take. [Accessed: 04-Apr-2022].

[21] U. Eker, G. Fountas, P. C. Anastasopoulos, and S. E. Still, “An exploratory investigation of public perceptions towards key benefits and concerns from the future use of Flying Cars,” *Travel Behaviour and Society*, vol. 19, pp. 54–66, 2020.

[22] M. Joselow and E&E News, “How climate-friendly would flying cars be?,” Scientific American. [Online]. Available: https://www.scientificamerican.com/article/how-climate-friendly-would-flying-cars-be/. [Accessed: 20-Feb-2022].

[23] S. S. Ahmed et al., “The flying car—challenges and strategies toward future adoption,” Front. Built Environ., vol. 6, 2020.

[24] L. M. Cysneiros, M. Raffi, and J. C. Sampaio do Prado Leite, “Software transparency as a key requirement for self-driving cars,” 2018 IEEE 26th International Requirements Engineering Conference (RE), 2018.

[25] Mofolasayo, Adekunle. (2020). Potential Policy Issues with Flying Car Technology. Transportation Research Procedia. 48. 10.1016/j.trpro.2020.08.002.

[26] F. Cage and Reuters Graphics, “The long road to electric cars in the U.S,” Reuters, Reuters, 07-Feb-2022.

[27]“TÜİK Kurumsal,” Gov.tr. [Online]. Available: https://data.tuik.gov.tr/Bulten/Index?p=Karayolu-Trafik-Kaza-Istatistikleri-2020-37436. [Accessed: 16-Apr-2022].

[28] “Autonomous flying vehicles hit the sky,” IEEE Innovation at Work, 01-Oct-2019. [Online]. Available: https://innovationatwork.ieee.org/autonomous-flying-vehicles-hit-the-sky/. [Accessed: 16-Apr-2022].

[29] V. Viswanathan, “Energy-efficiency of flying cars,” Medium, 09-Nov-2021. [Online]. Available: https://venkvis.medium.com/energy-efficiency-of-flying-cars-662bcf2662a. [Accessed: 16-Apr-2022].

[30] “How much do people spend daily, weekly and monthly on fuel for the car?,” Quora. [Online]. Available: https://www.quora.com/How-much-do-people-spend-daily-weekly-and-monthly-on-fuel-for-the-car. [Accessed: 16-Apr-2022].

[31] “Flying cars will undermine democracy and the environment,” Center for American Progress, 28-May-2020. [Online]. Available: https://www.americanprogress.org/article/flying-cars-will-undermine-democracy-environment/. [Accessed: 17-Apr-2022].

[32]2022. [Online]. Available: https://www.faa.gov/. [Accessed: 17- Apr- 2022].

[33] “Flying car market size, share, report, trends, analysis by 2035,” Allied Market Research. [Online]. Available: https://www.alliedmarketresearch.com/flying-car-market-A12515. [Accessed: 18-Apr-2022].

[34] “Flying cars market size, share & global report [2022-2040],” Fortunebusinessinsights.com. [Online]. Available:

https://www.fortunebusinessinsights.com/flying-cars-market-105378. [Accessed: 18-Apr-2022].

[35] A. P. Cohen, S. A. Shaheen, and E. M. Farrar, “Urban Air Mobility: History, ecosystem, market potential, and challenges,” *IEEE Transactions on Intelligent Transportation Systems*, vol. 22, no. 9, pp. 6074–6087, 2021.

[36] I. Wildhaber, “Artificial Intelligence and robotics, the workplace, and workplace-related law,” *Research Handbook on the Law of Artificial Intelligence*, pp. 577–608, 2018.

[37] J. Froehlich, M. Y. Chen, S. Consolvo, B. Harrison, and J. A. Landay, “MyExperience,” *Proceedings of the 5th international conference on Mobile systems, applications and services - MobiSys '07*, 2007.

8. Appendix: Interview Transcripts

8.1 Interview with CEO

Interviewer: In general, what is the technology that you developed is related to?

Interviewee: Now we have predictions about what will happen in the future. There are also studies in the world, but it is necessary to look at it a little more historically. For example, what is the reason for the emergence of cars? Cars have replaced horse-drawn carriages. We are looking at whether we can adapt this path in cars to flying cars and whether the technology is suitable for this. What kind of transition has it been? It is expected that something like this will happen here, but there are still horse carriages. In other words, when a product arrives, it does not completely pacify the other. Today, there are still horse carriages and people ride for fun. Not so much out of necessity. Oh, there are people who get on here out of necessity. If you go to India, they get on. If the man can't buy a car, he drives it. So what will the transition be like? How fast will it be? It is very difficult to predict, but it should be mentioned. Is the technology ready? Technology is considered ready for flying cars. Longer flights and safer flights will be possible with the increasing battery technology and the improvements made in the systems. Technology will be able to accelerate us towards that. Progress in autonomous systems is the progress of hardware rather than software in artificial intelligence. Artificial intelligence modules are progressing because this progress is provided by the acceleration of the internet. Slowly now satellites are starting to connect to the internet. So more and more, the world is preparing us for that. Cars emerged in 1880-1881, and on what technologies are we now positioning these cars and how was this possible? Tesla started slowly in 2003-2004 with the story

of using the first lithium batteries in cars. Tesla also has advanced technology. At that time, similar questions were asked about electric vehicles, but what about now? Battery technologies have evolved. In 2016, it reached the level we wanted. These batteries did not grow very quickly after that, they just got cheaper. Artificial intelligence modules became better at that time. The cards and machines we used on the device came to a level where we could get the results we wanted approximately at that time. In other words, the dates 2015-2016-2017 are very critical. Apart from that, these vehicles fly in the drone structure we use. Drones continued to evolve along with these developments. The algorithms there started to be open source and the hardware started to come out. Now when we combine them, the rest is already related to carbon fibers, carbon fiber has been used in aviation for many years. There are also avionics. In other words, the connection components, controller, etc. on which this device works. In the last period, more and more companies have started to enter this subject and produce products that we can use. After all, we cannot do everything ourselves. Therefore, the chance of being made technologically has been increasing in recent years. It will also increase in the coming period. Why is it increasing? A large market is involved. More people are working on this issue. More hardware, software systems are emerging. We take them and combine them, or if we can't find them, we code them ourselves. What would it take for it to spread as we move forward? Everyone should be able to use it. The helicopter also flies very well. Can we use it? No, the pilot is expensive, it is expensive to buy, noisy and we can't use it every day. So only a very certain group can use it. Everyone should use and reach this technology in order for it to become widespread. It has to be affordable. It has to be safe. It should not harm or disturb people, in terms of noise. We are working on these too. So there is no need to talk about the benefits. Where do you live? I am in Ankara.

Even in Ankara, there is traffic. Traffic is like hell in Istanbul anyway. Every day, one and a half to two hours is spent in traffic. Time flies in traffic. If we give back eighty percent of those one and a half to two hours, we'll save people's lives from traffic. There is a value here, and that value is time. Time is the one thing we can't buy. You know, we can't buy back even a precious second of everything. So everyone will follow it. Everyone will try to go from one place to another where they can comfortably watch the scenery. When it's ready, I'm sure anyone who isn't afraid of heights will want to use it. If he can get to that point or pay for it. That is, if we get up and take it from one end to the other for a thousand liras, it will not work. This will have to be double the taxi price. There is a way which autonomous flying cars. If you put a pilot in the vehicle, this pilot will not work for four or five thousand liras like a taxi driver, for this you need to get a pilot license. A pilot does not work less than thirty thousand forty thousand liras, which increases your costs. It increases the price. If there are ten thousand of them in the skies of Istanbul, where will we find so many pilots? According to an analysis in Paris, fifteen thousand units are needed only in Paris. It has to be something realistic in the background. How will you manage this air traffic? It is not possible for pilots to do this. A software has to fix this. That's why it has to be autonomous. There are companies that do not use autonomous technology. Eventually, they too will return to autonomy at some point. We started early as “Aircar”. We started too early. The next issue is this. Normal cars bought are 92-93 percent sitting in the garage of the house. Not everyone buys a flying car and puts it on the roof of their building. There is no such place for once. You can't leave it on the street like a car. Therefore, for it to be logical, resources must be used correctly. Sustainability doesn't just come from being electric. Sustainability also means making that product available to many people. Sharing is also critical here. In other words,

you will call from a mobile application and get on and off. You will go to work, you will go to school. Wherever you are going, you will come back. It ends there. It shouldn't be sitting in your garage the rest of the time. Other people should also be able to use it so that we can use the device 60-70 percent. This actually means serving more people with fewer pieces. It's like taxis anyway. If we use them like this, we can actually introduce a completely sustainable technology that can make people's lives easier.

Interviewer: What are the main features of flying cars, or rather AirCar?

Interwee: Electric Lithium-Ion batteries are used. The structure is composite carbon fiber, they all go into compositional structures. We use it differently than others. Apart from that, we mean autonomy with cameras and sensors. With on-board sensors, you can think of the same as Tesla. Other than that, these are basically the basis. Also, avionics is like our flight health.

Intervewiver: I will use a technical term. We call it stakeholders in our lesson. In other words, the groups that play a role in the emergence and use of technology. Who are they when you look at them from the point of view of your technology?

Interwee: Nvidia has a lot of carbon fiber manufacturers hardware, avionics manufacturers. Hardware manufacturers. Other than that, electric motor manufacturers. I'm not giving names there either. Because there are many. NASA. He works for the drawing of the airways. FAA, America's federal aviation agency for

civil aviation. Also, Euro Pineviation safe is the aviation institution of the European Union. They are also working on regulations. These are the stakeholders. In some countries, local municipalities or the state directly pave the way for this. We're meeting here too. We're meeting in secret. There is no such thing yet. What can we do in Turkey? These are the stakeholders in general. Also here are open source software systems working in artificial intelligence. We buy and use something from there as well.

Interviewer: At this point, you mentioned systems such as local, we call them the stakeholders of the measures, our patients. In other words, what will be the importance of those who are interested in law, those who prepare the legal infrastructure or local government centers?

Interwee: Normally aviation Turkey is dependent on the European Union. The European Union says you can fly it, gives a certificate to the device, and you can fly it with the rules of the airlines. Well, you'll never get a local permit again. You just come with that paperwork. You inform one of Turkey's local civil aviation, but this issue is a little different. Therefore, it requires planning on a municipal and city basis. Where will they land, where will they take off, how will you charge them? Will the electricity you supply there be enough? Will it strain the mains? Or you're making a noise there. So what do I know, are you near a nursing home? Will people go crazy? It's not noisy, but these are also critical, or are you flying over a restricted area? Here you are flying over the President's house? They're already closing them. Or like flying over a military ground? We need to work together on these sides as well. I say it is necessary. If you say you can do it in Turkey. No, we cannot do much, we try to reach

the municipality, but they are not very available. Nothing happens until you fly. Unfortunately. I would say neither side. These things are difficult in Turkey. But here we are doing our best. We don't sway a lot in Turkey, friends, but okay. So we will use it one day.

Interviewer: What can you say about the main users of AirCar, namely the target audience?

Interwee: The target audience is those who try to get from an emergency point to a place in the first place, and those where it is very difficult for traffic to go from one point to another. Because there will be few vehicles. The people who need it the most will get on the vehicle. Trying to go from one end of the Bosphorus to the other in Istanbul. It takes fifty minutes, but a kilometer further, if we fly, we will cross in two minutes. If someone needs it there, if his time is valuable, he will jump and go. In the first place, that is, when it comes down to the public, this is the usage. The number increased after that. And now, anyone, that is, whoever wants, will be able to use it.

Interviewer: What are the possible risks of flying cars?

Interwee: So there is a possibility of an accident. Hardware-based or software-based. Apart from that, there are problems that may occur in air traffic. Other than that there is none.

Interviewer: There may be risks in matters such as privacy, security and terrorist attacks. What do you think about it?

Interwee: So there is no problem with privacy. Anyway, now I can see all the buildings below the house. That's why we actually experience some things in our lives so much that we are not aware of it. I mean, or I can take binoculars and watch wherever I want. I'm looking down on probably five thousand buildings right now. If I put a binocular, I can see it. My flying high won't change much. I'm already doing this or I can fly by helicopter. They can always do when it comes to terrorist attacks. Terrorists always find something a means to launch a terrorist attack terrorist attack. That's why, since our device is autonomous, it will not go out of its way anyway. What can he do on his route? That's not a problem either, as it can't grab it and go and crash it. Then it goes autonomous. He detonates the bomb inside and dies only by himself. Nothing else will happen. The device falls down. It kills a few people at most. But if he landed on a subway again, he could kill five hundred people. Why would he come and do our place?

Interviewer: Since flying cars have a certain route, privacy is important in this respect. In other words, if there are people who need to protect their privacy, terrorist attacks can happen.

Interwee: So they get on the plane. Flying also has a clear route. If the important person is riding, the critical thing is this. By the way, you can follow planes, you know? Right now, one or even all of their planes are doing something right now, where did it come from? Did he come to Istanbul? So he can already watch. There is even one in America, a nineteen-year-old teenager following Elon Musk’s plane on a robot. Every time he moved, he shared it on Twitter. You know that job, right? I mean,

nobody cares about Elon Musk's safety at that point. How important is materiality at work? We love to make people look important, but you guys are very important. Everyone is so important. There is no such thing as a successful, important person. We are all human, we all work. If someone wants to know where I am going, they can already follow me. By the way, AirCar's routes are also confidential, so at the end of the day we will be providing its database. That conversation is also recorded, but in Zoom, someone can reach him in the backend if they want. We also support. A conversation is recorded somewhere, after that. It means that it can reach someone other than us. These are not critical. But to take control of someone, for example, the man is flying, he wants to kill. Takes control of the device. We have plans for that too. You know, there are issues such as no one can enter that line. These will be taken care of.

Interviewer: My question will be about sustainability. As an AirCar company, you have studies in terms of sustainability in the technologies, designs and organizations you produce. Also, can you give specific details about energy consumption and carbon emissions?

Interwee: AirCar is fully electric. Now, of course, there are doubts recently. So the question is, where does the electricity come from? It does not come out of the ground on its own. You can get it from the sun, you can get it from the wind, you can get it from the nuclear power plant. But most are not. Most of the electricity is produced from natural gas or coal, but there is a transition here. So there is an alternative to generating electricity. We leave the electricity to those who supply us. They, too, are working across the state to produce electricity from natural resources within the scope

of each country's own plans. It's not enough anymore. We cannot do such a thing. We are not his company. Apart from that, all the companies that I have founded as an entrepreneur, while we are making our products, are already based on sustainability. I can say that we are satisfied with this for now.

Interviewer: Do you get feedback from these users when designing and developing AirCar? We currently do not have users. You would have seen it.

Interwee: You are our potential users.

Interviewer: If so, then or is there a mechanism by which you get any feedback?

Interwee: It doesn't disappear. Municipalities, states, ministries, they are not very supportive. I mean, of course, because Turkey's agenda is different. Now we call it a flying car. You already know how skeptical people are that TOGG will even happen. We continue on our way. We develop things that we like, that we know to be true, and that we predict people's usage habits. Of course, we read a lot of reports, but we don't get up and talk to five hundred people at work. Because there is no need. So it's obvious what's going on.

Interviewer: What do you think about the future of flying cars? Is this technology really going to be widely used in the future? For example, you mentioned Istanbul. You mentioned the places with heavy traffic in Istanbul. Will it just fly autonomously from point to point here? Or will the person be able to go where they want?

Interwee: At first it will be exactly as you mentioned. We will be checking the points. Everything about the device, from who's riding it to how many people there are. After that, the city infrastructure and buildings need to be changed so that people can buy and put them in the future. Where will the man park it? Where will he put it? Yes, it can be done. It's possible. The man who lives in the countryside has a garage, he puts it in, but all the situations in the first place are point-to-point, just like the plane, which we manage. It goes from airport to airport. Here it goes to a point. It's a port, but ours is like a two-car port. That's when it's happening, so two cars. Yes, there is no need for huge investments. So that's how it will be used. How widespread will it be? So it depends on two things: how long will people accept it? They will suppress the people who accept and regulate. Secondly, how quickly and quickly will we be able to produce it? This is a second bottleneck. Both are difficult. So to make a prototype. There is a gap between putting a hundred grains into operation and producing ten thousand every year. In aviation, this has not yet been done. They produce at most three hundred and four hundred vehicles. Huge vehicles like Airbus and Boeing. It is necessary to combine the mass production capacity of the automobile with the safety aspects of aviation. This place is already open. Otherwise, there is no such thing as producing two hundred or three hundred vehicles. We'll see how this goes. We talk about them every day. Not easy.

8.2 Interview with CSO

Interviewer: Please tell us about the technology that you are developing.

Interviewee: Four billion people in the world live in big cities, and migration to metropolitan cities is a process that increases and does not decrease with the industrial

revolution. It is predicted that six billion people will live in big cities in 2050. Four billion people live in big metropolises such as Istanbul, New York, Los Angeles and London. No matter how much you develop the infrastructure, after all, the world has a certain surface area and does not expand. Therefore, with our current solutions, we cannot solve this problem by increasing roads, constructing bridges and underpasses. Human beings do not fit into metropolises anymore. For this reason, a market called a flying car has emerged. The technology we are currently producing is electric technology and it is not new in fact. Since the nineteenth century, people have tried every version of it so that I can put wings on my car and fly, put wheels on my plane and go on the ground. There is a process that has been tried with very interesting designs. You can think of it like a bicycle example, but this spreads over many years and people are trying to make flying cars every time. Why is that? Actually, because we have a problem of fitting into the earth. At the moment, the problem is getting bigger and the subject is getting more attention due to the advancement of technology. Flying car brands have been involved since the early 2000s. In 2015-2016, the development of this technology has accelerated. Currently, there are about 300 startups in the world on this subject. 100 of them have completed their first test flights and are on their way. The reason for the increase after 2015-2016 is the breakthrough in artificial intelligence. Computer engineers are aware of this breakthrough, a threshold has been crossed in technology, and it was predicted that with that threshold, autonomous flight and autonomous driving technologies could actually go further. Because the pilot cost is very high and these vehicles currently have piloted and autonomous ones. Regulations are not ready, but it needs to be autonomous so that people can get on and off. Because being a pilot and a driver are different concepts. Therefore, it is very costly to train everyone in this. Maybe there will be

only three or five flying cars in 2030. If you think that the market is growing, it is predicted that there will be three million flying taxis in the world by 2040, so the breakthrough in artificial intelligence, autonomous flight systems and avionics systems led to this.

The second technology is battery technology. It was a breakthrough in battery technology. Therefore, longer flight times have been achieved. The next breakthrough in battery technology is expected to be in 2024 or 2025, in which case costs will fall a lot and the market growth rate will increase. Just like the artificial intelligence breakthrough in 2015-2016.

The third breakthrough is the development in avionics technology. With lighter materials, technologies have emerged that can both consume less energy during take-off and landing and increase flight time.

Thanks to these three breakthroughs, the process accelerated from 2015-2016. So, everyone has a flying car design. Everyone is trying a different concept, like the bicycle example. Meanwhile, there are three different concepts that dominate the market. One of our designs is “AirCar”. Another is the drone-like design with propellers. Another is vehicles with winged structures that look more like airplanes and have tiny propellers on their wings. All three technologies are tools with different advantages and disadvantages. I will not go there. But what are we currently producing? What did we bring to society? We are considering these. Traffic problem is a very big problem in big cities. There are many details that have been studied, from where to park the flying cars and how to arrange them. The "AirCar" technology, which these 3 breakthroughs have brought in, is actually quieter helicopters that take off and land vertically in the city. They have very similar aspects with helicopters. Helicopters are not electric and they are very loud. That's why we

can't use them in the city and the helicopters run on gasoline. This creates a big problem in terms of carbon emissions. Therefore, “AirCar” solves the problem by using electricity. This also solves the sound problem. The carbon emission problem is also solved. Helicopters also crash more than planes. The risk and salary of helicopter pilots are also higher. As a result, as soon as you solve the carbon emission and sound problem, you also reduce the cost. By the way, more helicopters are very costly. An average helicopter today costs 300K 400K dollars. Small helicopters are the best-selling helicopters among helicopters, and as the size increases, the cost reaches 2 million 3 million dollars. On the other hand, when you look at AirCar technology, we are talking about flying cars between 100K-500K dollars. There is a very serious cost difference when you compare it with a 3 million helicopter. Therefore, we produce a technology that tries to solve these problems.

Interviewer: You mentioned the preparations of the infrastructure. Are there any infrastructure preparations in the air? So in terms of being in the air, are there things like flying traffic lights or something?

Interviewee: Yes. That's why the breakthrough in artificial intelligence is important. A system called “Air Traffic Management” is being developed. Upwards, we can open as many lanes as we want, because the sky is already empty and we can remove the lanes we have opened. No one can tell us anything. Zero investment cost. The problem here is that the flying cars will be flying between a hundred meters and four hundred meters. You know the planes are higher up and the helicopters are one below them. Small drones are under the helicopters. So, we're talking about a corridor once in a while. Between 100-400 meters. A "management" system, which we call "traffic

management", manages this corridor. Like when will your lights come on, which will be on, which will be red. For this, just as there are towers and radar systems for airplanes, this system, which is foreseen in the world and manages these short-haul flights, is being developed. Therefore, each country's own administration will be involved.

Also, a software company needs to be involved. It is necessary to have a software company and its manufacturers such as “Air Car” or the competitors in the world “Joby”, “Volocopter” brands should be involved. Thus, there must be inputs to the "Air Traffic Management" system. It's like the planes saying the tower will land. But since there are short distances here, the constant “Hello. I'm getting off. Yes, he's running too. He's getting off too." It shouldn't be. That's why artificial intelligence is so important. Who is where, how is flying, which corridor should we open for him, this needs to be supervised. Currently, this system is not fully installed. Everything we are talking about is being set up at the same time, friends. In other words, charging centers, vehicles themselves, traffic management systems are currently being set up. Questions such as whether this system is safe and healthy for human life continue to be asked. Regulations do not allow autonomous companies. You have to put one pilot seat. It will not fly autonomously. It will not be allowed. Because when you say autonomous, humans cannot intervene when there is a mistake. There is a passenger inside, the passenger cannot intervene anyway. What will happen? All this is being considered now. There should be a responsible human that always can communicate with the passenger in case of emergency. Therefore, everything we talk about affects the society at the same time, and the society gets curious as they hear about it. Feedback is being considered. For example, there are storm, rain or lightning situations. Then what about these tools? Current technologies are developed under

normal conditions, according to a certain wind rate and a certain fog rate. We are currently talking about devices that will fly from point A to point B. In the city where you go and get on the flying car in certain places, but from point A to point B, the number of these points will increase. Towards the 2050s, we will see a world where everyone starts to buy their own vehicles. It will happen sooner in America because the guys have huge lands. Then it will spread all over the world. When people start to buy their own flying car, the stage of how technology will change society will come into play. Cities will start to grow upwards like in Singapore. In cities growing upwards, imagine a building. There is a park on the thirtieth floor of the building. In fact, each floor of the city will have a neighborhood, a park. There will be a hospital in another place or floor. So we're going to start building cities like this. This is the part that makes me the most unhappy. So far, it's always very exciting, futuristic. From here on out, my heart is a little tight. Because I think of it as a situation similar to the Hunger Games. At present, architects have already begun work on building cities like this. Therefore, there will be cities where we live with buildings that are close to 1000 floors. The flying car will be a device that will take you from that floor to the bottom, it will go between the cities. That's how we're going to start making cities. We will use the cars, then people will want to have a car like this and gradually individual sales will start.

Interviewer: What are the main applications of flying cars?

Interviewee: Technical specifications of the car? Shall I leave this to Eray? Say what? Eray will tell you much better. That's why you'll hear more from him than from me.

Interviewer: What are the possible risks of flying cars?

Interviewee: As a risk, fire may occur due to batteries. Both the inside of the vehicle and the following should not be harmed. I think it's a pretty big risk and it's safe right now. Meanwhile, a lot of security systems are being installed. Because of the parachute system, the vehicle will fall on someone. That parachute could get stuck somewhere because it's in the city and that's a big risk. He can cause great damage to his city with one mistake anyway. That's why there is talk of a lot of things like flights starting outside the city and gradually coming into it. That's the biggest risk. There are risks in terms of privacy. As for attacks in software, of course there is, there is a risk of hacking because we are talking about the computer. We may call it a flying car, but this is actually the flying computer we can ride in. We started with software that does everything on its own, without linking the vehicle's own security to the outside. But we have to communicate with other tools and control centers. Of course there is a risk of hacking here, but the developments in the software are already purely to combat this. If you ask how this will be, engineers do not know exactly at the moment, but they are trying. A solution will be found for it. You can think of it like a banking system. Flying autonomous vehicles will have a GPS system in them, and for example, I'm a fugitive and if this information is actually given to the state via GPS while escaping, I am actually something like caught directly. Will these actually be shared with 3rd parties? This is also a risk and a specific situation. There needs to be regulation about it. The software regulations are one click behind because aviation is too cumbersome and too rigid a system. Too many elimination methods are used. Currently, even airplanes have autonomous flight systems, but there is also a pilot,

and a pilotless plane does not fly, and even if there are autonomous systems, the pilot takes the plane down. The system does not download. Let's see first, let everyone use artificial intelligence. Let's see what's going on? After that, they are in the mode of taking it, but there is a situation like this. All these tools, ours for example, are built to work without GPS but it works for security reasons. Because how will the vehicle find its own direction in a place where it is not? How will he follow his path? That's why it's used.

Interviewer: My question will be about sustainability. How do we work in terms of sustainability in designs and organizations we have made, and can you give a certain detail about energy consumption and carbon emission specifically?

Interviewee: Our first priority is that it is already electric, and since there are other parts other than electricity and batteries in our design, there is an inevitable carbon emission in the production of those parts. Zero emissions is the wrong word anyway. We also use it because the industry uses it, but zero emission is the wrong word. There is also the matter of both the production and the filling of those batteries. So, the business revolves around marketing most of the time. It is very important to do the engineering at the optimum. The primary goal is to bring that battery as close to zero emissions as possible. It is very important to produce with the least amount of parts, that is, it is necessary to eliminate many unnecessary parts. Thus, you save a lot in terms of both R&D and production. Since you already contribute to the carbon emission while producing, there will be carbon emissions. Thanks to this technology, we create another contribution to society and the economy. You create opportunities for the workforce. In this regard, there should be a design and engineering that is as

little complex as possible, can be produced quickly, and can be solved quickly. We are very focused on these.

Interviewer: Do you get feedback from users at work while you are developing it? Also, does anything happen with politicians in the legal process about this issue?

Interviewer: Negotiations are happening and there have been changes. It has a difference compared to other technological products. There are no potential users yet. We gave an example from Apple, the phone and so on. We are talking about a market that is progressing a little differently. Because we are talking about a world where we have just established the market. That's why the feedback we get is primarily how this flying car will be used from point A to point B. I mean the situation where people are most stuck in traffic or want to save time. We try to discover them first. We do not know exactly what will be allowed first in the regulations. Therefore, I will give an example from Istanbul. A vehicle and line from Taksim to Kadıköy may be very logical, but the regulations will not allow this immediately. Therefore, we are trying to get feedback on where people might need such a service the most and where regulations will be allowed. It is also important in which areas it can be used first. Currently, eight prototype countries have been selected in the world. How was this chosen? For example, Konya is a very quiet city. Although the flying car in Konya is quieter than the helicopter, there is always something flying overhead in Konya and everyone will be hearing that sound. They look back once in Istanbul and then they don't even hear that voice. Why is that? Because the voice of the city itself is very loud. Therefore, there are studies on the city's tolerance for noise, its demographic structure, its approach to such a service and its intention to pay money. These vehicles

are planned to be used in 175 cities in 2050. We receive such feedback. Another is about design. For example, we design two-person, four-person, eight-person vehicles. We also have vehicles called "intercity" between nearby cities. For example, between Istanbul and Izmit. How many people take taxis? An average driver and one passenger. Come on, you didn't know, it was two. How many people go out to traffic with their own cars during the day? When we look at the number of these, for example, we preferred to build a two-person vehicle. Why? Because nearly seventy percent of them travel with one or two people. So I can target seventy percent of people in traffic. Who is experiencing the problems and how are they experienced? And the vehicle takes shape with feedback such as what they can tolerate or not. Why is that? Because the market is just formed.

Interviewer: About the future of flying cars, do you really think the technology will become mainstream?

Interviewee: Yes, of course, I will also tell you how to begin. Since we are talking about flying cars now, of course, we are telling the story there, but in fact, technology will gradually shape our lives like this. First, we will start using the unmanned ones and extinguish the fires. We will do search and rescue with these, and they will be in two or three years. We will extinguish fires from 2024. They will be a flying ambulance. First, the necessary medical supplies will be transported to the hospital, and then they will be able to transport people. Between 2025 and 2030, there will be flying cars that carry cargo. I'm talking about something bigger, the one that carries material from port to ship or between two production facilities that carries material from ship to port. First they will become common and we will start to get used to

these flying devices, big flying devices with them. We are talking about an artificial intelligence behind them. How are we doing this right now? Someone is getting into a car, isn't it? It is navigated by a radar system. Right now, time and workforce are being created for these. Starting from 2030, we will start to see some flights that seem to be touristic, such as two points in Istanbul and two points in London, at designated points. Therefore, people around this, how should I build the houses and buildings that I will build new? Shall I redirect the city here then? Whether it be this or that, he will start them. An understanding began that no technological product is meaningful on its own. Electric vehicles in cities in Europe Electric gasoline vehicles have started to be banned in the city and their use will decrease considerably by 2030. In the city, gas stations will go and power stations will replace them, infrastructure is changing. Everything will be changing together, but it will be such a journey. Of course, we won't be connecting to Jetsons like this all at once.

8.3 Interview with R&D Engineer

Interviewer: Can you give some information about AirCar technology in general? Especially in terms of infrastructure and autonomous features. What will happen under bad weather conditions?

In my opinion, a world is being built according to people's dreams right now. I mean, they talked about horse carriages in a certain way at first. Horse carriages poured asphalt on their roads and somehow drew lanes and formed a road. Right now, because of these roads or because of this established order, the transition to autonomy for cars is a little hindered on earth. Because there is a system designed for a driver

standing behind the wheel. There are no restrictions at the moment when designing the sky above. So we can do as we want. Because the road means a restriction for you. When there is an autonomous world, it is independent of any path. We can think of it as a world where one day a departure can be a return one day, one can go and one can return at the same time, there can be various ports wherever we want, various infrastructures, various superstructures can exist only with our imagination. Here's the weather thing. They probably won't be flying in a storm or rain at first. In fact, this too will go completely step-by-step. At first, even people will not be flown. You know, it's going to start as a cargo. Maybe it will be in the form of an ambulance. So at first, maybe there will be a small cargo transportation. A system has been produced and someone has to test it. Our system's testers may actually be a cargo system. Or at first, it can carry small pharmacy supplies or emergency organs. It will be a process that gradually moves towards that living mechanism. When we came to the issue of transporting live people, we saw that the main purpose was that, for example, thousands of flight hours were filled over the course of five years, and trust in that system was now tested, or otherwise abandoned. It's actually like the cargo transportation industry. The moment we see this constant in the air, in the sky or on the ground, in ports, we will actually accept flying cars. Let's first consider scooters, for example. We were wondering if there will be that many scooters around. Now we look, we don't even care. You know, like fifty scooters side by side. There are even different brands. We don't care right now. People even bought their own scooter. As we said, some things will be accepted a little bit. That's why it will be accepted gradually, so we will ride on the other hand.

Interviewer: What are the main features and applications of flying cars?

Interwee: In fact, it has features like other cars. For example, we can do the same thing here, that is, you can add on the axis if you want. In terms of features, they are all electric. Why would we be thinking it's electric? Why is that? For example, my biggest question when I entered this industry was: Why were we dealing with flying cars when there were helicopters? This is a huge problem, there is already such a system. It happens as we say. In other words, what he said to point A and point B, he called the heliport. Well, you think it's loud. So let's do this quietly. You think you are harming the environment. Yes, then electric. Electricity seems to have such disadvantages as well. But when we look at it, there is another situation. There has been a system called helicopter for years. There is also a system called airplanes, but these are always reserved for the rich. A higher echelon has been allocated. Actually, this is the sector we call this sector. You know how the telephone is now, in the field of use of all of us, or if we go back twenty years, they call the phone from the switchboard. Another communication tool. Can you link me to this? Nobody can imagine. Everyone's pocket will be reduced to pocket size and everyone will have something to use. Actually, I look at the things we learned with that sector in order to make sense of the things we couldn't learn. At the moment, yes, helicopters are doing their own duty and they are carrying out their duties somehow. But it also needs to be expanded. So we need to be able to reach those jetsons in our dreams. We also need to be able to go from point A to point B freely from a bird's eye view, regardless of certain roads. This is the fact that we are always worried about our freedom, in fact, cars also limit our freedom. There is traffic, the roads are long. Bird's eye view of the three-kilometer ground, sometimes we see the lights there, no bridge was built there. And so on, we go twenty kilometers in twenty kilometers and in thirty-five minutes.

It's a place we normally go in five minutes. It both steals our time and limits our freedom. In this process, in fact, these are the continuation of what Eray Bey told. Even if we go over what he said, yes, it harms the environment, it makes a lot of noise. Even if five helicopters pass, not fifty at the same time, we will be very disturbed. And at the same time, it gives something extra to get from point A to point B, which is very costly, and this price hasn't dropped for years. There is such a truth. You know, we say that it will get cheaper soon, no, the price of a technology that has been used for twenty or thirty years, maybe forty years, has not decreased. So there is a problem here. We can look at this as well.

Interviewer: Actually, as an innovative technology manufacturer, I think it is right to ask about its lifespan. Now do you have competitors in this regard? In other words, you are producing a technology with unprecedented results. What does AirCar do that differ you from your competitors?

Interwee: Big companies are big right now. In fact, there are few competitors at the moment. All companies actually. It's always startup sized. Who are our competitors? In Germany, for example, it goes up to two big companies: Lilium and Volocopter. There are two big companies in America: Joby and Archer. In the UK there is Vertical Aerospace. These are the eldest ones, we can call them big brothers. Can we meet them? Now they are ours, so we started in the same places, but they are ahead of us. How ahead? Unfortunately, what we now call technology has also had a certain material dimension. In other words, while software can only have a human and effort dimension, producing the tool we call hardware, of course, also has a financial dimension. Those who get the financial dimension first, that is, the fund, their

investment progresses faster, but if we compare them in terms of features, for example, their benchmarks are created. You know, we have similar technologies in terms of energy, they will say, the calculations estimated, the batteries used, the motors used, the roads they will go with the propellers. We have autonomous technologies that make us stand out. Our autonomous software technologies. It was actually a great benefit for us that we started it earlier. Because other companies see the sector as something. Let's fly with the pilot first. So let's fly as a pilot inside or as a remote pilot outside. Then, by predicting that in the future we will not do anything with any pilot and fly autonomously, the company's vision and mission is actually time, and the role of softech in the system is actually here. This software muscle has become stronger than other companies because you are fully autonomizing the technology. In fact, we see that our software muscles and software autonomous perspective are more advanced than others. While there are targets that they will start at two thousand and twenty-five. We are further ahead in terms of autonomy. But in general, such a sector is already forming. All companies try to meet certain things. In Turkey, for example, there is Cezeri. It is also a product of Baykar. That's the purpose of commercialization. In general, Baykar produces military products. It is a product they promised to commercialize. A wall of Gelişim University, friends. There is something that Türk İş Teknik is trying to do. There are several drawings etc. But there are two examples flying in Turkey. It's three or two and a half hours from us.

Interviewer: Do the stakeholders, that is, the groups that regulate the legal and political infrastructure of the business, have an importance in the development of your technology? In other words, do you pay attention to such factors when making your technology?

Interwee: You know, really for evtols. How do you get from point A to point B? You regulator system builders and regulation builders have a question mark for you. But he has experienced these processes before. So how? He lived for drones, small drones, helicopters. There are people and communities where these people come together. For example, there is the Enitol community. In America, we are members of it, for example, we are informed about active issues. Some people in the team even go there to visit. In this way, all stakeholders are trying to contribute to the development of the system through them. There is a general directorate of civil aviation in Turkey. We can say that it takes a stance in Turkey and according to the decisions of the FAA. We can say that those who are close to those two, that is, those who are scrutinized there. Or we can say that they give feedback there. When you work with them, they try to create an order, a regulation based on the feedback they get from other companies they get from you and the test reports they get from the companies I've mentioned. Of course, this is not completely two-sided, but the other systems we talked about in those days are all united under the name of regulation. I'd say interacting with people who come together based on their past experiences.

Interviewer: Finally, is there anything you would like to add regarding the stakeholders and audience that contributed to the emergence of this technology in general?

Interwee: It's a very broad question. There are separate partners for battery technology. There are very different partners for this technology, that is, for mechanical technology, which I have heard, seen and researched. It's very different

for the engine. In other words, it's like a car, but we can think of it as a more comprehensive version of the car. It's like an airplane. For him, the scope and the partnership of the problem as a thing may be small related to the software partner, but it is very comprehensive in terms of hardware partnership.

Interviewer: What are the possible risks of flying cars?

Interwee: In the simplest way, flying objects in the air can be disturbing. It already bothers you on the plane. We hear it all the time. What if a bird enters the engine or something etc. It could really be there. Any of the hardware may not work at once. So it's a human product after all. Any product may not work. This can be subject to jammer attacks as the terrorism attack you are talking about. Because there are drone jammer attacks. But the important thing is this. What kind of precautions do you take against the dangers? We are taking action for some. For example, what precautions do we take? For example, we are developing an autonomous software called GPS. What does this do? In any case, what will the device do if our GPS is cut off in these jammer attacks or in any anti-attack? The device will determine a location as an algorithm based on historical GPS information and location information, as well as IME information and the route it will go, and will safely go to point B when it leaves the A point. An algorithm is designed and tested in this way, and it also works on small drones during our tests. It was something different. We have a thing called Imon descent. Again we have the algorithm. Again this is autonomous, developed by our tryptonic side made by artificial intelligence algorithms. Here, too, the event threw a stone, and suddenly the hardware malfunctioned. Suddenly one of the engines did not start. Something urgent or diminished. So something happened. One of the batteries

exploded. Anything we can think of. We urgently need to land in a suitable place. How? Lawn, grass or flat terrace. You know, let that camera at the bottom find a suitable place for us. While we were in an emergency, our wing was broken, something happened. We have very little left. It is such an algorithm. So the algorithm that finds the most suitable place to land as soon as possible is something. In fact, in this second algorithm, this is an algorithm that can prevent all the fantastic threats we mentioned, or block them if they occur. They also try to attach a parachute, saying that if the whole system stops at once, and so on. They don't think it's a big deal. Either the paratrooper dies but they think of it as a safety guard here. There is no other security at the moment. But other flying cars do, and they will be in our next versions as well. If you pay attention to some flying cars, they have wings. Not just eight engines like us. There is an engine, but there is a wing. It is actually a system that provides logic gliding in airplanes. If the engines suddenly break down, if the equipment suddenly breaks down, if there is a fire inside, if there is an explosion inside, at least it can be directly to a safe area, maybe the field, maybe the seaside, maybe the sea. Or a pond. There may be a technology to glide down there safely. What else do we have? Again, we have a system. That's it, detect and run away. Or we call it sense and abort. Feel again and run away. What's this? A different drone attack can happen to you. It can happen with a different flying object attack. Or it can be found if a flying animal attacks you. Or it may appear directly in front of you and so on. We must first perceive these obstacles as the first example and show an active reaction against them. This is actually a software system as an algorithm. This is the third. This is our solution. Threatened and autonomous. When we talk about these, both autonomous technologies and technological solutions against threats that may actually exist.

Something occurred to me. This one is very famous. What happened ten years ago? Let me not misremember, though. In America, there is this plane again, is the seagull entering the engine or whatever. That's why it goes down to the Hudson river, for example, because it is electric here, maybe it is, let me explain it like this. For example, we do not have an emergency notification. It happened again. It has to be an emergency lair, but water is everywhere. So it could be the sea. Can it land on it?

It'll probably go down because they're trying to make these waterproof too. Because it should not be blocked in the rain and mud. Let nothing happen. So you can think of it like a hoppers thing. Actually, for example, they do, you know, there are row competitions. What is a row? Actually this is it. Drone underwater. So it's a waterproof drone. If you make the hardware of the battery chambers resistant to water, nothing will happen. It may end in frustration. But according to the plans, there must be waterproof systems. You explained in great detail. Thank you so much. Thank you too. I couldn't find the first. If I find the first and fourth, I'll share it with you. Our foundation has already become one of our major projects.

Interviewer: For example, even in Tesla's best models, the range varies somewhat between six hundred and forty six hundred and fifty kilometers. You are building a flying car. In other words, you are making a mechanism that requires more energy. Yup. And this is how I perceive it, more precisely. If it's going to fly between point A and B, this helicopter is a flying car, etc. You would think that after you fly, most of your battery will be dead and a new person who comes after that will wait for a different charge again.

Interwee: Yes, we are thinking. Let's watch more science fiction movies. What happens in such a situation? So I think. There's one point where we've never made them despair. What were phones like in the past? For example, I remember when we took the back off. I had two or three spare batteries. For example, by not picking up our phone when it was over, they restricted our freedom again. Why can't I remove the battery from the back of my phone, I can't insert a new one. We can think so. When we arrive at any port, a new battery thing happens immediately. New battery arrives. The old one is out there somewhere. So we found the battery. For example, if you remember, there used to be laptops now. You were able to remove the laptop battery, but now it does, of course, with new things. In India, small electric motorcycles are direct, even they have such things. There are places. I also found this fourth one. We were doing something called the landing site suitability algorithm. What we mean by the suitability of the landing site is to be able to land correctly and we can think of the port as the definition of beautiful. Again, this is something done for security reasons. After all, you can land on any terrace. If you don't perceive that landing port correctly, if you just try to land on a situational basis, you can do a backflip and the vehicle may fly. Or you can harm any living creature, as well as the fourth one. It got my attention a lot. Just because it's so fancy. So I think what you're talking about will be like true electric vehicles. But what will your beginning and end be? What matters is real human adaptation. How will people react to these events? What will their attitudes be? In fact, how will they enter our lives? Like how soon they will get in. There are also question marks in my mind.

Interviewer: In other words, after the recent events, after the Russia-Ukraine Events, for example, the European Union was always saying that it was on the side of the

good, but then the events also showed us that it would give up the zero emission issue and manage more coal, and this actually shows us this thing as meeting the energy needs. Events depending on time can actually extend or reduce this sustainability process. You know, this is something that will be determined by time and conditions.

Interwee: In fact, the conditions of the time and political reasons also have a lot of influence. In other words, there is an event in Turkey and in the world. For example, if you are an election element of those ancient political events, war situations, elections, for example, in Turkey right now, you may be more popular. The fact that there is war affects him the most, but there is also a point where the world really goes. So there are things we are sure of, and I see that there are some exceptions. I don't approve of generalizing too much anyway, but one thing you are sure of is that people are really moving away from these fossil fuels. It takes alternative solutions to fossil fuels. And it aims to reproduce them. For example, my friend just mentioned, the tests are five hundred, six hundred and six hundred kilometers. But when we first started, it was a hundred kilometers. Here, too, our current target is eighty kilometers. Then it will be a hundred kilometers. Maybe two hundred. Maybe there will be more. The most important criteria in this, yes, time, condition, political reasons, but technology. Artificial intelligence emerged in the nineteen fifties or something, but why is it happening in 2015? Is the Mahdi coming? What is going on, something is happening all of a sudden, doing so much? With that software technology, that hardware technology is the right metric is real. So I think it shifts the inside to the right. How is it? Hardware technology. It has very good software technology, but it doesn't have the hardware to handle it. I think it is the same with flying vehicles and ground vehicles at the moment. Yes, a very good hardware technology has emerged, but at the moment, I

think the battery technology is still insufficient. Better battery technology is needed. So what happens in a very short time and goes for a very long time. Of course, this didn't exist before. So somehow there was no electricity for him. Think about it, they will charge the battery for hours. You know, three minutes to go when they point the battery. It doesn't make sense. I think technology will increase a little more. Further battery technology will evolve. Hardware technology will evolve. This artificial intelligence is still actually. So we still can't do big transactions on small devices. It's getting minimal, but we can't. Barriers to it will increase. Maybe he could say chip technology. And we will encounter a very interesting world.

The user feedback here is actually this. We can give ourselves test scenarios with the articles made, the studies done, the studies done by the ground companies and the studies done at the university. Unmanned test scenarios. In fact, the purpose of this is to make the system ready for humanity test scenarios. In other words, here is actually a set of rules for the preparation of your own test, which you have created from the feedback you have received from other systems, from 100% feedback. They make inferences according to them and you create new scenarios again.

Interviewer: I'm going to ask from this point of view. Have you ever had a situation like this? This privacy may be relevant. Either we dreamed of such a thing, but if we do it like this, we cannot legally pass it on the market. Or there is such a risk. For example, there was something when there were cars with LPG. There was an event like if LPG exploded. It wasn't actually gas. It was liquid though. You know, there was such an understanding in the nation. Could there be such a thing here as well?

Interwee: The perspective of the industry is very different. Here, I will try to convey it to you right away. The industry is not in trouble right now. It's not about what we should do. We said we should do something or we should do something according to the rules. Everyone's in trouble, let's do something. There are no ready made rules. Rules obey us if we are doing it right. Because that's what I just mentioned. For example, one of you said, you know who we should stay close to, we should stay close to someone. Your procedures are regulations because you have to stay close to them and you have to do something on the one hand, the tests I do, the inferences he makes, the drawings, the software, all you need to play closely with those big brothers, you know, close to the FAA or ESA. They also need to sell the truth they bought from you somehow. So if you're not a flying car manufacturer after all, you're not a regulatory center. When you work together, you work shoulder to shoulder, so one of them is not trying to push someone downwards, while they are both running hand in hand, but in the process, it's like you had to fall asleep, as if you had your own truths or ethical truths, for example, you won't steal. You know, people won't die going from point A to point B. Safely, within the framework of certain ethical truths, you Efe, this is a bit like the troll part of it. The realism of this is that they actually create written documents. Consistent with your feedback. This is how you write. If they don't like it, you talk again. You're always doing something like this, such as correspondence, letter flirting. This is how we did it, this is the proof of it, look, the sources are like this. A little bit then something will happen. It's like lobbying. Sure, sure, sure. So I'm actually trying not to use certain words. Whoever has a stronger lobby, who has a diaspora, for example, will say more or will. Well, they're already doing something like that. Here's the thing with the FAA. It was something that progressed between people, between consultants. That's why he generally recruits

former FAA employees, for example, this Joby, Archer. Good luck with the FAA. They shouldn't say too much about what I do, it's like they shouldn't say this is bad.

Interviewer: How do you see Air Car in the future? Do you think that flying cars will be used frequently in 30 years?

Interwee: This is Turkey. Here, as you know, revolutionary cars are always told like this. There may or may not be something here. The important thing is to run after that job. But I think the reality of flying cars will exist. I think we are approaching that age now, and I think it will start small between the two thousand and twenty-five and two thousand thirties, but at first, we can start in Dubai or something for tourism purposes. It can start as if you know, watching around. Or, as you mentioned, it can be an expensive sector for cargo transportation at first. For example, I say something, I say it will start with cargo, but it can be very expensive for cargo transportation, but it can be a good sector for organ transport, for example, for urgent organ transport. But the simplest, I think, is done as tourism. Because flying over these seas or ponds is also safe. When you fall, you fall into the sea. Think of places like the Bosphorus. There can also be such tourist tours. Exactly, but it also has advantages and disadvantages. Is there too much wind here? et cetera. They can also be resolved. In other words, it was like such a beautiful thing, especially in Istanbul. You know, there are ferry tours, this astro. It could be the type of thing. I don't know, Salt Lake tour can happen or things like the Salda Lake tour.

9. Credits

Arda İçöz conducted Theory, Method,Introduction, Analysis and Conclusion.

Ahmet Melih Gıcır conducted Introduction, Sustainability, User Feedback,Socio Technology Context. Analysis and Conclusion.

Zeynep Selcen Öztunç conducted International Context, Efficiency, and arranged the whole paper.

Erdem Deniz Erdağ conducted Economy, Privacy & Ethics, Safety.

Onur Vural conducted Introduction, Theory, Stakeholders, Analysis and Conclusion.

Noted that all group members involved the interview section. Therefore, all members contributed to this section.