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FROM INTENTION TO ACTION: SMART CITIES AND CITIZEN SCIENCE

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Preface

This bachelor thesis is my final task for completing the pre-master program "Environment and Society". Passing through this program was an important experience for me since it filled the gap between my bachelor and master degree. Skiping from Biomanagement and Sustainable Development (Bachelor's Degree) to Environment and Society (Master's degree) could not have been achieved without the knowledge of the pre-master program received. My desire to move from a more scientific direction to a political and economic one is about to take place by passing this thesis and enrolling in a master's program.

Before all, I would like to express my sincere thanks to certain people without whom writing the thesis would be impossible. First, I want to thank to my supervivior, namely prof. Huib Ernste, for his efforts to explain me how to apply the theory correctly and how to analyze my data. Then I would like to thank to Stefan Dimitrov, as well as all AirBG volunteers, for filling and distributing my survey. Last but not least, I would like to thank to Tsvetelina Popova and Green Sofia for providing me with information that is not available anywhere else, sparing enough time to me for finding out many interesting things that are relevant to my research.

Plamena Terziradeva, June 14 2018

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1. Background of the study
1.1 Effects of the air pollution

Air pollution is a significant risk factor for health in Europe and the whole world. A recent study of the global disease problem has shown that it is among the top 10 health risk factors in the world scale (The Lancet, 2017). It is estimated that 7 million people in the world died prematurely due to pollution; in European Union victims of premature death have become 400 000 people (EU Commission, 2013). Organization for Economic Affairs cooperation and development predicts that atmospheric pollution in 2050 will become the fundamental cause of global environmental deaths (OECD, 2012). Besides, air pollution is also classified as the major environmental causative agent of cancer (WHO, 2013).

Exposure to atmospheric air pollution is related to a wide range of acute and chronic healthcare effects ranging from irritant effects to death (Health effects of outdoor air pollution, 1996). Although the consequences of respiratory and cardiovascular diseases are good documented, new research shows air pollution as an emerging risk for children's health and even diabetes (WHO, 2013a). Especially sensitive and vulnerable are affected groups such as pregnant women, children, adults and people who are already suffering from respiratory and other serious illnesses as well as low-income groups.

Powder particles (aerosols) are the main and most massive atmospheric pollutant, a major component in the formation of "fogginess" and / or smog (Влъкненски, Стойчев § Чутуркова, 2013). The name itself suggests that the powder aerosols are composed of solid particles, small water droplets and further adsorbed on their surface other chemical substances (organic compounds, metals, allergens in the form of pollen fragments, molds and / or spores) (Влъкненски et. al, 2013). The health effects provoked by dust, depend on the size of the chemical composition of the solids, depend on the other compounds adsorbed on their surface and on the area of the respiratory system in which they are deposited, as well (Влъкненски et. al, 2013). These fine particulate matters, that are considered as the most massive air pollutant will be used with the abbreviation PMF in this research.

1.2 Air pollution in Bulgaria

In recent years, data on fine particulate (PM10) levels in ambient air, registered by the National Environmental Monitoring System (NSEM), shows periodic exceeding of the norms for many areas in Bulgaria, both in industrial zones, the so-called "hot spots", and in urban areas as well (НИС, 2011; НИС, 2015). The air in Bulgaria is among the most polluted in Europe. Each year Bulgarian cities rank among the leading places in the most polluted air in Europe (Greenpeace, 2016). Although air quality has improved over the last decades, it is still deteriorating compared to European and world standards. Among the main air pollutants in Bulgaria are coal-fired power plants for electricity and heat generation, domestic solid fuel combustion, transport and other industrial processes (Greenpeace, 2016). Every winter, we are witnesses of a thin gray diaper that covers the settlements in the country. Chimneys that smoke in every shade of gray and black are a common picture. Still a large part of the country's population is heated by burning solid fuel (mostly low-quality coal). The stoves used are inefficient and the combustion of solid fuels is accompanied by the release of harmful elements.

1.3 Government measures

The air quality in Bulgaria is assessed according to the requirements of Environmental Protection Act (ЗАКОН, 2015), and the Law for the purity of the ambient air (ЗАКОН, 2016), regulated by norms for the main pollutants in the atmospheric air. The National Environmental Monitoring System performs an assessment of the quality of the atmospheric air over the territory of the country divided into 6 Areas for Assessment and Management of Ambient Air Quality approved by Order of the Minister of the Environment and Water. In 2016 the National System for Air Quality Control consists of the following points: 34 fixed automatic measuring stations (AIS); 4 AIS for air quality monitoring in forest ecosystems (Rozhen, Yundola, Vitinya and Staro Oryahovo); 5 Differential Optical Absorption Spectroscopies located in the cities of Svishtov, Nikopol, Silistra, Bourgas and Ruzena; as well as 9 points with manual sampling and subsequent laboratory analysis (EAOC, 2016). In the National Monitoring System of atmospheric air, the concentrations of the basic parameters according to the Clean Air Act are controlled daily: the concentrations of fine particulate matters (PM10, PM2.5), sulfur dioxide, nitrogen dioxide / nitrogen oxides, carbon monoxide, ozone, benzene, lead, cadmium, nickel, arsenic, polycyclic aromatic hydrocarbons (EAOC, 2016). All automatic stations operate in a continuous mode of operation (24 hours) and the data for the air quality from them is sent in real time to the relevant Regional Environmental Inspectorate, and then transferred to the Central Dispatching Center in the Executive Environment Agency in the National Air Quality Control Database (EAOC, 2017). Manual air monitoring stations work only in the daylight (4 sampling per days, 5 days per week) (EAOC, 2017).

The air quality system also has 6 mobile automatic stations (MAS) included in the regional laboratories in Sofia, Plovdiv, Pleven, Stara Zagora, Varna and Rousse (EAOC, 2017). The stations are distributed proportionally on the whole country, enabling them to serve on the territory of the whole country. MAS are used to perform additional measurements in areas where there are no or limited number of stationary stations, as well as in emergency situations, orders from state and municipal organizations to track the effect of the implementation of municipal programs to reduce the level of atmospheric pollutants. The activity of MAS is annually regulated by schedules approved by the Minister of Environment and Water (EAOC, 2017). So far, the stations are well organized and well positioned to serve as a source of up-to-date air quality information for the municipalities, by showing the concentration levels on screens situated within the cities. These displays show in one section the permissible values for the respective pollutant and in another section the current quantity. Although the municipality has the intention to build a network of these stations in order to manage better the air quality, Bulgarians resent that despite the high values, no measures are taken by the municipality/government to improve the air conditions.

1.4 Citizen measures

Hardly ever before citizens of Sofia, Bulgaria were so sensitive about the air pollution in the capital as at the beginning of 2018. The tension that has arisen and the expectations for immediate actions have made the issue more political, and the attempts of various experts to speak objectively about the problem sank into the general sea of dissatisfaction. In Sofia, the topic of air pollution is becoming increasingly more important, and the ecological application of Kuznets curve probably can explain the increased attention on the topic. The economic upturn, almost the zero unemployment in the capital

and the emerging sustainable urban middle class, is already looking for solutions to problems that are beyond purely economic. Probably these are the reasons of the increased attention to the environmental issues in the country this year. However, according to the citizens of Sofia, the municipality does not take any actions or adequate measures to deal with the dirty air. Thus, the population decided to take the matters into their own hands. In 2017, several non-governmental organizations and lawyers have filed a lawsuit against Sofia Municipality's inaction regarding the high levels of air pollution in Sofia. In a letter to the media they reported that they are suing the municipality "on behalf of all living, working and studying people in the capital" (Дневник, 2017). That is how it all started. At the end of 2017, the first outcries against the dirty air in some of the outlying metropolitan neighborhoods began. They were subsequently followed by the inner quarters of the city, and finally there were demonstrations in almost all, bigger Bulgarian cities (Mediapool, 2017; Дарик, 2018).

1.5 AirBG – citizen science

The realisation of an independent civil project has sensibilised the Bulgarian society to the problem of the air pollution. The name of the foundation that is working on the project is Code Bulgaria, the project itself is named AirBG (the abbreviation is the official name). According to the formal website of AirBG the project has started officially on 5th of April 2017. It is an independent citizen initiative that aims at bringing more knowledge about the gasification of cities, excessive pollution with PM, detection of sources of pollution, investigation and publicity of causes of pollution, and measures for improving air quality by the legislative, municipal and executive power or the lack of such measures (AirBG, n.d.). The project is taken as an idea from Stuttgart, Germany (AirBG, n.d.), where Code for Germany program of the Open Knowledge Foundation Germany promotes transparency, open data and citizen science (Lufdaten, n.d.). OK Lab Stuttgart works for the Luftdaten.info / AirBG.info projects to measure fine particulate matter (PMF) in the surrounding environment (AirBG, n.d.). Every citizen can become one of the many adopters of measuring stations by installing a station at home, in the office, at the villa, with relatives and friends. Luftdaten.info / AirBG.info generate a continually updated map with the PMF data for every city in Bulgaria, Europe and the whole world, where sensors are installed (AirBG, n.d.). Through WI-FI the data is sent to an online platform which shows with colours the air quality in different areas for the specific city (see: Picture 1).
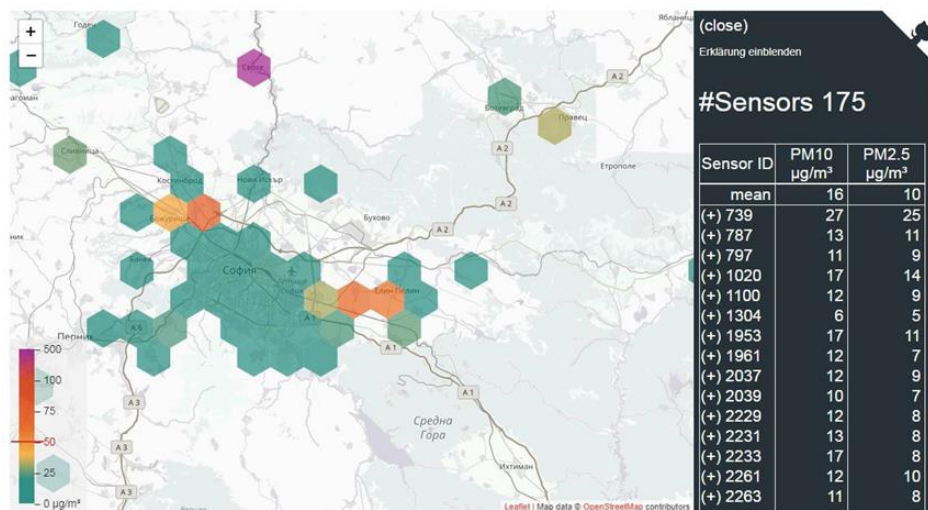
Picture 1: The levels of PMs in Sofia measured by #Sensors 175

Nearly two years ago, citizens of Stuttgart, Germany, launched the Luftdaten.info project to draw everyone's attention to the chronic air pollution problems in their city and the chronic reluctance of authorities to take resolute measures to solve the problem (AirBG, n.d.). Today the project works in more than 26 countries around the world and one of them is Bulgaria (AirBG, n.d.). Local groups, consisting of designers, developers, journalists and others, meet regularly in the laboratories of Luftdaten.info and their representatives around the world (AirBG, n.d.). They develop applications that inform, positively influence and support the public, and make the work of the state and municipal agencies more transparent.

In order to get a better understanding of the project`s entity, the following details will be clarified, according to AirBG:

How the project is funded?

The project is funded only by donations, work by volunteers, and donations from the citizens as it follows: (1) the equipment (controllers, sensors, materials) is purchased by the Luftdaten.info headquarters team, which allows the items to be imported in Bulgaria without undesirable complicated procedures, and gives more negotiation power to the volunteers in Bulgaria as well; (2) a logistics Bulgarian company accomplishes the transportation quickly and for free; (3) the installation of the stations is done by people, which are called Apostles; (4) the assemblage of the sensors is again conducted by the Apostles as a voluntary work or by the adopters of the same sensors; (5) the donations that are given by the people bought a sensor are used for the maintenance of the same, and (5) a courier company performs the transportation of the assembled sensors again as a voluntary work.

What are these sensors?

The sensors consist of several parts, namely: controller, and sensors for PM, atmospheric pressure, temperature and humidity. All these parts are assembled together and connected in a sewer pipe, measuring the average level of PM2.5, PM10, temperature, humidity and atmospheric pressure.

How these sensors work?

For proper work, the stations need electricity and Wi-Fi through which the controller sends text data to the online platform.

1.6 Interview with Tzvetelina Popova – Popova, T. (2018, May 21). Personal interview.

Tzvetelina Popova is familiar with various programs and strategies that are being worked on for dealing with the problem of polluted air in Bulgaria. She has previously been secretary of the Sustainable Energy Development Action Plan Management Committee and is aware of the existing problems in Bulgaria that contribute to air pollution as well as the mismanagement of people working at the different administrative levels of the state. In this sub-chapter I will explain our brief but very interesting conversation.

The Action Plan for Sustainable Energy Development of Sofia Municipality (Sustainable Energy Development Action Plan) is elaborated in connection with the accession of Sofia to the Covenant of

Mayors (ПДУЕР, 2012). The baseline for the plan is the existing strategic, program documents and plans development of Sofia Municipality, as well as the inventory of "Denkstatt Bulgaria" Ltd CO2 emissions emitted to the atmosphere as a result of energy consumption in the Sofia Municipality for 2007 and 2011 years (ПДУЕР, 2012). A number of studies and reports have been used in connection with the use of energy in Sofia, the use of renewable energy sources, waste, transport, mobility, and others.

During her work on the plan, as well as during the other years of experience in the administration, Ms. Popova has seen the shortcomings of the management and planning in the country. The main topics we discussed during our conversation were: (a) existing problems in administration and the overall governance, (b) major air pollutants, and (c) the main effect of the Code Bulgaria`s initiative and AirBG project on society`s way of thinking.

1.6.1 Problems in the administration

As one of the most important problems in the administration in Bulgaria that Ms. Popova has noted is the lack of preventive measures taken by the government and/or municipalities. Risk management requires the availability of necessary conditions in the system of one institution, which are expressed in: Strategic Development Plan and Annual Operational Plans; resource assurance of objectives and measures in the long run - human resources, material assets, financial resources, sufficient and accessible information (Дичев, 2009). Although in theory this is clear and what is needed to be done as well, preventative measures in the administration are not well developed, mainly because of the lack of coordination between different institutions. The second problem noticed by Ms. Popova. The central aspect of the development of this coordination is the coordinated activities as concrete process of interaction of actors, including actors at all levels. It is crucial for the municipality to work and coordinate with different Non-governmental organizations, and with the business. In that way, the solutions for different problems will be taken easier, the administration will exactly know what the business needs, and also, all the solutions will be more practical oriented – this is important, because Ms. Popova pointed out that most of the people who are working in the administration do not know what is really necessary for the business in practice, and work only in theory. Next to the coordination, the communication comes, or the lack of it. When there is no coordination between the activities of the public institutions and the private ones, and the public institutions themselves, there is also no enough communication with the society. Every day, legislative, executive and judiciary institutions make decisions that can make it easier, but also endanger the business of any company. Very often the activity of some branches and of the whole economy can be strongly influenced by the decisions and policies of the parliament, the institutions of the executive and local authorities and even the judiciary. They can both help the business and heavily harm it. That is why successful communication with institutions is vital for the companies. As fourth disadvantage it was mentioned the experience of the employees at the different levels of the administration. The lack of young people is a prerequisite for working on a stereotype without the availability of new ideas, as well as for insufficiently qualified staff. Moreover, the fact that there is no room for development for young people repels them.

The last detriment for efficient work on behalf of the Sofia municipality specifically, which we discussed is related to the overlook of urban planner`s opinion, which results in poor planning or the overall lack of such. The great potential for development of Sofia with the onset of democratic changes was not realized and, unfortunately, in many ways was irretrievably lost. The structure of the city, which has existed since Roman times, was gradually neglected, while Sofia's greatest treasures - the green spaces and the

connection with Vitosha mountain - were neglected at the expense of chaotic construction and overbuilding. According to Ms. Popova urban planning is one of the most essential functions of management related to each process in the society, but in Bulgaria it is associated with the communism period which leads to insufficient efforts directed in this direction.

1.6.2 Main air pollutants

Further to the previous paragraph and the problem with the urban planning in Sofia, one of the main air pollutants could be notified to be the over- and random construction of residential buildings. One phenomenon could be observed in the city – buildings next to each other, without any kind of order or infrastructure around them. As two of the biggest mistakes of urban planning, Ms. Popova`s opinion is that they are: (a) the main boulevard, called Tzarigradsko Shose, which runs through the entire center from the one end of the city to the other, and the traffic thus pollutes the whole area, and (b) the fact that Sofia is surrounded by Vitosha Mountain and the excessive construction of buildings totally stops the airflow which in turn does not allow air purification.

Among the main air pollutants in Bulgaria, according to Ms. Popova, is also the energy production: coal-fired power plants, which are electricity and heat generations, and domestic solid fuel combustion. Energy production is the industry contributing the most to air pollution in the country. It includes two main productions: coal mining and power generation that pollute. Most of the coal is of high ash content and low calorific value, and the conditions are not conducive to the development of high-efficiency coal mining. On the other hand, especially during the winter, the domestic heating systems with solid fuel combustion in a lot of the neighbourhoods of Sofia, and most of the small cities in the country, contribute to the air pollution. Major pollutants such as sulfur dioxide, nitrogen dioxide, ozone, carbon monoxide and fine particulate matter (PM) are found in the air, which are the main problem in the country.

Last but not least, the transport is deemed as very important air pollutant. The road transport is so harmful for the environment in Bulgaria because of the outdated car parks and the technical failures of the cars driven in the country. Also, diesel engines contribute to a significant part of air pollution.

Apart from the main air pollutants, in Sofia there are historical, socio-economic and geographic circumstances / features / obstacles to be highlighted in relation to air quality pollution. Firstly, geographically, Sofia is located in a valley. This favors the containment and accumulation of atmospheric pollutants in adverse weather conditions, such as fog, temperature inversion, windlessness. Secondly, due to socio-economic reasons, many households cannot switch to environmentally friendly heating.

1.6.3 Society`s way of thinking after the project AirBG

Citizen science turns out to be a brilliant way for us, as inhabitants of the world, to observe the environment, our health and our lives to make the necessary discoveries and technologies so that we live better, healthier and happier. This type of initiatives, especially in countries such as Bulgaria, where citizens have not so far been used to speak out their claims towards state institutions, is an excellent way to change people's mentality, behavior and points of view at various issues, including not only ecological. One of the main effects on society as a result of the AirBG project, according to Ms. Popova, is the awareness of the population, influencing by <u>informing people</u> for different environmental problems, in this case – for issues related to the air pollution. Because of such civil initiatives, every citizen has at least minimal scientific literacy or, more precisely, knowledge of how they themselves affect the environment and ways to reduce their harm, awareness, commitment and responsibility for scientific excellence, terms,

problems of the world in which he/she lives. These problems are undoubtedly related to ecology, which implies knowledge of nature protection, higher general culture and education. AirBG allows to the society to have preliminary information about environmental issues that exist in the country, and having this knowledge, young people are becoming increasingly more interested in the problems and probable solutions to these problems. They are becoming more active in the process of decision making, and towards the institution, having different wishes and needs. This does not allow to the state to manipulate and deceive the society since it is more familiar with different scientific facts and is able to express an ably opinion on a given issue.

As it was mentioned above in this study, that the application of the environmental Kuznets curve can be observed in Bulgaria, Ms. Popova also agree with this statement. Notwithstanding, she believes that this phenomenon can be observed mostly in Sofia, less often in some other bigger cities in the country like Plovdiv, Varna, Bourgas, but it does not exist to such extent in the small populated areas. This is understandable because still smaller cities cannot reach the standard that exists in the capital and there all is about survival and nutrition, not looking for a good quality of life. In spite of the existing economic inequalities and the low standard of living observed in the smaller towns in the country, even there, sometimes there are protests and a loud statement of the citizens' opinion. A good example of this is the referendum held in Tran 2017 in connection with gold mining. The citizens actively voted, and the golden opponents held a crushing victory. Obviously, regardless of all of the listed problems and our population`s psychology (that we have never been so active so far for public issues), when people see that the situation really goes wrong, they are demonstrating their point of view loudly, uniting the whole population.

In conclusion, it could be said that Ms. Popova is quite optimistic about the situation in Bulgaria. She certainly thinks that the change due to globalization and the information flow in the younger generation could bring about something better, a more active society, knowing increasingly more about different problems. However, in addition to the rising economic level, she thinks that the most important things for the self-development of the Bulgarian society is the sense of responsibility to future generations, and to our planet. The things our population have to take root in their mentality are: (a) self-consciousness that we are citizens of the world and everything we do leaves a lasting trace to the next generation; (b) self-education, so that we can control and separate ourselves from the wrong behavior; (c) the understanding that the role model we are to our children is of utmost importance, since they are like a sponge, remembering everything we do and say, and (d) our commitment to the society must increase, being more cohesive to each other, so to be able to achieve higher goals together.

1.7 Transport network in Sofia

In this chapter, some numbers will be presented derived from a report by Green Sofia, which makes Sofia-Bristol comparison in relation to Sofia`s application for Green Capital of Europe. The report was drafted in 2017 in order to get an idea of the differences between a city that is applying and a city that has already won the title of Green Capital of Europe. According to it, an important feature of Sofia's traffic today is the extremely high level of motorization. The data shows that in 2011 it was 656 vehicles / 1000 citizens. This is substantially higher than many European cities. Analyzes show that more economically developed cities have motorcycle levels below 450 vehicles per 1000 citizens, showing the tendency that the higher the annual GDP per inhabitant is, the less the car ownership per 1000 citizens is.

Public transport

Main feature of the urban transport on the territory of the Sofia city is the high share of vehicles. According to the information from 2014, the relative share of the passengers transported by type of transport is as follows: 40.77% buses, 32.19% metro, 19.50% tram and 7.54% trolley buses. Given this data it can be concluded that in Sofia nearly 60% of the serving public transport is zero-emission. Since 2014, the Sofia Metro area has been expanded, passengers are increasing and, in the meantime, the bus fleet is being renewed, and today around 40% of all buses are low-emission.

This means that if Sofia municipality maintains and develops the metro, tramway network and invests long-termly in electric buses, the city has the opportunity to set a 100% zero-emission urban transport target in the next decade.

Bicycle transport

The main reference document in this section is the Plan for Development of Bicycle Transport on the territory of Sofia Municipality 2012-2017. The vision it proposes is to turn Sofia into a "bicycle city" where people of all ages can move safely, quickly and comfortably by bicycle. The objective of the plan is to increase the share of bicycle trips from 1% to 3% of the total number of trips with different vehicles on the territory of Sofia Municipality.

According to a survey distributed among the residents of Sofia, it becomes clear that:

Bicycles are owned approximately by 18% of the city's population.

- 24% use the bicycle only to work / school
- 25% of people use the bicycle only for recreation, of which:
- 18.5% for a city walk
- 3% solely for sport
- 3.5% only for tourism

Share of the population living within 300 meters to frequent urban transport line	Sofia`s route network has a sufficient density and corresponds to the developed European cities close by territory and population.	
Breakdown of all trips under 5 km., according to the way of travel	Car	30.5% (2009) This is a doubling for the past 10 years.
	Public transport	49% (2009) For comparison, in 2000, it has been 65%
	Bicycle	<1% (2016)
	Walking	11.1% (2009)
	Others	3.9% (2009) train, service transport
Share of buses running in the city that are low emission (at least Euro V)	41%	

Table 1: Summary of the transport network in Sofia city

The tools for management of the transport infrastructure from an administrative point of view are: The decisions of Sofia Municipal Council, the programs and strategies for development and the orders of the Mayor of Sofia Municipality.

In a technological aspect, up to now, 195 traffic lights have been connected to the Traffic Control Center, out of a total of 350 traffic light crossings. By the end of 2017, the number of them will reach 200, and this will include the city center, the main entry-exit transport arteries and key junctions such as Sofia Airport, Central Railway Station and others.

A system for prioritization of urban transport (including buses, trolleybuses and trams) has been introduced. At that time, the system was implemented at 30 intersections. The remaining 170 numbers will be added to the project, following the preparation of projects on the operation of the traffic lights and the reprogramming of the system. The prioritization of urban transport is done by extending the green signal in the direction of the vehicle movement, by prioritizing the routes and timing of the particular line. The traffic management system receives location data by means of a GPS signal emitted by a device in the vehicle, the system analyzes the signal and understands whether it is delayed and, if necessary, prolongs the duration of the green signal according to predefined parameters.

Sofia Metropolitan Transport, with the support of the Sofia Municipality, undertakes a series of tests of electric motors. Through these test trials in 2017, over 40 000 km were passed with residents and over 2 tons of harmful emissions were saved preserving the quality and comfort of travel; as well as reducing the travel cost.

Over the last ten years, the growth of the population and the number of private cars has increased considerably, which has led to serious challenges faced by Sofia Municipality on a daily basis, due to heavy traffic and congestion. In view of the existing challenges, one of the main tasks Sofia Municipality has set is to improve the conditions for strategic and spatial planning of urban mobility by developing a long-term Sustainable Urban Mobility Plan. The implementation of the specific measures envisaged in such a document will ensure the development of an adequate transport system tailored to the needs and problems of the modern urban environment and guaranteeing successful and sustainable transport development for the benefit of the citizens and the society, continuity in the urban development policy, urban conditions, traffic safety, the use of alternative ways of transport, improving urban logistics, implementation of modern ICT technologies.

As part of the overall strategy of Sofia Municipality for the development of urban transport with the financial support of the Operational Program "Regional Development" 2007-2013, the project "Integrated metropolitan public transport" was implemented. The purchased trolley buses are 50 and are owned by the Czech company Skoda Electric. They are equipped with air conditioning, low floor and tiltable when the trolley stops at the stop. Light and sound signaling on the first door makes it easier for people with reduced vision to get in touch. Trolleybuses have asynchronous motors, with electric energy recuperation. They have modern control systems, which leads to electricity savings of about 15%. The modernization of the tram line includes the track on Bulgaria Blvd. from Vitosha Blvd. to Borovo neighborhood which has a length of 3,7 km. An important part of the project is the installation of 1020 modern electronic information boards. They are designed to display real time passenger information on arriving at a stop on a relevant route from the metropolitan public transport network. Tracks show vehicle type, line number, end stop, time of arrival and current time. They also have a voice announcement module to help people with vision problems. Electronic information boards are a modern solution of the RTPI (Real Time Passenger

Information) Passenger Information System. The project also implements an intelligent information system covering 20 of the busiest crossroads in Sofia. Along with its construction, a component for delivery and installation of on-board equipment for 750 public transport vehicles is also implemented. Through an intelligent traffic management system, public transport vehicles will improve their mobility and their planned timetable without accumulating delays.

From the realisation of the project, the following parameters are expected to be improved: (1) to increase the interest of Sofia citizens towards urban transport through improved access; (2) to improve the movement of the population, including workers and the general public, giving priority to environmentally friendly urban transport; (3) to reduce congestion and increase the capacity and speed of urban transport, and (4) to improve the environment by reducing emissions, developing clean urban transport and reorienting from the use of buses to trams. Reduced emissions - they account for 3.2% of the total project benefits.

2. Statement of the problem
2.1 Environmental Awareness

The concept of environmental awareness consists of two basic steps: 1) to understand the threats and the options that are available and (2) to adjust your values, attitude and preferences towards achieving goals (Takala, 1991). On the other hand, the concept of human activities includes the decisions that the society or the community take, and the following actions that has an objective of preserving a particular aspect of the environment (Takala, 1991). According to the experiment conducted by Takala (1991), it can be noticed that people are more willing to undertake actions and make decisions that do not restrict their freedom, like to accept alterations in the public transport or lead-free petrol policies, whereas they tend to reject proposals like limitation of the cars.

Environmental issues are one of the most significant problems of the day. It is becoming increasingly aware that they are inextricably linked to economic and social challenges and have common roots. For the first time this idea has been expressed clearly in the report of the Club of Rome "Limits to Growth" (1972) where it is formulated the thesis that the expansive technological development leads on one side to dangerously depleting natural resources and a threat to the future existence, and on the other, to increased social and economic inequalities. Inarguably, environmental problems are an integral part of today's valid mental constants and world-wide models.

In fact, over the past decades, a global transformation has been taking place the development of human civilization. It is related to the establishment of a new model, defined as sustainable and balanced development. The aim is to change population`s attitude, it's actions, and to create a society which synergize with the environment in which it lives (Димов § Мантарова, n.d.). Therefore, sustainable development has two main objectives: a) to achieve economic development, ensuring an increasing standard of living, and (b) to preserve natural wealth, by improving the quality of the environment (Димов § Мантарова, n.d.). Practically this can be accomplished through forming and bringing into operation of a new value system, of new models of thinking and behavior of society and man toward nature.

All aforementioned processes are part of the environmental consciousness development that has at least two interrelated components: ecological attitude and environmental behavior. Ecological attitude is not

limited to meaningful attitude to natural resources but it is multifaceted and includes at least three components: (a) respect to nature; (b) rethinking attitudes towards other people, including the significant issue of tolerance and cultural diversity, and (c) self-esteem, aimed at a new quality of life, called by some modern researchers "flourishing" (Николова, 2014).

According to Takala (1991), there is another framework which can contribute to the participation of the psychological knowledge in the natural science that says that there are three dimensions that play essential role in the humans' differentiation, namely: a) cultural and social structural fundamental elements that shape people`s choices and general behaviour; (b) the actions and decisions taken at different levels with the aim to manage the interaction, like values and public perception; and (c) the interactions between the environment and human being, which include primarily the use of natural resources and the consequences of this use.

In terms of the synergism between the environment and the population there are few factors that can lead to the reconciliation between the environmental and economic development, and reaching the so-called Kuznets curve, namely: more open political system, resilience income for environmental quality, increasing environmental education level and consequently the environmental awareness, and alterations in the processes of consumption and production (Selden & Song, 1994). The environmental Kuznets curve supposes inversely proportional relationship between the environmental degradation and the income per capita (Stern, 2004). The economic growth of low level of development and income countries, is always related to the use of natural resources sector as mining, agriculture etc. All these activities lead to further depletion of natural resources and environmental pollution. However, due to economy`s structural and technological resources change, the spread of environmentally friendly technologies, the entry into the post-industrial stage of the priorities, the development of information technologies and services, the impact on the environment is reduced. This contributes to improving the well-being of people as a whole and the development of its requirements for better environmental quality. According to Özokcu & Özdemir (2017), environmental problems which are a consequence of economic development could be avoided if the environmental Kuznets`s curve is valid, no matter whether a developed or underdeveloped economy is discussed.

From what has been said so far, it is obvious that in Bulgaria there is a change for the whole population, which is becoming increasingly more concerned about the environmental conditions and its health. This can be seen in the already mentioned protests, but mostly because of the Code Bulgaria initiative distribution. Moreover, Bulgaria now is in its post-industrial period, and after the accession in the European Union and the adoption of new legislations (Mazur, Phutkaradze & Phutkaradze, 2015), it could be said that in the country there is a tendency of an increasing economic development for the last few years (БАН, 2016). Nevertheless, the European Commission has shown facts related to the air pollution in Bulgaria, and what are the roots of the problem. According to the EU Commission (2017), the measurements show that Bulgarian citizens within the whole country breathes air that is considered as harmful to the health, which has significant economic consequences for labor productivity and the healthcare system. Although the concentrations of PM2.5 and PM10 are generally decreasing over the years, they remain much higher than the border values set by the EU and the World Health Organization to protect the health of the mankind. Bulgaria has the highest concentrations of PM2.5 in the urban environment among all 28 EU countries, as well as the highest concentrations of PM10. This makes it the EU country with the highest share of external costs of air pollution that leads to loss of over 2 million working days and over 11,000 cases of premature death annually. In general, the Bulgarian legal order establishes a clear system for access to justice on environmental issues. However, unstable policies and lack of trust in basic public institutions, such as the judiciary, constitute significant obstacles economic and

environmental development. Corruption remains a serious problem and the response of the national authorities to this problem continues to be hampered by weak and fragmented institutions. Bulgaria is lagging behind with the implementation of the INSPIRE Directive, which would provide a favorable framework for active dissemination of the environmental information to the public.

Considering all these facts about the country as well as the theoretical information related to the ecological consciousness of the people, it can be concluded that the Bulgarians have decided to take matters in their own hands and show that they are aware of the consequences of the dirty air and that they want actions taken on behalf of the government. Approach as the citizen science one combines ecological research with environmental attitude (Dickinson et al., 2012) and has significant effects on the society. In this research, mainly the environmental awareness of people who have built their own air quality station from AirBG for air quality measurements will be discussed. In particular, their environmental behavior in connection with the transport mode choice from home to work / university / school.

2.2 Citizen science

In recent years, projects where groups of nonprofessional researchers are involved in research tasks coordinated by scientists have gained popularity (Добрева § Иванова, 2014); such types of initiatives are called civil science, and they do not refer to the investigative science only, but to the meaning of science as a body of accumulated knowledge, referring to the nonlinear process of making science (Dickinson & Bonney, 2012). Citizen science reveals a distinction between the form of science nowadays and the historical one, namely because of the fact that the science today is accessible to everyone, it is not a privileged for few anymore (Silvertown, 2009). About the dissemination of this kind of initiatives undoubtedly new information technologies help because they allow groups of people to communicate quickly, easily and effectively in context-specific environments. There are three ways by which the general public can participate in scientific researches identified: a) by contribution with data, (b) by collaboration in terms of data collection, dissemination of findings or analyzing data, and (c) by co-creation of the project in terms of an active participation of the public involved during most of the steps of the scientific process (Bonney et al., 2009; Tweddle, Robinson, Roy & Pocock, 2012). In all these situations, the projects are created by scientists but the general public has more or less active role in the realisation of the project and its distribution or commercialisation. Inarguably, according to the description of the AirBG project, the general public take an active part in this project. Citizens gather resources, work voluntarily, draw conclusions for the effectiveness of the stations, translate results into actions, discuss results and ask new questions, and much more activities. In other words, they spend their personal time available with the aim to increase the environmental awareness and to require some actions by the municipalities and the government related to the air pollution. All these steps are considered as part of the co-creation of one project between scientists and citizens (Bonney et al., 2009; Cooper, Dickinson, Phillips & Bonney, 2007). Such projects can be considered as one of the modern methods of involving more people in scientific related projects and are a possible way to extend the knowledge and skills of participants in such initiatives. This kind of knowledge in turn can contributes to the development of more responsible society because people are able to understand key scientific concepts and to realise what the consequences of our actions could be. At the annual meeting of the Ecological Society of America held in Milwaukee, Wisconsin in 2008, it has been understood why citizen science has such a significant role on socio-psychological level, namely because: a) it is an available tool for information dissemination about projects, and gathering of information as well; (b) it is an alternative way for the scientists to use free source of skills, computation power, labour and finances, and (c) it allows to the research funders to impose upon

grant holders to undertake project-related science outreach as a form of a public accountability (Dickinson et al., 2012; Silvertown, 2009).

The concept of citizen science is fundamental for the project of Code Bulgaria and it will be used as a theoretical background for this research as well. Inarguably, the human interaction in ecosystem processes is a reason of the accelerated loss of ecosystems functions and attributes, but on the other hand, human capacity of change implementation is able to address different environmental problems in the urban areas (Cooper, Dickinson, Phillips & Bonney, 2007) and not only. By this concept, general citizens can become "citizen scientists" by using their free time to engage in a scientific process (Dickinson, Bonney & Fitzpatrick, 2015). This is what can be observed through the project AirBG. In fact, the terms "civil science" and "civilian scientist" have been used since the 1960s years of the 20th century, but formally entered the Oxford Dictionary in June 2014 (OED, 2014). Civil science is defined as "scientific work done by members of the general public, often in co-operation with, or under the leadership of professional scientists or/and scientific institutions", and a civilian scholar is defined as a" member of the community, an amateur in the field, who is engaged in scientific work, often in collaborating with or under the guidance of professional scientists and scientific institutions" (Добрева § Иванова, 2014). The biggest benefit for both parties in this process is that on one hand, citizens are motivated to contribute to a scientific achievement or a solution that preserves nature; on the other hand, the benefit to the scientist is that the citizens allow him/her to gather information that cannot be gathered otherwise due to the lack of time and resources (Tulloch, Possingham, Joseph, Szabo & Marti, 2013). In our case, the benefits are mainly for the citizens, but not only for those who work for the project. They are helping in the development of an ecological awareness of Bulgarians, which in turn leads to changes in the behavior of the population and influence on the policy or/and measures taken by the government. In that sense, it could be mentioned that citizen science leads to a high engagement of the public scientific activities, however, the process of conducting science is not always realised (Bonney et al., 2009). Moreover, these kind of projects can contribute to the development of science-related skills, and more responsible behaviour. Mueller & Tippins (2011), defines the community that works on citizen science as "minilaboratory for democratic participation", and to be honest, I think that this could be the best definition. It is supposed to be democratic because as it was said above, the trust to the European agencies by the population in Europe turns out to be quite low (Dickinson & Bonney, 2012). Through a survey of Eurobarometer (2016), it is concluded that only 31 percent of the European population consider the national governments as trustworthy, for the national parliaments this number is similar, namely 32 percent, and for the political parties, it is extremely low – only 16 percent. Having these numbers in mind, citizen science could be developed as one of the most powerful tools for tackling environmental issues by building scientific knowledge, informing policy shaping, and inspiring public actions (Chess & Purcell, 1999; Dickinson et al.,2012; Dietz & Stern, 2008; McKinley et al., 2017; Predmore, Stern, Mortimer & Seesholtz, 2011; Rowe & Frewer, 2005).

For citizen science as a theory and the projects for which it can be used, there is sufficient information. Still, however, it remains incomplete what the motives of the public involved in civil science-based projects are. The literature reveals two main classifications used for describing the motivation for environmental volunteering. The first one is related to intrinsic and extrinsic motivations: Finkelstein (2009) identifies motivations that are extrinsic as for example job pursuing-oriented goals; the intrinsic motives are described as an inherent desire for something interesting and satisfying. Katz (1960) has developed the second classification, and Clary and Snyder (1999) has established functional approach to describe the reasons of the continuing volunteering. This classification consists of six categories: a) understanding - an opportunity for new knowledge gathering; (b) values - an opportunity to be involved into somebody`s life/interests; (c) social - an opportunity to meet new people; (d) enhancement - an opportunity for a

further self-development; (e) career - an opportunity for experience gaining; (f) protective - an opportunity to address personal problem. Wright et al. (2015) has modified the categorization of Clary and Snyder by presenting it in the following way: a) recreation-based motivation – the desire for the citizens to be among the nature; (b) personal values; (c) personal growth; (d) social interactions and (e) project organization.

All of these classifications show the main reasons why people would be willing to devote their personal time to contribute to an ecological project. However, they pertain for the society itself. It is believed that one of the main reasons that encourages the scientists to adopt a citizen science approach is to raise awareness and engage people (Bird et al. 2014; Kampen et al. 2015; Wright et al. 2015; Geoghegan, 2016). In the case of the AirBG project, it is supposed that the pattern that makes people engaged in an activity exist, but not only because of their interest in science or other similar motive, but because they realize that they have to make a clear and vociferous statement to the government by showing responsibility to protect the environment, but above all their health. In the chapter where the results of this research are discussed, the motives for adopting an AirBG station of the citizens will be presented.

2.3 Knowledge gap

As a result of the literature that has been reviewed, the motives that would lead to voluntary participation of the public in environmental projects, as well as the development of environmental awareness and behavior have been presented. However, this study focuses on a specific case in a country that has so far not seen similar phenomena where citizens are clearly expressing their stance on environmental issues, and more specifically on the measures that are taken by the government on national level and by the municipalities in the different cities on regional or local level. It is quite clear, even though it is still only a hypothesis, that the society has an attitude toward environmental behaviour, as well as an intention to perform this behaviour, however, there is no information about the relation between both of them. Moreover, as it is said above, a specific case is explored in this research, thus, it is always possible all of these information, concepts, and theories to cannot be applied to this case after the data analysis. It is still not clear whether the project AirBG of Code Bulgaria foundation has contributed to the environmental behaviour of the Bulgarian population, and more specifically to the transport mode choice for the journey from home to university / work / school of the people who have adopted a station for air quality measurements from AirBG.

3. Research objective

This project aims to evaluate how this kind of citizen initiative, as the project AirBG of Code Bulgaria, has an effect on the travel mode choice of the Bulgarians citizens who have adopted a sensor for air quality measurements. Inevitably, after this winter the air pollution issue has become more popular among the society, especially Sofia`s citizens. This research will try retrospectively to understand the factors that predict people`s intention to buy a sensor and what is the relationship between the purchase of a sensor for air quality measurements and the environmental behaviour of the citizens in their choice of travel mode from home to university / work / school. Knowing this, it will be possible to become clear what are the general effects on the population after the winter in 2017-2018, and is this going to have long-term impact on further actions on behalf of the society and government. The objective will be achieved through

a survey which will be launched among a group of people that have bought a sensor.

Concluding, the main goal of this research can be stated as follows:

Further understanding of the factors that predict people`s intention to buy a sensor and the relationship between purchasing the sensor and the travel mode choice of the adopters of an AirBG station.

4. Research questions

With the aim to achieve the aforementioned objective, the main research question is stated as it follows:

What is the relation between the purchase of an AirBG sensor for air quality measurements and the travel mode choice of the adopters?

The three factors that are identified by the Theory of Planned Behaviour, defined by Ajzen, as influencing the intention and the following behaviour are: behaviour beliefs, normative beliefs, and control beliefs (Puntoni, 1970). All of them are considered as playing an essential role in the behaviour change. Consequently, all of them will be explored in this research. Having said that, the following sub-questions are identified, and their answers will reach to the answer of the main research question:
1. What are the reported behaviour beliefs and their influence on the attitude toward using an alternative transport such as public transport, bicycle or walking?
2. What are the reported normative beliefs and their influence on the subjective norms?
3. What are the reported control beliefs and their influence on the perceived behavioral control?
4. What are the reported moral norms and their influence on the intention?

5. Is there a relation at all between the intention and the actual environmental behaviour in the case of the travel mode choice of the people who have adopted a station?

5. Scientific relevance

As it is said above, there is no literature available that shows the real contribution of the AirBG project to the development of environmental behavior in Bulgarians. In fact, there are still no research on the effect of the project on the population. This research will contribute by partly filling the knowledge gap and investigating whether this project indeed has contributed to an increase in the environmental awareness toward the air pollution and further changes in the societal behavior in the sense of changing the travel mode from home to work / university / school. This research can be used as a basis for creation of more successful citizen science projects, as well as for further policy improvements by the government or the municipalities. Moreover, the study can help to Code Bulgaria foundation in some improvements of the AirBG project by knowing whether this project has influenced the behaviour of the adopters.

6. Societal relevance

Only increasing knowledge does not help so much for further behavioral changes. This research will reveal the beliefs of the citizens that have a desire for more environmentally friendly and healthier lifestyle, and also the possible increase in the environmental consciousness in the sense of using an alternative transport (public transport, bicycle or walking) from home to work / university / school. This in turn can contribute in developing the most efficient policy related to this issue, and the way of controlling the situation as well.

7. Practice-oriented research

Broadly speaking, there are two options for the orientation of one research project. Verschuren, Doorewaard & Mellion (2010) identify them as practice- and theory-oriented. The theory-oriented research aims at filling a gap in an already constructed theory or at developing a completely new one, whereas the practice-oriented project tries to contribute to an intervention that can change an existing situation and solve a practical problem. Even though, this research goal is to contribute with theoretical knowledge, it will be more practical oriented because the specific case is identified first and then a theory is chosen to explain this case, not the way around.

8. Research Framework

The research framework of this project consists of few steps that will lead to the final answer of the research questions, as well as to the achievement of the research objective. The paper starts with a preliminary research for what is already known for the environmental awareness toward the air pollution and for the citizen science. These two concepts will be used as a theoretical background for the research. Then, a survey will be launched with the aim one to can answer the sub-questions. After the research conduction, statements about the research object (citizens` behaviour) could be made (Verschuren et al., 2010). The research perspective (conceptual framework) illustrates the aspects that will be studied during the research (Verschuren et al., 2010). Through the conceptual framework analysis that is designed according to the theory used in this research, namely the Theory of planned behaviour, and the evaluation of the citizens` behaviour, the main research question will be answered.
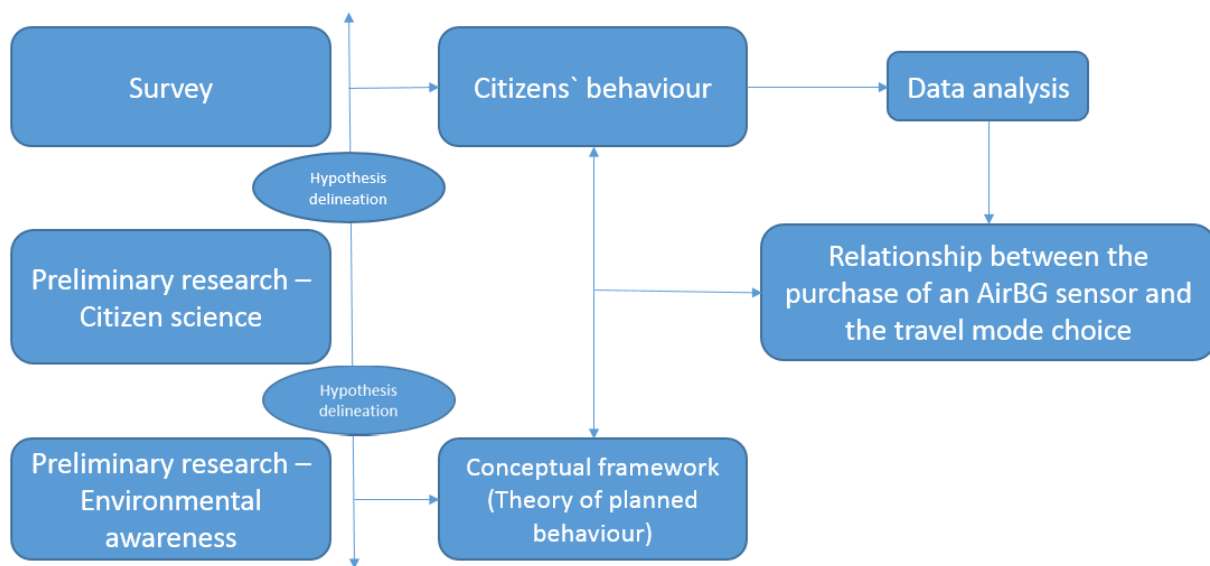

Figure 1:
Research Framework

9. Theoretical Framework

The Theory of Planned Behaviour (TPB) will be used for this research, which predicts an individual`s intention to engage in a behaviour at a specific time and place, and explain the socio-psychological factors that determine the individual`s decision to engage to the AirBG project (Fielding, McDonald & Louis, 2008). This theory enriches the Theory of Reasoned Action (TRA), underlining the main role of social knowledge in the form of subjective norms (the individual's beliefs), explaining the behavioral intention as a combination of several beliefs (Ajzen, 1985). This specific behaviour is driven by three behaviour intentions: attitude towards behaviour; subjective norms, and perceived behaviour control (Ajzen, 1991). These intentions in turn are influenced by behaviour, normative and control beliefs respectively (Sabah, 2016). In this research it is argued that the project AirBG of Code Bulgaria has played a crucial role in the more environmentally friendly behaviour development. According to the Theory of planned behaviour the behaviour itself is influenced by knowledge, attitudes, perceptions of norms and intentions (Ajzen, 1991). That is why, this theory perfectly fits to our case, as for intention will be considered the desire to adopt a station, and as behaviour will be explored the process of buying a sensor, as well as changing traveling mode or other activities that are related to the actual environmentally friendly behaviour.

9.1 Behavioural beliefs and Attitude towards behaviour

In this sub-section it will be explored whether already existed behaviour beliefs lead to the formation of negative or positive "attitude toward behaviour". Behavioural beliefs are perceived as the predictors of an attitude toward an actual act (Ajzen, 2006). In other words, the subjective probability of certain consequences after a certain actual behaviour (Han, Hsu & Sheu, 2010). In the case of AirBG few beliefs could be identified (see: Figure 2) related to the consequences of an alternative mode of transport (public transport; bicycle; walking) choice from home to work / university / school: (a) the transport is slow; (b) this way of traveling is an opportunity to avoid congestions; (c) it is reliable; (d) it is comfortable; (e) this is also an opportunity for telephoning, reading or listening to music; (f) this alternative transport is more environmentally friendly; (g) this choice will lead to healthier population; (h) with this transport the journey will be stress-free; (i) the transport is weather independent; (j) this is an opportunity for social contacts; (k) it corresponds to my lifestyle; (l) it is well combined with other activities such as going to the doctor after work, picking up the children for school etc.; (m) this way of traveling is saving money, and (n) it is saving time. The operationalisation of these behavioural beliefs can measure by considering what the person think will be the outcome of his/her choice of travel mode and by stating his/her clear position towards the air pollution issue. Thus, these beliefs connect the behaviour to the outcome (Kavoura, Sakas & Tomaras, 2017) and represent the individual`s perceived probability of the outcome and the evaluation of the consequences (Han & Kim, 2010). Moreover, the attitude toward a certain behaviour (toward environmentally friendly behaviour by using an alternative transport) represents the individual`s positive or negative evaluation of the behaviour, and the psychological emotion that arise when the person engages himself/herself in a certain activity (Greaves, Zibarras & Stride, 2013; Eagly & Chaiken, 1993; Han & Kim, 2010; Han, Hsu & Sheu, 2010). The evaluation is based on their expectancies that regarding whether these outcomes are desirable (Ajzen, 1985). If individual`s attitude is more positive, then it is expected that his/her intention will be positive as well (Taylor & Todd, 1995), and consequently the person is more likely to engage in that specific behaviour (Ajzen, 1991; Cheng, Lam & Hsu, 2006; Han, Hsu & Sheu, 2010).

So far, a hypothesis that will be tested can be constructed namely in that way:

H1: Behavioural beliefs have positive effect on the perceived control behaviour, which in turn has positive influence on the intention to use an alternative mode of transport such as public transport, bicycle or walking.
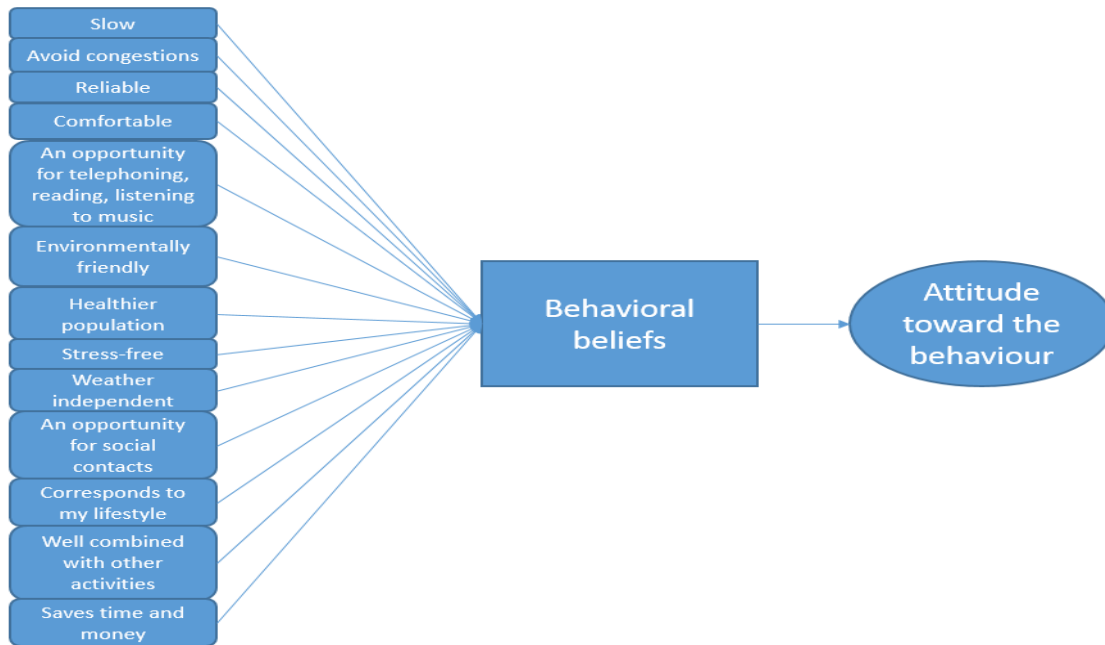
Figure 2:
Behavioural
Beliefs

9.2 Normative beliefs and Subjective norms

As normative beliefs it is referred to the norms that people stick to. In that sense, there are two types of norms: (a) the average – what most people do, or in other words – the target behaviour, and (b) the normative – what people have to do (Kavoura, Sakas &Tomaras, 2017; Sheeran & Orbell, 1999). Normative beliefs are assumed as the weakest predictor of behavioural intention among the three indicators (Armitage & Connor, 2001). This is because they could be distorted by the idiosyncrasies of the person (Nigbur et al., 2010), and in that way the researcher to be too focused on the individual behaviour paying too much attention to the identity of the person (Terry, Hogg & White, 1999). Normative beliefs result in subjective norms and refer to the approval or disapproval of an individual`s performance of a certain behaviour (Tegova, 2010; Greaves, Zibarras & Stride, 2013; Han, Hsu & Sheu, 2010), representing the individual`s correlation between particular behaviour and the opinion of the reference group about it (Fishbein and Ajzen, 1977).

In this sub-section perceived expectations and behaviours will be considered, combined with the person's motivation to comply with the referents in question; these considerations are the normative beliefs which are already in the memory and produce a perceived social pressure (Niaura, 2013), or subjective norms with respect to performing the behaviour (Ajzen, 2016; Han & Kim, 2010). The subjective norms, as the perceptions of the person inculcated by the society whether to engage or not to a particular behaviour

(Maichum, Parichatnon & Peng, 2016) are measured based on the motivation for compliance (Ajzen, 2006; Mancha & Yoder, 2015); then, the products are summed with the aim the subjective norms to be determined (Han & Kim, 2010). It is assumed that if the individual has higher societal (normative) support (like group membership or self-evaluation as environmental activist) to behave pro-environmentally, it is more likely to has greater intention for engagement in particular activity (Fielding, McDonald & Louis, 2008). As normative beliefs could be stated the perceptions of the immediate social network that is important for the participant as family, friends, relative (Han & Kim, 2010; Han, Hsu & Sheu, 2010; Macovei, 2015). According to Markus & Kitayama (1991), people who are individualists are not so prone to be influenced by normative beliefs, compared to collectivists, because they mainly pursue personal goals (Mancha & Yoder, 2015). On the other hand, Niaura (2013) explains the subjective norms in regard of environmental issues as whether a planned behaviour that is eco-friendly should be implemented or not. He refers to the contemporary green lifestyle that become increasingly more modern than ever before and that forms beliefs about sustainable consumption that can influence the actual behaviour (Valle, Rebelo, Reis & Menezes, 2005).

In our case three normative beliefs are identified (see: Figure 3) as possibly influential on the people who have bought a station and their travel mode choice from home to work / university / school: (a) first group, that probably has an impact, is the group of the people in the immediate surrounding (home and work environment) of the participant consisting of people who influence his habitus, and more specifically, their opinion about the participant's actions, whether they have supported him or not, to what extend they expect the participant to choose an alternative mode of transport such as public transport, bicycle or walking; (b) the research will focus on the two most important people for the participant – the most important person in his/her home environment (partner, sibling, parent etc.) and the most important one in his/her work environment (colleague (from work / university) or classmate for adopters who are still at school); (c) as a third group, the AirBG membership will be indicated, because its influence during the whole process is crucial for the development of environmental consciousness. The hypothesis that is derived for these beliefs is as it follows:

H2: Normative beliefs have a positive influence on the subjective norms, which in turn on using an alternative mode of transport such as public transport, bicycle or walking.
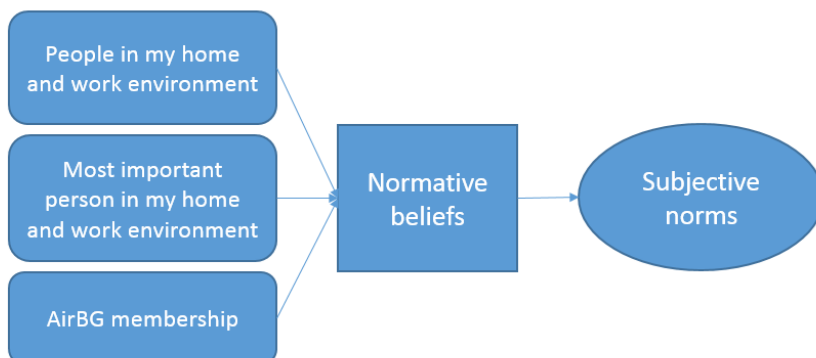

Figure 3: Normative Beliefs

9.3 Control beliefs - Perceived behavioural control

Perceived behaviour control is included from the Theory of Reasoned Action in the Theory of

Planned Behaviour with the aim to encompasses people with low degree of volition (Tegova, 2010; Han & Kim, 2010). Both theories assume that behaviour is the result of consciously taken decisions (Tegova, 2010). However, these decisions could be influenced by control beliefs, which are existed (external) factors that can influence the individual`s ability to perform a behaviour (Ajzen & Dasgupta, 2015; Ajzen, 2006), which is related to the perceived ease that the individual has for the performance of a particular task (Knabe, 2009; Greaves et al., 2013; Han, Hsu & Sheu, 2010; Maichum et al., 2016). The perceived control behaviour refers to the volitional control that person has for some action (Fielding, McDonald & Louis, 2008; Ajzen, 1991; Han & Kim, 2010), and being a function of the control beliefs, it is also defined as the degree to which the power of control factors will facilitate or interfere the behavioural performance of the individual (Ajzen & Dasgupta, 2015), and consequently the individual`s perception of the extent to which the performance will be easy or difficult (Ajzen, 1991). It increases when individuals perceive they have more resources and confidence (Ajzen, 1985). Control factors that influence the performance of the behaviour could be experience, knowledge, media exposure (Sommer, 2011), or time, money, chance (Chen & Tung, 2014), and all of them show the extent to which the participant feels that he/she is able to enact the behaviour, showing the confidence of the person (Ramsay, Thomas, Croal, Grimshaw & Eccles, 2010). In addition, factors that are not controlled from the participant can be included such as weather, and transport conditions. The perceived power consists of the level of importance that these resources and opportunities have for the achievement of the outcomes (Ajzen & Madden, 1986). Thus, when persons are not able to control their resources (or they do not have significant amount of them (Madden, Ellen & Ajzen, 1992)), there is little likelihood to engage themselves in the behaviour (Chen & Tung, 2014), even though if they have positive attitude/subjective norm related to the activity (Han, Hsu & Sheu, 2010).

Having in mind that the participant can be engaged in a particular behaviour only when he/she has both – ability and motivation to perform it (Maichum et al., 2016), in this research the following control beliefs will be alluded (see: Figure 4): (a) time, (b) money, (c) weather; (d) conditions of the transport such as comfortability, reliability and rapidity, and (e) the participant`s personal lifestyle

H3: Control beliefs have positive effect on the perceived control behaviour, which in turn has positive influence on the intention to use an alternative mode of transport such as public transport, bicycle or walking.
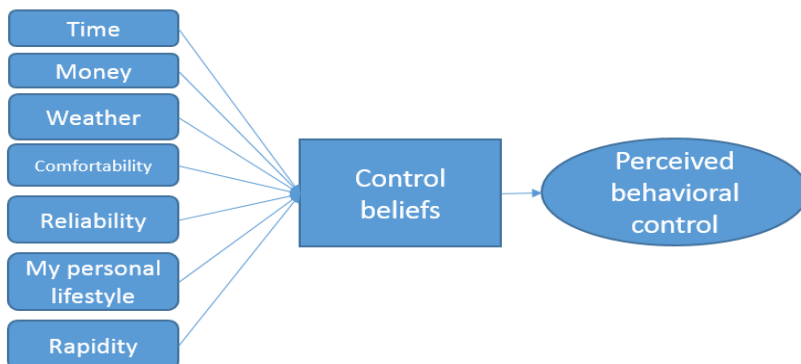

Figure 4:
Control beliefs

9.4 Moral norms

Man and morality are inextricably linked, because in every society the actions of individuals have to be reconciled in a common activity. Morality, by its very nature, is a set of rules for regulating the actions of man in society, but unlike such written norms for the settlement of human relationships, such as the laws, morality is distinguished by its unwritten character. This is rather a set of rules, which are understood by themselves, they are not imposed as a limitation from the outside by the power and will of an institution, as in the laws, but as a self-consciousness of an internal ban and restriction.

These norms link them to individual human abilities to think and reason both for their own behaviour and to judge others' attitudes towards one's own self. There are few researches that show the role of the moral norms towards an environmentally friendly behaviour such as recycling (Chen & Tung, 2009) or visiting green hotels (Han & Kim, 2010). Generally, there are meta-analysis that explore the prediction significance of these norms to the intention for specific action (Gifford, 2014). These norms are additional for the Theory of Planned Behaviour and aim at focusing on the inner characteristics of the participant. They improve the theory by showing the general attitude toward the environment (in our case) of the participant. Researches show that general personal feelings are responsible for some decision taking and behaviour performance (Ajzen, 1991), and these feelings are perceived as obligations which can help in power improvement of the theory. In other words, moral norms can explain the responsibility taken by the adopters for the morally performance of the specific behaviour, namely the choice of an alternative mode of transport such as public transport, bicycle or walking, while they are facing with an ethical situation (Beck and Ajzen, 1991). This duty of the participant to act more environmentally friendly can strongly influence his/her choice of transport. However, the exact contribution of the moral norms is disputed. In some studies, it is between 1-10% (Beck & Ajzen, 1991), in others it is over 10% (Kurland, 1995).

In our case, it could be said that moral norms have some importance, because they can prompt the participant to a specific action (to the use of an alternative mode of transport). The moral norms that are identified in this research (see: Figure 5) are: (a) the expectancy toward the participant in the sense of the transport mode used by him/her; (b) the participant`s perception related to the environmental problems on global and local level; (c) the responsibility that the participant take toward the environmental issues; (d) the participant`s opinion about the relation between the transport and air pollution.

The fourth hypothesis in this study can be delineated as it follows:

H4: Moral norms (e.g. responsibility towards the environment) force adopters to behave pro-environmentally and to use an alternative mode of transport.
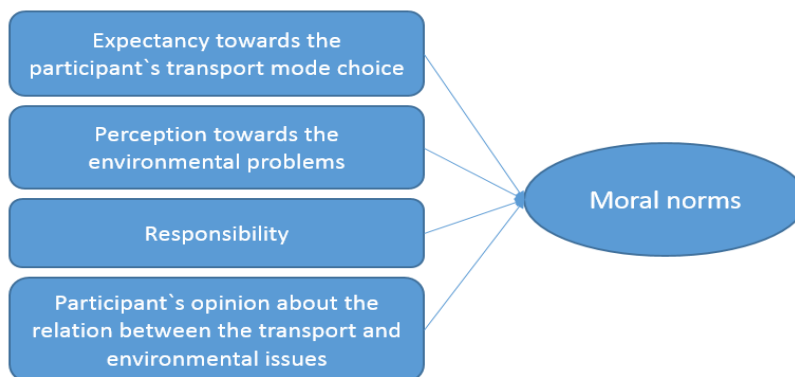

Figure 5:
Moral norms

9.5 Behavioural intention

In this research the intention of the participants will be investigated for behaving more environmentally friendly in the sense of the travel mode choice (between personal car and an alternative transport such as public transport, bicycle or walking). In turn, the intention is a latent variable that cannot be measured directly, therefore the four explained above indicators will be used as antecedent choice processes (Tegova, 2010) for measuring the intention. Then, the intention will be used as an immediate antecedent of the individual`s willingness to engage in a particular behaviour (Han & Kim, 2010). In our case, the socio-psychological model of environmental activism in the sense of the intention for engaging in such a behaviour (Fung & Adams, 2017), will be tested among part of the citizens of Sofia, Bulgaria. The Theory of Planned Behaviour (TPB) can enable us to examine the social, personal and non-volitional determinants on the intention (Han et al., 2010), and the readiness (Mancha & Yoder, 2015; Niaura, 2013), compared to the previous version – the Theory of Reasoned Action (Ajzen, 1985). According to Ajzen & Fishbein (2002), TPB allows us to predict the human behaviour because it is under him/her volition and control of intention, where the intention is supposed to be the most powerful determinant of an individual`s actual behaviour (Fielding et al., 2008). Thus, people have the strongest intention to perform a particular behaviour when they have social support, control over their resources, moral obligations, and positive attitude towards the activity (Fielding et al., 2008). As an indicator that influences the intention, and that is not included in the Theory of Planned Behaviour is stated the variable self-identity, and the literature reveals many studies where this indicator considerably influence the individual`s intention towards behaviour (Armitage & Conner, 1999; Callero, Howard & Piliavin, 1988; Conner & Armitage, 1998; Cook, Kerr & Moore, 2002; Spark & Shepherd, 1992; Sparks & Guthrie, 1998; Terry, Hogg & White 1999), by improving the TPB model (Mancha & Yoder, 2015).

When it comes to the pro-environmental behaviour it is often defined as "intentionally reducing the negative impact that an action can have on the environment", and is performed every day (Dono, Webb & Richardson, 2010; Kollmuss &
Agyeman, 2002). In our case this activity is travelling by the public transport, cycling or walking on foot every day from home to work / university / school. Meta-analysis reveal plethora of studies where the TPB is applied explaining environmental intentions and behaviour (Armitage & Connor, 2001). Accordingly, the serial, fifth hypothesis we will delineate will be:

H5: The four antecedent beliefs/norms will significantly predict the intention for using an alternative mode of transport such as public transport, bicycle or walking.

9.6 Actual behaviour

Most often, the actual behaviour is studied through the TPB. However, in the case of the environmental behaviour, dozens of analysis show that the environmental concern is a direct predictor of a specific environmental behaviour (Gilg, Barr & Ford, 2005; Ajzen & Fishbein, 1977). Understanding what motivates people to behave pro-environmentally is an essential part of a sustainable future development (Fielding & Head, 2012; Johnson, Johnson-Pynn, Lugumya, Kityo & Drescher, 2013; Wiernik, Wiernik, Ones & Dilchert, 2013), and the changes in humanity`s behaviour are important to be investigated because most of the environmental degradations are caused by human behaviour (Oskamp, 1995). Accordingly, this research will investigate the potential eco-friendly behaviour among the population in Sofia, Bulgaria after the effects on the environmental consciousness exerted by the project AirBG of Code Bulgaria, more specifically – the travel mode choice of the adopters of a station for air quality measurements. Including all of the variables explained (behaviour, normative, control beliefs, and moral norms which influence the

intention), a comprehensive understanding of the individual`s decision formation will be introduced (Han & Yoon, 2015).

For better understanding of the behaviour, it should be defined in terms of Target, Action, Context and Time (TACT) (Ajzen, 2006). The purpose of this principle is to improve the quality of the used theory by providing information to the participants about: (a) who/what is the target; (b) what is the considered action; (c) in what context the action is considered, and (d) what is the timeframe for the action (Cooke, Dahdah, Norman & French, 2014). In the case of AirBG project, the target is not polluted air; the action is being environmentalist in the sense of travelling by public transport, bicycle or walking; the context is urban, Sofia city, and the timeframe is the forthcoming 3 months. Another principle that has to be observed is the principle of compatibility which shows that all of the indicators, namely attitude, subjective norm, perceived behavioral control, moral norms and intention are defined with the same elements (TACT) as the behaviour (Ajzen, 2006). In our case, the principle is complied because all of the other constructs refer to the same action, target, timeframe and context. However, the context "urban environment" is quite specific, because people can behave eco-friendly everywhere.

9.7 Limitations of the theory

Even though the Theory of Planned Behaviour is an extension and more developed version of the Theory of Reasoned Action, some studies argue that TPB is incomplete (Gifford, 2014) mainly because Firstly, because the moral norm is not included as an indicator that significantly measure the intention for environmentally friendly behaviour (Bamberg & Möser, 2007; Hines, Hungerford & Tomera, 1987; Klöckner, 2013). That is why, in this study these norms will be included so to be most accurate. Secondly, an intention-behavioural gap exists since in meta-analysis of Bamberg & Möser (2007), it is concluded that only 27% of the variable "actual behaviour" is explained by the variable "intention". This gap is also stated by Ajzen, Czasch & Flood (2009), Tegova (2010), and Schwartz (1977).

9.8 Conceptual model

In this sub-section the conceptual model of the research will be presented (see: Figure 5). In the figure below the typical conceptual model for the Theory of Planned Behaviour will be figured with the only two alterations – firstly, as a precondition, the purchase of an AirBG sensor will be stated. This is because the study is interested only to these people who have adopted a station for air quality measurements. Secondly, the variable moral norms will e included so the research to be able to identify the general feelings and obligations towards the environmental issues and the transport of the participants.

The concept is defined by Taufique, Siwar, Chamhuri & Sarah (2016), and Fryxell & Lo (2003) as the knowledge of the activities that lead to environmental degradations, and the solutions towards sustainable development. If an individual is well-informed with the consequences of his/her actions, there is higher likelihood for and intention toward environmentally friendly behaviour (Lee, Choi, Youn & Lee, 2012). Thus, one, last hypothesis will be delineated, namely:

H5: Adopting an AirBG sensor for air quality measurements is positively associated with all the beliefs that have a role in the transport mode choice of the individual.
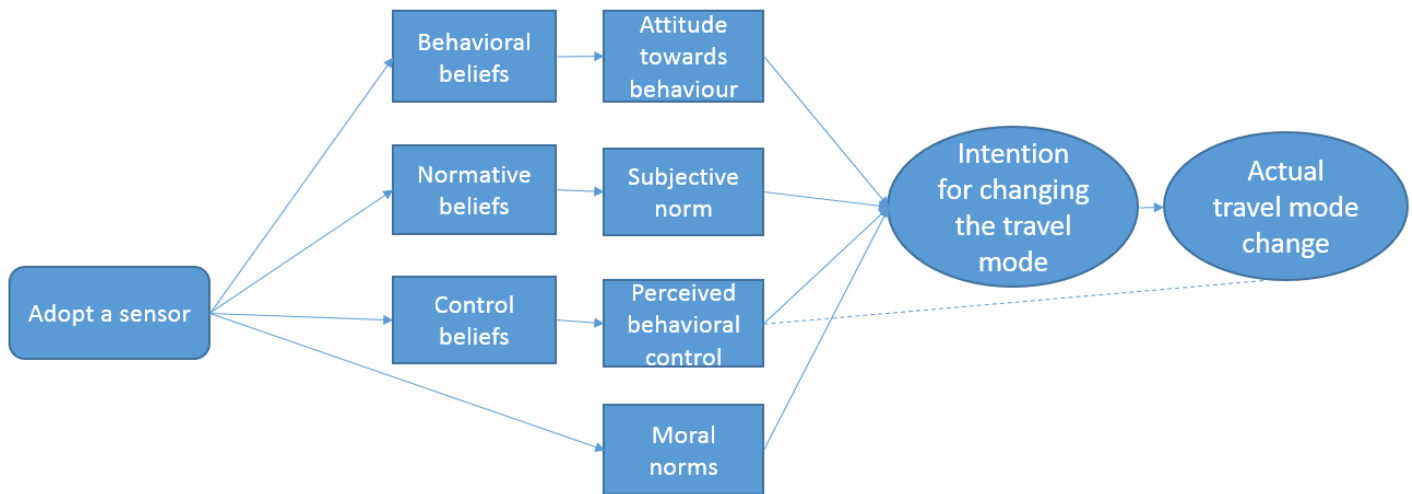
10. Methodology

10.1 Research strategy

Different research strategies exist, influenced by the research objective and entity. Before choosing a specific research strategy, the researcher has to give answers to few questions. First, this research purpose is to generalize the results and to reveal a broader overview of the selected discipline. Thus, a quantitative method will be used (Verschuren & Doorewaard, 2010). Second key decision that lead to the use of quantitative method is that the results in this research is preferred to be presented in tables, graphs, figures etc.

A quantitative strategy has the following characteristics (Studopediya, 2015): (a) it is used for research large enough for the number of objects (in the case of AirBG the number of the participants has to be minimum 30); (b) the study focuses on the level of macro-analysis of facts and events; (c) the analysis has deductive logic: abstractions - the facts from the action of concepts; (d) to perform quantitative research standardized methods are used for collecting information from first hand; (e) measuring instruments developed and tested in high pilotage are used, usually formalized; (f) the data is presented in the form of charts, figures, tables, and (g) analysis is performed by statistical methods.

Having these quantitative methods features in mind, in this research it is decided one specific quantitative method to be used, namely: Structural Equation Modelling, which will analyse the structural relationship between measured variables and latent constructs. This method will be used because we have more than one linear equation, and because we have a variable (actual behaviour) that cannot be directly measured.

10.2 Data collection

The survey is the most common quantitative methods tool of social information gathering. Separate units of research may be not only individuals but also any social objects united by at least one common

attribute (in our case, those adopted a sensor). The survey used in this research will investigate retrospectively the behavioral, normative, control beliefs, and moral norms that exist in the citizens that have bought a sensor from AirBG in Sofia, Bulgaria. They will show the intention to an actual use of an alternative mode of transport such as public transport, bicycle or walking on behalf of these people. A survey will be used also because this research is empirical and the researcher will gather the data by herself. Moreover because: (a) it will provide an accurate picture of the situation that the literature cannot; (b) it opts for empirical research; (c) as well as for generalization and breadth, not depth; (d) the data is gathered from a late number of research units; (d) the method is less time consuming for data collection; (e) this research strategy is reductionist one and the assertion is formulated in terms of the relation between all the variables; there are two kind of reductions: first, where the reality is reduced to a set of research units, and second, where these research units are reduced to a set of variables (the three beliefs, intention and actual behaviour).

In the case of AirBG a cross-sectional survey will be used because it has all of the aforementioned characteristics, and it is gathered at a certain moment from a specific set of people, inducing most public opinions.

10.3 Data analysis

For analysing the data gathered through surveys, the programme IBM® SPSS® Amos will be used. This program is a powerful tool for extending standard multivariate analysis methods. This method is preferred by researchers because it estimates the multiple and interrelated dependence in a single analysis.

10.4 Advantages and Disadvantages of the chosen research strategy

As advantages few features could be marked, namely: (a) through quantitative method a lot of information is accessible; (b) moreover, the scope is large and obtains the overall picture. However, some disadvantages also could be noticed as: (a) the depth and knowledge only concern the set of variables; (b) the preparation of the questionnaire requires a lot of pre-knowledge, and (c) it is less flexible due to the high degree of pre-structuring.

10.5 Participants and sampling design
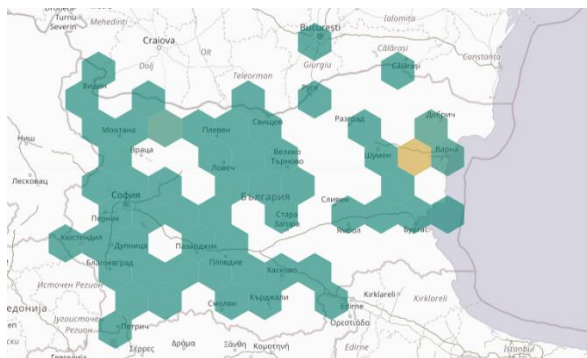
Picture 2: Sensors among the country

Participants:

On the map, it could be seen that almost in the whole country there are adopters of an AirBG station for air quality measurements. Although the project is relatively new, people who have such a sensor are many and are scattered all over Bulgaria, which again talks about the high activity and interest of society in

relation to environmental problems. People who were asked to complete the survey are only those who have a station for measuring air quality. There is a total of ... adoptive people across the country, and the survey is filled in by 98, 8 of which are invalid because many of the questions have not been filled and were deleted. That is why 89 valid questionnaires remained. This number is enough to show the general trend in people's behavior and in particular in their choice of home-to-work / university / school mode of transport after purchasing the sensor.

Procedures:

This study posted a research internet-based questionnaire on Facebook; firstly, trying to convince different people to share the post, and disseminate the survey. In that way, the questionnaire was completed by around 30 people who have a sensor. Secondly, the link was posted in a closed group in which only people who have a station are added. That was the place where most of the answers came from – around 60. Due to a convincing message to the participants, it was managed to gather a representative sample of people who can show what are the current trends among the adopters in their behavior. The main materials used for the collection of data were a computer, Qualtrics software, and a survey consisted of questions related to the behavioural, normative, control beliefs, and moral norms of the participants related to their intention to use an alternative mode of transport such as public transport, bicycle or walking, and an information sheet before the survey with basic information about the research and the students. For the data collection a lot of help was received by one of the founders of Code Bulgaria foundation, and the project AirBG, named Stefan Dimitrov. He wrote the researcher message in a closed group in the social media. No money or any other material incentives were available for completing the questionnaire. Probably people were motivated by the fact that for the first time in Bulgaria, such a research is being conducted, and they are clearly interested in the results because the most of them have written their emails so in the end of the study to receive a report of the final results.

Survey description:

The survey was divided in sections all of them based on the Theory of Planned Behaviour. It starts with background questions related to overall perception of the participant's overall perception of the various causes that generated the desire to adopt an AirBG station for measuring air purity, causes such as: "This action will contribute to the preservation of the environment", or "My relatives and friends told me to do so". Questions related to the participant's opinion on the measures taken by the government and the municipality on contaminated air so far followed. The other questions show how often the participant used alternative home-to-work / university / school transport before and after his/her sensor supply, as well as his/her overall perception of the use of an alternative mode of transport. Most of the questions have are with Likert Scale from 1 to 7 or from 1 to 10. Scale 1 to 10 was selected in most cases because it is known that people do not prefer extremes. There are also some questions with multiple choice answers or with blank field for participant`s own answer (like for the questions related to the minutes needed for the journey from home to work/university/school with car or with an alternative transport).

The questions directly related to the behavioural, normative, control beliefs, and moral norms are following. Firstly, for the behavioural beliefs, the first question asks about the alternative transport which is most possible to be used by the participant if he/she does not use his/her personal car. Then, different characteristics are enumerated so the researcher to be able to understand the beliefs of the outcome of the person. Secondly, the questions related to the normative beliefs are divided in three sub-sections as it follows: (a) the overall percentage of people who use an alternative mode of transport in the home and

work/university/school environment of the participant, (b) the opinion of the most important people for the participant when it comes to the alternative transport use, and their reaction if the respondent use it daily, and (c) the extent to which the person is influenced by the AirBG membership is measured. Thirdly, few questions about the control beliefs were asked for examining the extent to which the decision about the type of transport used on a daily basis depends on the respondent as well as the degree of importance for different characteristics of the alternative transport that are not controlled by the participant. Fourthly, questions related to the moral norms were asked, and aim at revealing the participant's overall way of thinking, how he/she looks at global and local environmental issues, what is his/her role in them, and in their decisions as well, whether he/she believes that the problem of polluted air in Bulgaria exists, as well as the overall link between traffic and the air pollution.

Finally, questions related to the intention of the participant to use an alternative mode of transport were asked such as: "Do you consider to use an alternative mode of transport (public transport, bicycle, walking) next time when you travel from home to work / university / school?", or "Which is the mode of transport which you intent to use most often for the journey from home to work/university/school in the forthcoming three months?".

The final questions are related to the participant's age and education level in order to find out whether the environmental awareness and citizen science initiatives are most common among the young and/or educated generation.

11. Analysis

11.1 Exploratory Factor Analysis for the Background Questions

Before the main analysis, an exploratory factor analysis of the background questions was conducted. This aimed at separating the questions in few groups that show the hidden factors behind the indicators, because of the high number of indicators for the latent variable "Background questions". The analysis was performed in SPSS software.

In the beginning of the analysis, its adequacy and significance were checked. Looking at table 2, it could be seen that the model is adequate because the Kaiser-Meyer-Olkin indices value is 0.79. We want more than 0.6, therefore the model is adequate. Moreover, the significance is less than 0.05 (.000) which means that the model is significant. Looking at these numbers, it could be concluded that there are significant factors, and consequently, the variables are dependent.

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.790
Bartlett's Test of Sphericity	Approx. Chi-Square	664.778
	df	171
	Sig.	.000

Table 2: KMO and Bartlett's Test for adequacy of the model.

For explaining how many common variables / factors are meaningful, we are looking at the Total Variance Explained Table, and Scree Plot. We are interested in the "eigenvalue" of all of the factors so to understand

what percentage of the variance it explains. These are the total correlations that are visible in the dataset explained by the different components. The first component is that explain always the most. Examining Table 3, and Picture 3, it could be seen that we have 19 components. 6.476 is the eigenvalue of the first component, which means that 35% of the variation is explained by the first one. The second component explains 14% of the variation, the third one – 9.5%, the fourth one – 7.9%, the fifth one – 6%. Consequently, if we have 5 components of these 19, we already have 72,4% of the variation explained that is visible in the dataset. Criteria which SPSS uses to determine what the optimum number of components is that the eigenvalue should be larger than 1! If it is smaller than 1, it will explain less than the original variable.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	6.476	34.087	34.087	6.476	34.087	34.087
2	2.878	15.149	49.236	2.878	15.149	49.236
3	1.812	9.535	58.771	1.812	9.535	58.771
4	1.535	8.081	66.853	1.535	8.081	66.853
5	1.140	5.998	72.850	1.140	5.998	72.850
6	.772	4.062	76.913			
7	.642	3.380	80.292			
8	.612	3.220	83.512			
9	.602	3.170	86.682			
10	.490	2.581	89.263			
11	.405	2.133	91.396			
12	.344	1.810	93.207			
13	.300	1.580	94.787			
14	.265	1.393	96.180			
15	.222	1.166	97.346			
16	.184	.968	98.314			
17	.139	.729	99.043			
18	.102	.538	99.581			
19	.080	.419	100.000			

Extraction Method: Principal Component Analysis.

Table 3: Total Variance Explained by the first 5 components.

Picture 3: Scree Plot with the eigenvalues of all of the components.

 Here also could be seen that the first 5 components explain the biggest part of the variation.
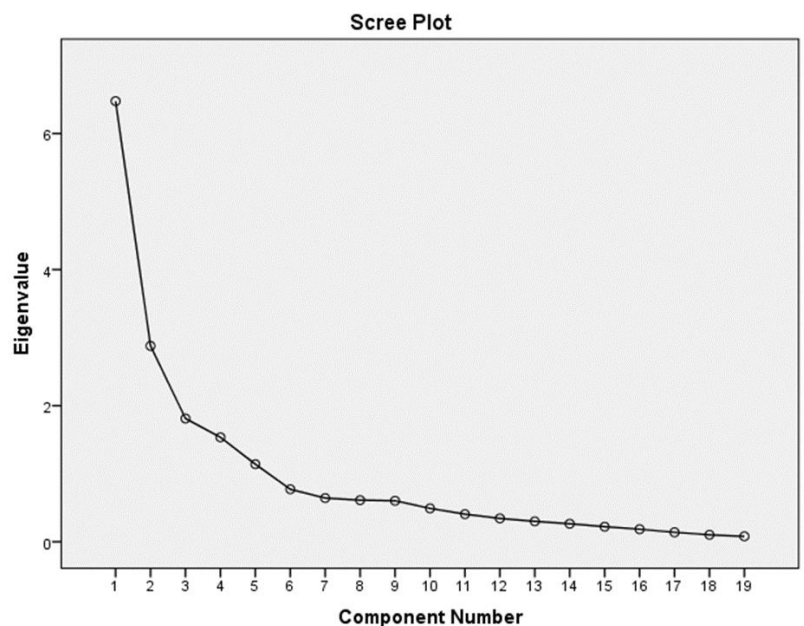
Next step was to scale the loadings of the factors by dividing them by the corresponding communality, and in that way "polarizing" them, using Varimax rotation. This is done because the interpretation of the loadings would be easier by having them between 0 and 1. The criteria here is not that the first component explains the most – the components are formed to be calculated in such a way that we have as much polarization either 1 or 0, as possible. Looking at Table 4, it could be seen that indicators BQ6_2, Q7_2, BQ10, BQ6_1, BQ7_1, BQ9, BQ8, BQ5 are influenced by factor 1, and measure relatively the same. BQ8 also is influenced by factor 3. Indicators BQ4_3, BQ4_2, BQ4_1, and BQ4_4 are influenced by factor 2. Questions BQ8, BQ1_1, BQ1_2, BQ1_3, BQ1_4 are influenced by factor 3, indicators BQ1_4 and BQ3 by factor 4, and factor 5 influences indicator BQ4_5.

Rotated Factor Matrix[a]					
	Factor				
	1	2	3	4	5
BQ6_2	.848				
BQ7_2	.843				
BQ10	.842				
BQ6_1	-.791				
BQ7_1	-.788				
BQ9	-.762				
BQ5	.649				
BQ8	-.527		-.490		
BQ2					
BQ4_3		.923			
BQ4_1		.709			
BQ4_4		.612			
BQ4_2		.594			
BQ1_1			.772		
BQ1_2			.745		
BQ1_3			.623		
BQ1_4			.519	.455	
BQ3				-.592	
BQ4_5					.584

Extraction Method: Principal Axis Factoring.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 7 iterations.

Table 4: Rotated Factor Matrix – showing the rotated loadings of the hidden factors behind the indicators.

Having all of the aforementioned information, one final check of the significance was conducted. Table 5 shows the suitability of the data for structural detection by using the values of two indices – KMO and Bartlett's Test. We want our KMO value to be high (close to 1.0), in that way it could be concluded that the results from the factor analysis could be useful with the data, because our KMO value is 0.790. Here, again our significance is less than 0.05, therefore our model is significant.

| KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.790
Bartlett's Test of Sphericity	Approx. Chi-Square	664.778
	df	171
	Sig.	.000

Table 5: KMO and Bartlett's Test for usefulness and significance of the analysis.

The last step of the exploratory analysis was to the researcher to look at those questions that are under each of these 5 new hidden factors, reading them, and decide what is exactly the common characteristic that each one of these questions is trying to measure. However, after examining the survey and the questions included for the variable Background Questions, it was concluded that only three among these five factors will be used in the final model in AMOS. the first three factors that are with the highest eigenvalue will be used, and after looking at the questions that are explained by them, it was concluded that the names of the new latent variables will be as it follows: (1) Causes (for purchasing an AirBG sensor); (2) Personal understanding (for the air pollution issue), and (3) Transport recently used (how often, when and what kind of transport was used recently by the participant). The factors that were excluded from the model are those that explain the (1) Municipality actions (factor 2), and (2) the Folk psychology (the specific way of thinking of the Bulgarians that influence the perception for the existing environmental problems – factor 4). Firstly, they include very low number of indicators (only one when we exclude BQ4_1 for factor 4 because it is also influenced by factor 3; thus, it is a problematic one), as well as theoretically they are considered as not so influential and significant for the intention and more environmentally friendly behaviour.

11.2   AMOS analysis of the latent variables separately

Before analysing the complete model in AMOS SPSS, an analysis of all the latent variables separately was conducted with the aim to improve the models with only indicators that are statistically significant for the specific latent variable without the influence of the variables. Thus, the behavioural, normative, control beliefs, moral norms, intention and actual behaviour were separately analyzed.
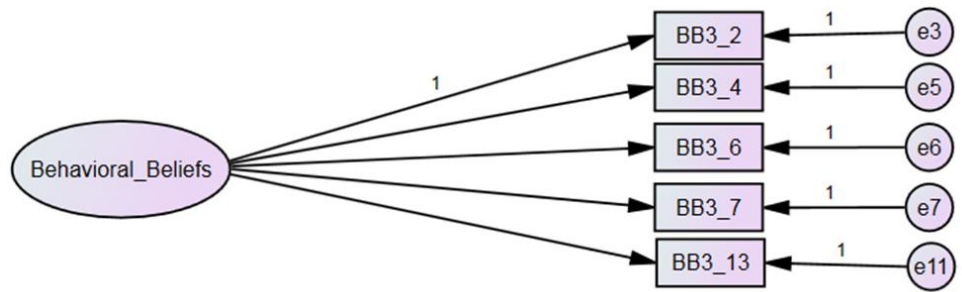
Behavioural Beliefs
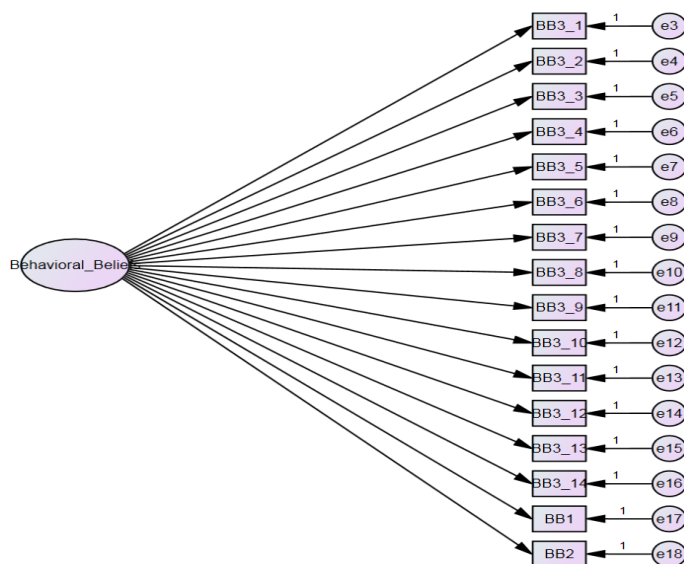
Originally, the behavioural beliefs in this analysis had a lot of indicators, a lot of questions asked related to this variable. That is why, before improving the model, it looked as on picture 4.

Picture 4: The variable Behavioral Beliefs with all the indicators.

After improving the model, the result is shown on picture 5.

Picture 5: Improved model for the variable Behavioral Beliefs.

All indicators exclusions from the model are theoretically based. BB1 and BB2 are the first two question asked about the behavioural beliefs, and it is considered that they are not necessary for the model because they just reveal what is the alternative transport which is characterized in the next indicators. The indicators from BB3_1 to BB3_13 are different characteristics of the alternative transport used by the participant, and some of them were shown as statistically insignificant, with not sufficiently high standardized regression weight, or theoretically were considered as not so important. In the end, the characteristics that were included in the model are "Way to avoid congestions", "Comfortable", "Environmentally friendly", "Will contribute to healthier population", and "Time saver". The model shows very good model of fit, as it is shown on table 5:

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	10	7.358	5	.195	1.472
Saturated model	15	.000	0		
Independence model	5	116.274	10	.000	11.627

Table 5: Values of Parameters and Chi-square/DF that show good model of fit.

It also could be seen that almost all the indicators are statistically significant for the model (table 6), even though there is only one indicator shows as insignificant (indicator "Comfortable") which is considered as highly important for the behavioural beliefs of using an alternative transport for the journey from home to work / university / school.

Regression Weights: (Group number 1 - Default model)

Table 6: Statistical significant of the indicators for variable Behavioral Beliefs.

			Estimate	S.E.	C.R.	P	Label
BB3_2	<---	Behavioral_Beliefs	1.000				
BB3_4	<---	Behavioral_Beliefs	.782	.241	3.253	.001	
BB3_6	<---	Behavioral_Beliefs	1.409	.324	4.342	***	
BB3_7	<---	Behavioral_Beliefs	1.489	.340	4.385	***	
BB3_13	<---	Behavioral_Beliefs	1.002	.294	3.406	***	

Normative Beliefs:

On picture 6 could be seen the original model of the variable Normative Beliefs.
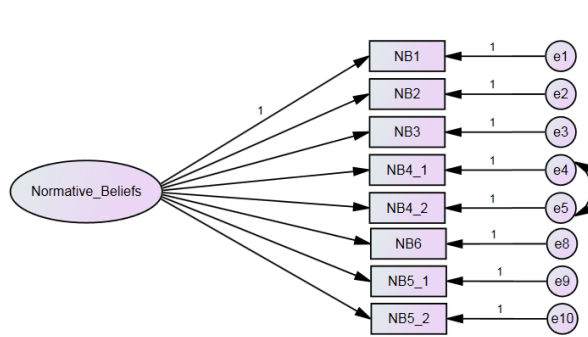
Picture 6: All the indicators for the variable Normative Beliefs.

After running the analysis, it was seen that some of the indicators were not statistically significant, and also that an error term was necessary to be included for a better goodness of fit. The improved model is shown in Picture 7, with the reduced number of indicators, and the additional error between NB4_1, and NB4_2. These indicators are related because the question is about the reaction of participant`s most important people at his/her work and home environment for his/her using of an alternative mode of transport (the person at home and at work for example could be the same).
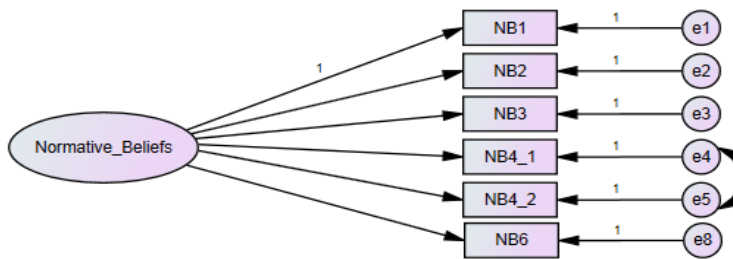
Picture 7: Included indicators for the variable Normative Beliefs.

For the final model of this variable, there is a good model of fit with CMIN/DF = 1.178, and P=0.308, as it is seen on Table 7, and even though there are some indicators that are still not highly significant (see: Table 8), they are included in the model because of the strong theoretical basis that they have related to the variable. NB3 is a question that measure the extend of importance for the participant of the reaction of the people that are in his/her everyday environment (friends, relatives, colleagues, classmates). For the norms that some people stick to, these people`s reaction is quite important to be measured, that is why, this indicator is included. For indicator NB4_1 (how often the most important person for the participant in his/her home environment uses alternative transport) it could be said that it is a pair with indicator NB4_2 (how often the most important person for the participant in his/her work environment uses alternative transport), which is shown as statistically significant. Finally, NB6 measures the extent to which the membership in AirBG influences the decision making process for what kind of transport to be used by the participant from home to work / university / school. NB6 is considered to be highly important because theoretically it is supposed that this membership is the cause or the result of the environmental behavioural of the person.

CMIN

Table 7: Model of fit of the final model for the variable Normative Beliefs.

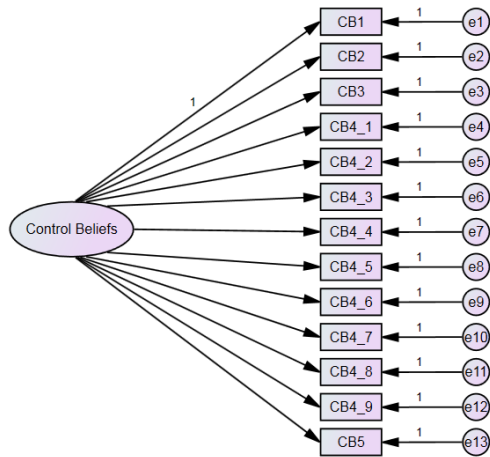| Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	13	9.423	8	.308	1.178
Saturated model	21	.000	0		
Independence model	6	134.259	15	.000	8.951

Table 8: Statistical significant of the indicators included in the final model for the variable Normative Beliefs.
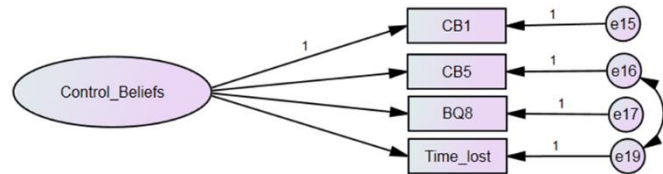
Regression Weights: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
NB1	<---	Normative_Beliefs	1.000				
NB2	<---	Normative_Beliefs	-1.119	.155	-7.201	***	
NB3	<---	Normative_Beliefs	-.187	.077	-2.442	.015	
NB4_1	<---	Normative_Beliefs	-.073	.143	-.509	.611	
NB4_2	<---	Normative_Beliefs	-.695	.127	-5.487	***	
NB6	<---	Normative_Beliefs	.474	.174	2.729	.006	

Control Beliefs

Initially, the analysis for the variable Control Beliefs was run with all its indicators as it is shown in Picture 8. However, apparently, this model was not quite good because the model of fit was very low, and almost all of the indicators were not statistically significant. That is why, the model was improved by the reducing of some indicators, as well as inclusion of some others. After looking at the survey, it was concluded that all questions that are under the name "CB4_", which are the questions for the characteristics important to the participant for his/her decision making process for using alternative transport, are not appropriate for the variable Control Beliefs measurement, because they can show what is important for the person, but not what is dependent on the person, and what is not. Thus, the question was not asked appropriately. CB2 and CB3 are questions related to the time needed for the journey from home to work / university / school with a car, and with an alternative transport. Theoretically, the also cannot measure this variable properly. However, these two were used by creating a new variable in SPSS, which calculate the time lost for the journey, which already can be used for the variable Control Beliefs. Therefore, except for the exclusion of all aforementioned indicators, some others were included: (1) the indicator "Time_lost" which calculate the time needed traveling by alternative transport minus the time needed when traveling by car, and (2) the indicator taken from the background questions (BQ8), which is related to the possibility of using an alternative transport for the forthcoming 3 months. The final model for the variable Control Beliefs could be seen in Picture 9. After checking the modification indices, a covariance between CB5 and Time_lost was included so to improve the goodness of fit (see: Table 9). Even though the standardized regression weights, as well as the statistical significant of the indicators included in the model are not sufficient (see: Table 10), this model will be used as a final one for the complete model in AMOS, because of the theoretical importance of the Control Beliefs as somethings that indirectly influence the participant's decision whether to use his/her private car or alternative transport, as there is always something that does not depend entirely on us, and only Control Beliefs can measure it.

Picture 8: Original model with all indicators for the variable Control Beliefs.

Picture 9: Final model for the variable Control Beliefs.

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	9	.349	1	.554	.349
Saturated model	10	.000	0		
Independence model	4	3.626	6	.727	.604

Table 9: Goodness of fit for the final model.

Regression Weights: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
CB1	<---	Control_Beliefs	1.000				
CB5	<---	Control_Beliefs	1.008	2.110	.478	.633	
BQ8	<---	Control_Beliefs	.722	1.204	.600	.549	
Time_lost	<---	Control_Beliefs	1.932	6.029	.320	.749	

Standardized Regression Weights: (Group number 1 - Default model)

			Estimate
CB1	<---	Control_Beliefs	.333
CB5	<---	Control_Beliefs	.332
BQ8	<---	Control_Beliefs	.197
Time_lost	<---	Control_Beliefs	.115

Table 10: Statistical significance and standardized regression weights of the indicators included in the model for the variable Control Beliefs.

Moral Norms

Moral norms is a variable that was included additionally to the Theory of Planned Behaviour because it can measure the personal attitude toward the environmental issues as well as the characteristic of the personality of the participant as it could be seen from the questionnaire. However, when the model was constructed in AMOS for this variable, looking at the questions related to it, it was noticed that in the AMOS model cannot be included only one latent variable for "Moral norms", that is why it was separated into two – Personality, and Attitude as it
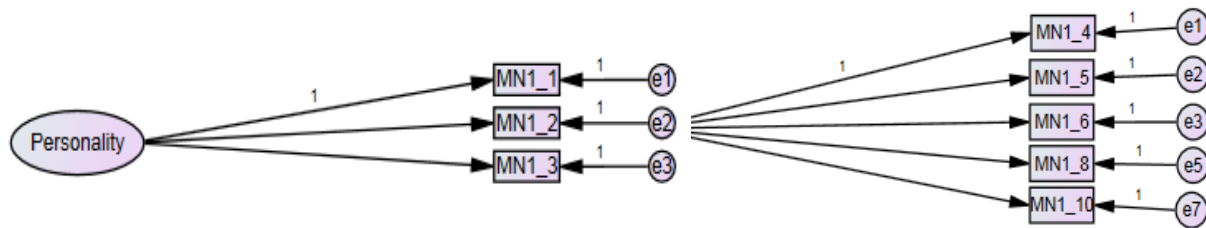
was explained above. The models of the
two variables can be seen in Picture 10 and Picture 11 respectively.

Picture 10: Final model in AMOS for the variable Personality.

Picture 11: Final model in AMOS for the variable Attitude

Personality variable measures the common characteristics of the person choice who is filling the survey related to the mode of transport, whereas Attitude variable measures his/her attitude towards the general / global environmental problems.

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	6	.000	0		
Saturated model	6	.000	0		
Independence model	3	96.944	3	.000	32.315

Unfortunately, while running the analysis for the variable Personality, there is no text output for the goodness of fit of the model (see: Table 10).

Table 10: Goodness of fit of the variable Personality

The statistical significant is not sufficient as well for the tree indicators (see: Table 11), but the variable will be included because it is considered as influential to the intention because it to some extend it depends on the personality for the degree of engagement to some environmental activities.

Regression Weights: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
MN1_1	<---	Personality	-1.419	.539	-2.632	.008	
MN1_2	<---	Personality	1.000				
MN1_3	<---	Personality	.268	.114	2.359	.018	

Table 11: Statistical significant of the indicators of the variable Personality.

On the other hand, the goodness of fit for the second variable – Attitude – is quite good as well as all of the indicators are shown as statistically significant. This could be seen on Table 12 and Table 13.

Table 12: Model fit of the variable Attitude.

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	10	4.900	5	.428	.980
Saturated model	15	.000	0		
Independence model	5	87.118	10	.000	8.712

Regression Weights: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
MN1_4	<---	Attitude	1.000				
MN1_5	<---	Attitude	.993	.260	3.816	***	
MN1_6	<---	Attitude	-.870	.232	-3.741	***	
MN1_8	<---	Attitude	1.208	.293	4.125	***	
MN1_10	<---	Attitude	-1.212	.298	-4.068	***	

Table 13: Statistical significant of the indicators of the variable Attitude.

Even though there are no sufficient output for the variable Personality, it will be used in the complete model along with the variable Attitude, because theoretically it is supposed that the personal point of view, and the specific characteristics (lifestyle, job position etc.) of the participant could be essential for the decisions taken by him/her.

Behavioural Intention

For the model of the variable Intention, almost all of the indicators were included except for the questions IN5 because it did not show a good statistical significant, and theoretically, it was concluded that the questions before are enough, and including IN5 could lead to the repetition of some information. The final model for this variable can be seen in Picture 12.
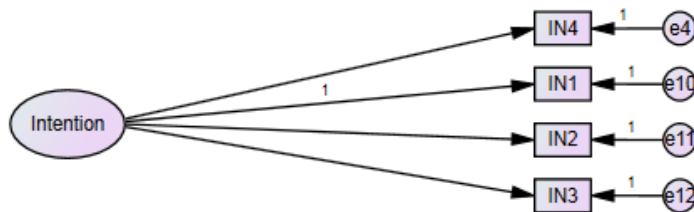
Picture 12: Final model in AMOS for the variable Intention.

Running the analysis, the text output shows very good model fit as well as statistical significant and high standardized regression weights for all of the indicators for this variable as it could be seen in Table 14 and Table 15 respectively.

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	8	3.687	2	.158	1.844
Saturated model	10	.000	0		
Independence model	4	190.730	6	.000	31.788

Table 14: Goodness of fit for the variable Intention model.

Table 15: Statistical significant and standardized regression weight of all of the indicators for the variable Intention.

**Regression Weights: (Group number 1 - Default model)**

	Estimate	S.E.	C.R.	P	Label
IN4 <--- Intention	-.897	.113	-7.931	***	
IN1 <--- Intention	1.000				
IN2 <--- Intention	-.870	.118	-7.366	***	
IN3 <--- Intention	1.064	.109	9.781	***	

Standardized Regression Weights: (Group number 1 - Default model)

	Estimate
IN4 <--- Intention	-.752
IN1 <--- Intention	.842
IN2 <--- Intention	-.712
IN3 <--- Intention	.899

Actual Behaviour

For the latent variable Actual Behaviour, some of the questions asked in the beginning of the survey were included, namely: BQ6_1, BG6_2, BG7_1, and BQ7_2. These are the indicators that show the difference between the mode of transport choice before and after the purchase of an AirBG sensor for air quality measurements. The model that was used in AMOS is shown in Picture 13.
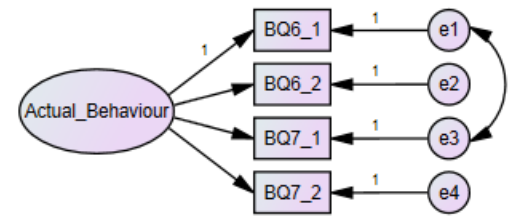
Picture 13: Model in AMOS of the variable Actual Behaviour

After running the analysis, the model of fit was not very good, that is why it was chosen the modification indices to me calculated. It was shown that a covariance between indicators BG6_1 and BG7_2 should be included and that was theoretically logical, because both of them are measuring the extent of the car use after and before purchasing a sensor respectively. After this inclusion of the covariance, the X2/DF value is not very sufficient again, even though It is close to 3 (see: Table 16).

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	9	3.707	1	.054	3.707
Saturated model	10	.000	0		
Independence model	4	172.114	6	.000	28.686

Picture 16: Goodness of fit of Behaviour model.

Nevertheless, the statistical significant for all of the indicators is quite good, thus the model will be left in this in this composition (see: Table 17) for the complete model.

Table 17: Statistical significant for all of the indicators for the variable Behaviour.

Regression Weights: (Group number 1 - Default model)

	Estimate	S.E.	C.R.	P	Label
BQ6_1 <--- Actual_Behaviour	1.000				
BQ6_2 <--- Actual_Behaviour	-1.787	.456	-3.923	***	
BQ7_1 <--- Actual_Behaviour	1.323	.260	5.089	***	
BQ7_2 <--- Actual_Behaviour	-2.395	.666	-3.598	***	

11.3   AMOS analysis of the combined model

After the analysis of all latent variables separately, the complete model was drawn in AMOS. unfortunately, for the whole model there is no sufficient results, the probability level cannot be computed, and the result is not correct. That is why, the whole model also was separated in two part: (1) measuring the influence of the background questions to the Behavioral, Normative, Control Beliefs and Moral Norms, and (2) the influence of all of the aforementioned latent variables to the intention and the actual performance of a specific behaviour, namely the use of an alternative transport for the journey from home to work / university / school. In this chapter, both of these models will be described separately, explaining all of their limitations as well.

11.3.1 Influence of the background questions to the Behavioral, Normative, Control Beliefs and Moral Norms

Using the factors that were revealed after the exploratory factor analysis in SPSS, a model was created in AMOS in which the extent of influence of these factors was measured to the latent variables that measure the intention. The complete model could be seen in Picture 14.
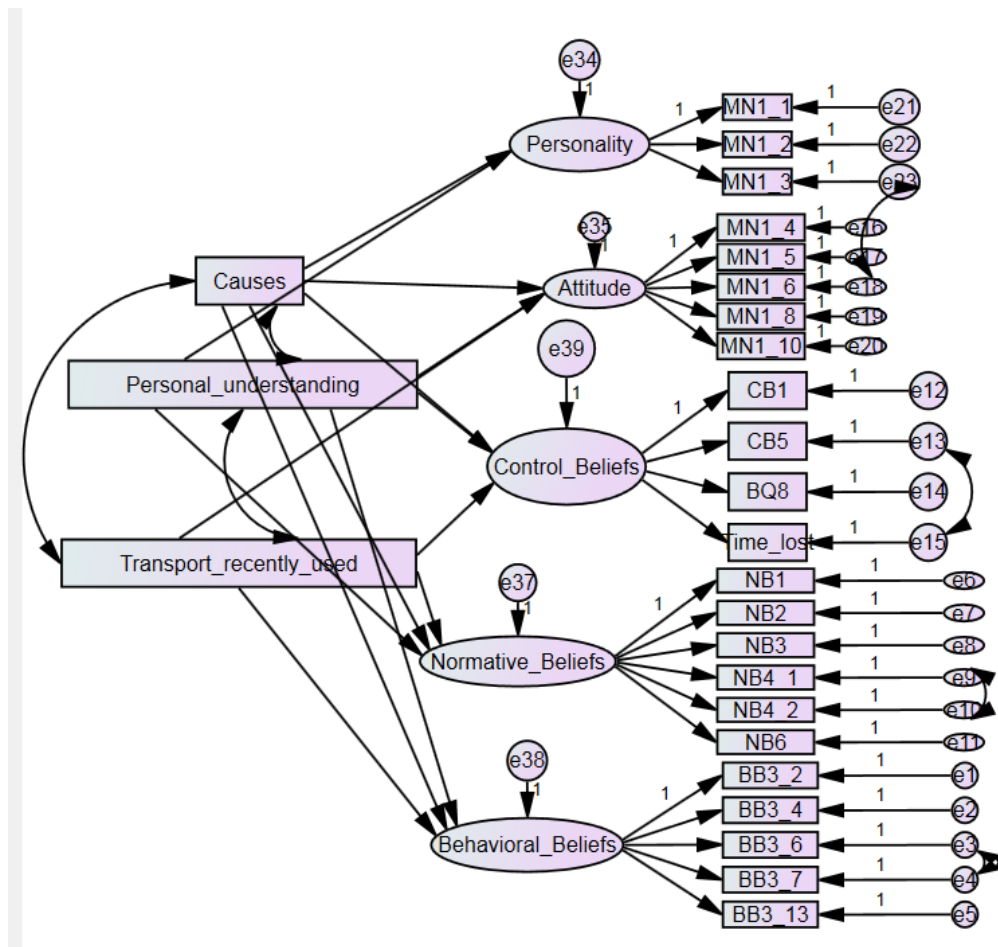
Picture 14: Complete model for the influence of the background questions and the hidden factors behind them to the Behavioral, Normative, Control Beliefs, and Moral Norms.

For improving the model, the modification indices were inspected and some correlations were included – between MN1_3 (a person in my position is expected to use a car for his / her journey from home to work

/ university / school) and MN1_6 (I feel responsible for my actions towards the environment as well as for future generations), and between Time_lost and CB5 (If you do not feel well and / or unexpected obligations require your time, would it make it more difficult to use alternative transport (public transport, bicycle, walking)). Unfortunately, even after the inspection of the modification indices, this suggested very small improvements in the model fit.

<u>Overall model fit</u>

After calculating the estimates, the text output is not highly sufficient, because it could be seen that the goodness of fit is not very high. Even though it was tried to be improved by covariance inclusion, the indicators that ae shown as not statistically significant are not excluded from the model because they are supposed to be theoretically very important for the actual environmental behaviour. AGFI = 0.669 which means that 66% of the variance in the environmental behaviour is explained by the model, even though the predicted model suggests a poor fit of the data with P = 0.000 (less than 0.05), but with X2/DF = 1.447, which is less than 3, so this indice is sufficient (see: Table 18). However, the value of Pclose is better – 0.050 (see: Table 19), but RMSEA = 0.067 (close to 0.05 but not less), which does not show close fit of the data.

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	70	406.713	281	.000	1.447
Saturated model	351	.000	0		
Independence model	26	933.240	325	.000	2.872

Table 18: Goodness of fit for the model.

MSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.067	.050	.082	.050
Independence model	.146	.135	.157	.000

Table 19: Pclose for the model.

Description of the influence of the different indicators

Looking at the table with the statistical significances of all of the indicators (see: Table 20), it could be noticed that most of them are highly significant for the model. Those that are not significant are the ones that were problematic even in the analysis of the latent variables separately.

Table 20: Statistical significant of the indicators.

Regression Weights: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
Personality	<---	Personal_understanding	.523	.244	2.144	.032	
Attitude	<---	Transport_recently_used	.037	.152	.243	.808	
Control_Beliefs	<---	Causes	-.337	.201	-1.678	.093	
Normative_Beliefs	<---	Causes	.974	.273	3.564	***	
Behavioral_Beliefs	<---	Causes	.829	.218	3.801	***	
Attitude	<---	Causes	.072	.151	.476	.634	
Personality	<---	Causes	-2.083	.246	-8.481	***	
Attitude	<---	Personal_understanding	.343	.165	2.073	.038	
Control_Beliefs	<---	Personal_understanding	-.438	.251	-1.745	.081	
Normative_Beliefs	<---	Personal_understanding	.407	.279	1.459	.145	
Behavioral_Beliefs	<---	Personal_understanding	.227	.186	1.221	.222	
Behavioral_Beliefs	<---	Transport_recently_used	-.392	.189	-2.073	.038	
Normative_Beliefs	<---	Transport_recently_used	-.199	.274	-.726	.468	
Control_Beliefs	<---	Transport_recently_used	.315	.191	1.649	.099	
BB3_2	<---	Behavioral_Beliefs	1.000				
BB3_4	<---	Behavioral_Beliefs	.992	.226	4.400	***	
BB3_6	<---	Behavioral_Beliefs	.638	.205	3.103	.002	
BB3_7	<---	Behavioral_Beliefs	.904	.206	4.394	***	
BB3_13	<---	Behavioral_Beliefs	.939	.243	3.863	***	
NB1	<---	Normative_Beliefs	1.000				
NB2	<---	Normative_Beliefs	.911	.151	6.012	***	
NB3	<---	Normative_Beliefs	.121	.115	1.052	.293	
NB4_1	<---	Normative_Beliefs	.041	.133	.307	.759	
NB4_2	<---	Normative_Beliefs	.497	.134	3.697	***	
NB6	<---	Normative_Beliefs	.512	.185	2.766	.006	
CB1	<---	Control_Beliefs	1.000				
CB5	<---	Control_Beliefs	1.020	.834	1.223	.221	
BQ8	<---	Control_Beliefs	3.857	2.162	1.784	.074	
Time_lost	<---	Control_Beliefs	2.643	3.412	.775	.439	
MN1_4	<---	Attitude	1.000				
MN1_5	<---	Attitude	.945	.261	3.618	***	
MN1_6	<---	Attitude	1.055	.265	3.979	***	
MN1_8	<---	Attitude	1.062	.281	3.780	***	
MN1_10	<---	Attitude	1.385	.354	3.913	***	
MN1_1	<---	Personality	1.000				
MN1_2	<---	Personality	.894	.128	6.981	***	
MN1_3	<---	Personality	.198	.114	1.737	.082	

This study aims at explaining the relation between the intention of using an alternative transport for the journey from home to work / university / school after purchasing an AirBG sensor for air quality measurements and the actual performance of this behaviour. Before all, for this part of research it will be explained how the background information in the survey, namely the causes of buying a sensor, the transport that is recently used, and the personal understanding of the situation can influence the behavioral, normative control beliefs, and the moral norms.

When we look at the table with the standardized regression coefficients (see: Table 21), it can easily be described to what extent which indicator influences the variable. Having the standardized weights between -1 and 1, all of them that are close to -1 or 1 can be concluded as highly influential, and the way around – all of them that are close to 0 are supposed to not be essential for the variable, without any influence on it.

Table 21: Standardized regression coefficients for the indicators included in the model.

Standardized Regression Weights: (Group number 1 - Default model)

			Estimate
Personality	<---	Personal_understanding	.198
Attitude	<---	Transport_recently_used	.029
Control_Beliefs	<---	Causes	-.504
Normative_Beliefs	<---	Causes	.404
Behavioral_Beliefs	<---	Causes	.541
Attitude	<---	Causes	.063
Personality	<---	Causes	-.812
Attitude	<---	Personal_understanding	.293
Control_Beliefs	<---	Personal_understanding	-.637
Normative_Beliefs	<---	Personal_understanding	.164
Behavioral_Beliefs	<---	Personal_understanding	.144
Behavioral_Beliefs	<---	Transport_recently_used	-.229
Normative_Beliefs	<---	Transport_recently_used	-.074
Control_Beliefs	<---	Transport_recently_used	.421
BB3_2	<---	Behavioral_Beliefs	.599
BB3_4	<---	Behavioral_Beliefs	.669
BB3_6	<---	Behavioral_Beliefs	.426
BB3_7	<---	Behavioral_Beliefs	.668
BB3_13	<---	Behavioral_Beliefs	.546
NB1	<---	Normative_Beliefs	.909
NB2	<---	Normative_Beliefs	.740
NB3	<---	Normative_Beliefs	.120
NB4_1	<---	Normative_Beliefs	.035
NB4_2	<---	Normative_Beliefs	.423
NB6	<---	Normative_Beliefs	.316
CB1	<---	Control_Beliefs	.186
CB5	<---	Control_Beliefs	.167
BQ8	<---	Control_Beliefs	.629
Time_lost	<---	Control_Beliefs	.088
MN1_4	<---	Attitude	.570
MN1_5	<---	Attitude	.544
MN1_6	<---	Attitude	.606
MN1_8	<---	Attitude	.583
MN1_10	<---	Attitude	.621
MN1_1	<---	Personality	.903
MN1_2	<---	Personality	.744
MN1_3	<---	Personality	.183

(1) Relationship between Causes and all types of beliefs: theoretically it is supposed that the cause that led to the adoption of an AirBG sensor can influence the expected outcome for the participant (behavioural beliefs); the norms that he/she sticks to – towards the society, towards AirBG, or even towards the environment (Normative Beliefs), and the factors that are not dependent on the participant, and which he/she cannot influence on (Control Beliefs). the causes identified in the survey are: protection of the environment, healthier population or expected action by the participant from his/her relatives and friends. From the table, it could be seen that the influence of the Causes towards the Personality (-0.812) is very high, very close to -1, whereas its influence towards the Normative Beliefs (0.404), Behavioural Beliefs (0.541), and Control Beliefs (-0.502) is between 0 and +-1, which means that the impact is not so high, but it is not insignificant as well. On the other hand, the Causes that have led to the purchase of a sensor obviously do not influence the Attitude – a relation that is with regression coefficient only 0.063.

(2) Relationship between Transport_recently_used and all types of beliefs: Transport recently used is a variable that shows the choice of transport mode by the participant before and after purchasing a sensor. Thus, it was supposed to be connected with the variable Attitude towards the environment (a variable that measures the general attitude towards the environment of the participant through different environmental actions, responsibility etc.). However, the model shows insignificant influence of the Transport used to the Attitude with only 0.029 regression weight. For most of the variables the recently used transport is show as not so influential – with only -0.074 to the Normative Beliefs, -0.229 to the Behavioral Beliefs, and with very low influence towards the Control Beliefs (0.421).

(3) Relationship between Personal_understanding and all types of beliefs: finally, the third factor – Personal understanding shows specific characteristics of the person that is filling the questionnaire such as to what extent he/she is environmentally active (towards the problem with the air pollution), to what extent he/she is trying to convince people around him/her to be more environmentally friendly (driving less their private cars) etc. That is why, it was supposed that this factor will mostly influence the variable Personality, which also explain some of the personality characteristics but in more general way – to what extent the person perceives him-/herself as responsible for the damage of the environment in global scale, does this person deems that global environmental problems are overexaggerated etc. However, even for the strong theoretical basis

for this relationship, the model in AMOS says that the influence of the factor Personal Understanding is not significant towards the variable Personality with a regression coefficient 0.198. This factor shows higher impact on the variable Control Beliefs with regression weight-0.637, but no influence on the variables Attitude (0.293), Normative Beliefs (0.174), and Behavioural Beliefs (0.144).

(4) Relationship between variable Behavioral Beliefs and its indicators: the highest influence for this variable is shown by indicators BB3_4 – Comfortability achievement by using alternative transport (0.667) and BB3_7 – contribution to a healthier population as a result of using an alternative transport (0.668). for the other three indicators, the regression coefficients are not so high, but they are not insignificant as well – with 0.599 for BB3_2 (way to avoid congestions), 0.546 for BB3_13 (will save money), and 0.426 for BB3_6 (environmentally friendly transport).

(5) Relationship between variable Normative Beliefs and its indicators: NB1 and NB2 are shown as highly influential for this variable with 0.909 for NB1 which is the indicators that measures the percentage of colleagues / classmates and relatives who travel with alternative transport. NB2 with regression weight 0.740 measures the same but for the percentage of them that use their own car. NB4_2 is almost between 0 and 1 with 0.423 which means that normative beliefs are also influenced by the extent of using alternative transport by the most important colleague / classmate for the participant. Unfortunately, other indicators show quite poor influence with 0.316 for NB6 (the impact of the AirBG membership), 0.035 of NB4_1 (extent of using alternative transport by the most important person (relative, wife/husband) for the participant), and 0.120 for NB3 (the reaction of the people that surround the participant if he/she is using alternative transport permanently.

(6) Relationship between variable Control Beliefs and its indicators: BQ8 (the only indicator for the variable Control Beliefs that is taken from another part of the survey) shows the highest influence on the variable Control Beliefs with regression weight of 0.629. For the other indicators, the regression weights are not so sufficient – with 0.186 for CB1 (the extent to which the decision for using alternative transport or not depends only on the participant), 0.167 for CB5 (the possibility of having some obligations or the participant does not feel very well – the extent to which this will influence his/her decision), and the modest influence of the indicator Time_lost with 0.088 regression weight.

(7) Relationship between variable Attitude and its indicators: for the variable Attitude probably the most important indicators are MN1_6 – measures the extent of responsibility felt by the participant towards the future generation (with 0.606 regression weight), and MN1_10 – the responsibility felt by the participant when he/she sees devastated environment (0.621). indicators MN1_4, MN1_5, and MN1_8 also show not insignificant impact, but not quite high. MN4_4 (the extent of exaggeration of the global environmental problems for the participant) with regression weight of 0.570, MN1_5 (the extent to which the participant suppose that environmental issues can be solved only by the institution responsible for them) – 0.544, and 0.583 for MN1_8 (the extent of engagement of the participant in environmental activities).

(8) Relationship between variable Personality and its indicators: this variable is most influenced by two of its three indicators, namely MN1_1 (common to the participant to use alternative transport) with regression weight 0.903, and MN1_2 (common to the participant to use his/her private car) with regression weight 0.744. the third MN1_3 (the correspondence of the transport use with the job position) indicator has almost no influence on the variable Personality with

regression coefficient 0.183. Thus, important indicator here is the personal characteristic, but not the norms that must be met by the participant because of his/her job position.

11.3.2 Influence of Behavioral, Normative, Control Beliefs and Moral Norms over the Intention and the Behaviour to use an alternative transport form home to work / university / school.

In this part of the study will be shown the last and main part of the analysis that was conducted in this bachelor thesis. The relation between different beliefs and norms and the intention towards environmental activism and consequently the actual behaviour will be examined. The complete model in AMOS can be seen in Picture 15 with all variables and indicators included so to understand the influence of all of them to the intention. All of the correlations are included because variables Behavioral, Normative, Control Beliefs, Attitude and Personality are all exogenous variables. After computing the estimates, it was resulted in a poor model fit, which led to the inspection of the modification indices. The covariences that are between some of the indicators were included with the aim to improve the goodness of fit of the model.

Picture 15: Complete model in AMOS
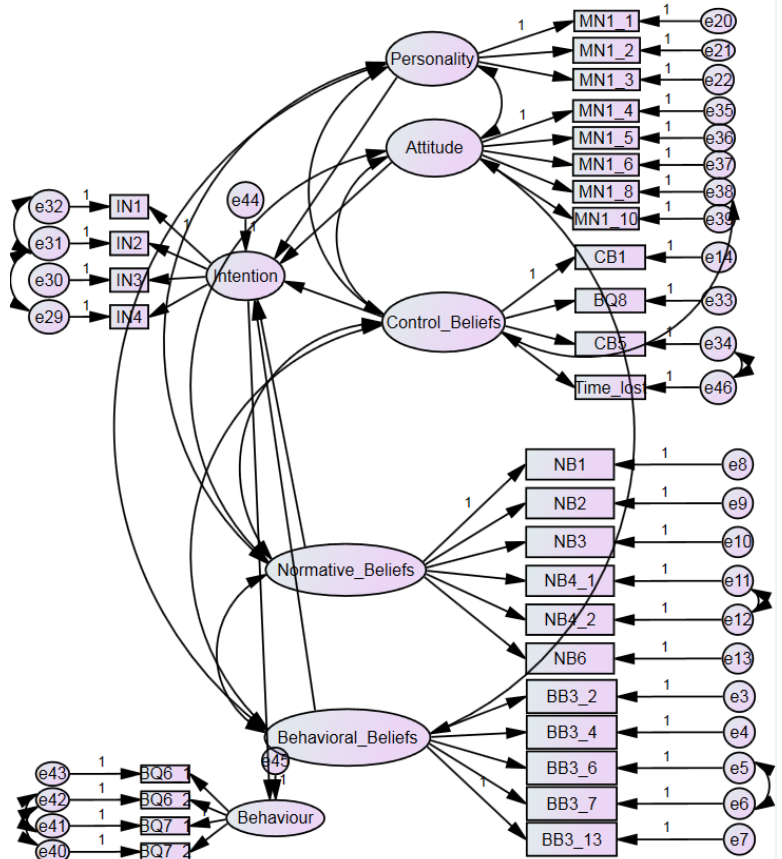
Indicators BB3_6 (the belief that using alternative transport will lead to environment preservation) and BB3_7 (the belief that this action will lead to a healthier population) are even theoretically correlated because of the strong relationship between environment and human health. NB4_1 (how often does participant`s most important person (relative, wife/husband) uses alternative transport) and NB4_2 (how often does participant`s most important colleague/classmate uses alternative transport) are also theoretically correlated because these people can overlap. CB5 (the extent to which it is possible for the participant to use alternative transport if unexpected obligations require his/her time) and indicator Time_lost (the time that is lost if the person uses alternative transport, not his/her private car) are logically related because of the time factor. For the variable Intention between all of indicators there is a covariences, as it follows: between IN1 and IN2 which are the same questions but the former one is measuring the possibility of using alternative transport for participant`s next journey, and the latter measures the same but for his/her personal car. The case with IN3 and IN4 is the same – questions that measure how often the participant intends to use his/her car (IN3) or alternative transport (IN4) while traveling from home to work/university/school in the forthcoming three months. Finally, for the variable Behavioral Beliefs, there is correlation between BQ6_2 and BQ7_2 which measure

the frequency of alternative transport use after and before the purchase of an AirBG sensor respectively. BQ6_1 and BQ7_1 are measuring the same but for the car use.

Overall model fit

Unfortunately, even after the inclusion of all of these correlations between the indicators after the inspection of the modification indices, the model shows poor model fit. Even though 66% of the variance is explained by the data (see: Table 22), the model goodness of fit is poor because of the P and Pclose value which are both below 0.05 – 0.000 and 0.001 respectively (see: Table 23 and 24). However, the X2/DF ration was improved lowing it to the value of 0.503 which is a good one because it is below 3 (see: Table 23). RMSEA is also not sufficient because it is over 0.05 (see: Table 24).

RMR, GFI

Model	RMR	GFI	AGFI	PGFI
Default model	1.285	.726	.668	.600
Saturated model	.000	1.000		
Independence model	2.924	.332	.287	.311

Table 22: the percent of variance explained by the data.

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	86	616.303	410	.000	1.503
Saturated model	496	.000	0		
Independence model	31	1463.743	465	.000	3.148

Table 23: Goodness of fit table with P and X2/DF values.

Table 24: Pclose value that also shows the model fit, and RMSEA value that shows whether the model has a close fit.

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.076	.063	.088	.001
Independence model	.156	.147	.165	.000

It could be seen that some of the indices are not sufficient related to the model fit but at least the X2/DF ratio is low enough so the model to be used for analysis. On Table 25 the statistical significances of all of the indicators are presented and it could be seen that 17 among 30 relations are statistically significant.

The most problematic variable is again Control Beliefs which could be seen also in the separated analysis of all of the latent variables chapter. The relations between the Behavioral, Normative, Control Beliefs, Attitude and Personality with the Intention are also not highly significant. However, the statistical significance of the relation between Intention and Behaviour is the closest towards the sufficient one. The analysis has shown that even the exclusion of some of the indicators that are not with high significance does not change the model fit, that is why, all of them was used in the analysis.

Table 25: Statistical significances of all of the relations in the model.

Description of the influence of the different indicators

Standardized Regression Weights: (Group number 1 - Default model)

			Estimate
Intention	<---	Behavioral_Beliefs	.149
Intention	<---	Normative_Beliefs	-.125
Intention	<---	Control_Beliefs	.736
Intention	<---	Attitude	.207
Intention	<---	Personality	.594
Behaviour	<---	Intention	.947
BB3_2	<---	Behavioral_Beliefs	.604
BB3_4	<---	Behavioral_Beliefs	.628
BB3_6	<---	Behavioral_Beliefs	.388
BB3_7	<---	Behavioral_Beliefs	.628
BB3_13	<---	Behavioral_Beliefs	.622
NB1	<---	Normative_Beliefs	.906
NB2	<---	Normative_Beliefs	.742
NB3	<---	Normative_Beliefs	.122
NB4_1	<---	Normative_Beliefs	.016
NB4_2	<---	Normative_Beliefs	.415
NB6	<---	Normative_Beliefs	.324
CB1	<---	Control_Beliefs	.164
IN4	<---	Intention	.619
IN3	<---	Intention	.809
IN2	<---	Intention	.707
IN1	<---	Intention	.792
BQ8	<---	Control_Beliefs	.451
CB5	<---	Control_Beliefs	.311
MN1_1	<---	Personality	.889
MN1_2	<---	Personality	.752
MN1_3	<---	Personality	.238
MN1_4	<---	Attitude	.522
MN1_5	<---	Attitude	.525
MN1_6	<---	Attitude	.643
MN1_8	<---	Attitude	.552
MN1_10	<---	Attitude	.680
BQ7_2	<---	Behaviour	.648
BQ7_1	<---	Behaviour	.738
BQ6_2	<---	Behaviour	.693
BQ6_1	<---	Behaviour	.765
Time_lost	<---	Control_Beliefs	.304

Regression Weights: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
Intention	<---	Behavioral_Beliefs	.310	.898	.345	.730	
Intention	<---	Normative_Beliefs	-.176	.248	-.712	.477	
Intention	<---	Control_Beliefs	4.243	4.940	.859	.390	
Intention	<---	Attitude	.678	1.247	.544	.587	
Intention	<---	Personality	.800	.311	2.573	.010	
Behaviour	<---	Intention	.842	.120	7.040	***	
BB3_2	<---	Behavioral_Beliefs	.943	.215	4.388	***	
BB3_4	<---	Behavioral_Beliefs	.870	.193	4.508	***	
BB3_6	<---	Behavioral_Beliefs	.543	.181	3.007	.003	
BB3_7	<---	Behavioral_Beliefs	.795	.176	4.511	***	
BB3_13	<---	Behavioral_Beliefs	1.000				
NB1	<---	Normative_Beliefs	1.000				
NB2	<---	Normative_Beliefs	.915	.140	6.557	***	
NB3	<---	Normative_Beliefs	.123	.115	1.069	.285	
NB4_1	<---	Normative_Beliefs	.019	.133	.141	.887	
NB4_2	<---	Normative_Beliefs	.489	.132	3.704	***	
NB6	<---	Normative_Beliefs	.526	.183	2.874	.004	
CB1	<---	Control_Beliefs	1.000				
IN4	<---	Intention	.720	.119	6.054	***	
IN3	<---	Intention	.941	.111	8.442	***	
IN2	<---	Intention	.832	.132	6.309	***	
IN1	<---	Intention	1.000				
BQ8	<---	Control_Beliefs	3.144	2.277	1.380	.167	
CB5	<---	Control_Beliefs	2.152	1.662	1.295	.195	
MN1_1	<---	Personality	1.000				
MN1_2	<---	Personality	.918	.113	8.126	***	
MN1_3	<---	Personality	.263	.123	2.149	.032	
MN1_4	<---	Attitude	1.000				
MN1_5	<---	Attitude	.997	.293	3.401	***	
MN1_6	<---	Attitude	1.228	.324	3.797	***	
MN1_8	<---	Attitude	1.096	.316	3.466	***	
MN1_10	<---	Attitude	1.657	.426	3.885	***	
BQ7_2	<---	Behaviour	.800	.137	5.853	***	
BQ7_1	<---	Behaviour	1.000				
BQ6_2	<---	Behaviour	.800	.135	5.943	***	
BQ6_1	<---	Behaviour	.976	.140	6.968	***	
Time_lost	<---	Control_Beliefs	10.376	8.052	1.289	.198	

The influence of the indicators on the variables is explained looking at the table that shows the standardized regression coefficients of the indicators and variables (see: Table 26). As it was said in the previous sub-chapter the weights that are close to -1 or 1 are considered as highly influential, whereas those that are close to 0 have no influence on the variables.

Table 26: Standardized regression weights of all of the indicators and variables in the model.

(1) Relation between Behavioral Beliefs and its indicators: in this model, compared to the previous one more than two indicators have influence on the behavioural beliefs, namely BB3_2 with regression weight of 0.604 (way to avoid congestions), BB3_4 with 0.628 (comfortability) and BB3_7 with 0.628 (will contribute to healthier population) again and BB3_13 with 0.622 (Money saver).the indicator BB3_6 (environmentally friendly transport) is still not influential as it was already seen with regression coefficient 0.388.

(2) Relation between Normative Beliefs and its indicators: the same case as the previous model NB1 and NB2 (the percentage of people around the participant who travel by alternative transport and by car respectively) are with high influence towards the variable: 0.906 for NB1 and 0.742 for NB2. The other 4 are not so influential because of the low regression coefficients that they have, except for NB6 with 0.324 which is however closer to 0, so it is also not very sufficient.

(3) Relation between Control Beliefs and its indicators: again BQ8 shows the highest influence towards the variable even though it is even lower than in the previous model (0.451). The other two indicators obviously have no impact on the variable (with 0.311 for CB5 and 0.304 for Time_lost).

(4) Relation between Attitude and its indicators: here again the results show that the most influential indicators are MN1_6 (the extent of responsibility feeling towards the future generations) with regression coefficient of 0.643 and MN1_10 (the extent of responsibility feeling towards the environment as a citizen of the planet) with 0.680. The other three indicators are with lower impact that is between 0 and 1, namely 0.522 for MN1_4, 0.525 for MN1_5 and 0.552 for MN1_8.

(5) Relation between Personality and its indicators: here again the most influential indicators are considered to be MN1_2 (the common characteristic of the person for using alternative transport) with regression coefficient of 0.889 and MN1_2 (the common characteristic of using personal car) with 0.752. the indicator that measures the impact of the person`s job position over the mode of transport used form home to work / university / school (MN1_3) is with low influence of 0.238.

(6) Relation between Behavioral, Normative Control Beliefs and Moral Norms and the Intention and Actual Behaviour: from the results it could be seen that the things that are not dependent on our participant`s own decision, namely the control beliefs, as well as the personality characteristics have the highest influence on the Intention to behave pro-environmentally and to use alternative transport. The regression coefficient of the Control Beliefs is 0.736, whereas of the Personality variable – 0.594 (which is not as high as it is wanted, but it is again sufficient). The lowest influence is shown to have Normative Beliefs (what people around the participant expect him/her to do) with -0.125 and Behavioral Beliefs (the expected result from the behavioral performance by the participant) with 0.149. The Attitude variable shows a little bit higher regression coefficient and consequently influence towards the intention with 0.207.

Fortunately, at least the relation between Intention and Actual Behaviour is quite high and sufficient with regression coefficient of 0.947 which shows that all the indicators that are observed directly by the survey that predict the Intention can be used for the prediction of the actual behaviour. Therefore, as it was supposed theoretically intention can predict the behaviour via different beliefs and norms.

11.4 Participants sample

As it was explained in the beginning of the Methodology chapter, the survey was constructed through the Qualtrics website. Thus, according to some reports that are available after the distribution and completion of the questionnaire by the participants, it is possible to make an average model of the participant according to the data received by the questions. On Graph 1, the sample of the ages among the participants can be seen since the average age is 32.
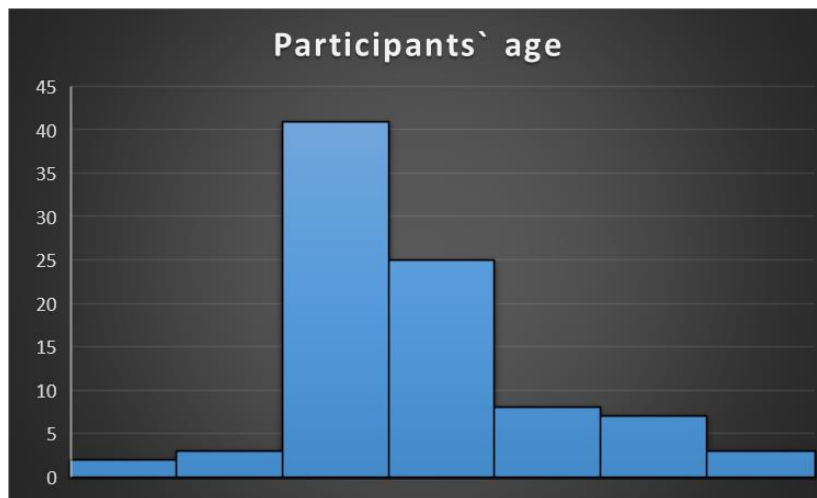
Graph 1: Participants` age sample

Furthermore, there is a question in the survey that asks about the education that the participants have, which was an important question because in that way it is possible to suppose the extend of importance of the degree obtained by the participant towards the environmental activism. On Graph 2, it is noticed that almost all of the participants have Bachelor / Master Degree, which allows us to say that the higher education enables people to perceive the environmental issues as something personal and something that they can act upon. The legend of the graph shows the five categories that was possible to choose. According to Qualtrics report, 83.52% of the participants have obtained Bachelor`s or Master`s Degree before purchasing an AirBG sensor for air quality measurements.
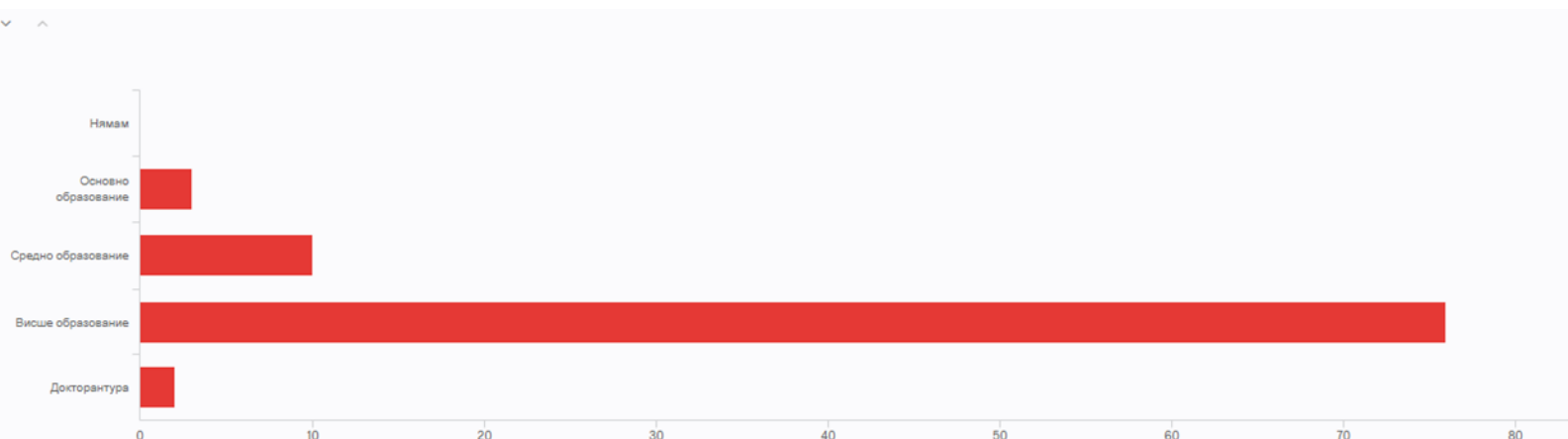
Graph 2: The most common education level among the participants.

Legend: 1. No education
        2. Secondary School
        3. High School
        4. Bachelor / Master Degree
        5. PhD

12. Disadvantages of the model

While looking at the analysis chapter, it could be noticed that there is one quite problematic model for this research. After hard work on improving it, there was at least an AMOS text output, before this, there was no result, and only unidentified models. However, everything that was suggested by AMOS and by theoretical background to have some improvement skills over the model was done but the model again had no very sufficient goodness of fit and standardized regression coefficients for all of the indicators. There are few disadvantages of the model and of the research as well that can be an obstacle for a useful model and thus need some improvements in further research. These detriments are namely: (1) as it was said above the low regression weights of some of the indicators and the low model fit; (2) the lack of control group and the consequential analogical disadvantage of the model – it cannot be compared to another group of people that have not bought these sensors for air quality measurements, and (3) according to the questions that are asked in the questionnaire it could be said that for some of the indicators it cannot be said whether they are the cause or the result of the specific behaviour.

13. Conclusions

Having said these disadvantages of the model it could be said that specific and unconditional conclusions cannot be made because of the low model fit. However, in the theoretical part of this research some hypotheses were delignated, and some answers to them and to the research questions will be given:

1) *The purchase of an AirBG sensor for air quality measurements has significantly positive influence on the travel mode choice of the adopters:* this hypothesis cannot be said that it is confirmed by the analysis because of the low regression coefficients of the factors Causes, Personal understanding and Transport recently used towards the latent variables related to the beliefs and the norms.
2) *Behavioural beliefs have a positive influence on the subjective norms, which in turn on using an alternative mode of transport such as public transport, bicycle or walking:* the coefficient of 0.149 for the relation between Behavioral Beliefs and Intention shows that the beliefs for different outcomes of the participants have no high impact on the intention to use an alternative mode of transport.
3) *Normative beliefs have a positive influence on the subjective norms, which in turn on using an alternative mode of transport such as public transport, bicycle or walking:* normative beliefs such as behavioral ones have low influence on the intention; thus, this hypothesis is not proved as well.
4) *Control beliefs have a positive influence on the subjective norms, which in turn on using an alternative mode of transport such as public transport, bicycle or walking:* this hypothesis was

proved correctly because after the analysis it was seen that the influence of the control beliefs on the intention is quite high.

5) *Moral Norms have a positive influence on the subjective norms, which in turn on using an alternative mode of transport such as public transport, bicycle or walking:* here, the two variables show different influence, namely Personality shows higher impact on the intention, whereas Attitude lower one but again not insignificant.

6) *The four antecedent beliefs/norms will significantly predict the intention for using an alternative mode of transport such as public transport, bicycle or walking:* Not all of the four antecedents significantly predict the intention of the participant to use an alternative mode of transport. Only two of them are highly influential – Control Beliefs and Moral Norms, whereas Behavioral and Normative Beliefs are analyzed as not so dominant. Again, here it could be said that it is quite important to say that because of the poor model fit and the poor results as a whole, this conclusion cannot be so unconditional.

This research also has a research main question and some sub-questions that was expected to be answered. Even thought, the model analysis is not quite good, it can be concluded at least according to the results that were obtained so far. The sub-questions were:

1) What are the reported behaviour beliefs and their influence on the attitude toward using an alternative transport such as public transport, bicycle or walking?

The behavioral beliefs that were reported in this analysis were as it follows: (a) way to avoid congestions; (b) comfortability; (c) environmentally friendly mode of transport; (d) healthier population), and (e) money saver. According to the regression coefficients, they have not high influence on the intention (attitude) to use an alternative transport such as public transport bicycle and walking.

2) What are the reported normative beliefs and their influence on the intention?

For the analysis the normative beliefs that were significant and reported were as it follows: (a) the percentage of colleagues / classmates and relatives who travel with alternative transport from home to work / university / school; (b) the percentage of colleagues / classmates and relatives who travel by car from home to work / university / school; (c) the extent of approval of the people that surround the participant if he/she uses alternative transport permanently; (d) the frequency of alternative transport use by the most important person and most important colleague/classmate for the participants, and (e) the extent of influence of the AirBG membership over the decision whether to use an alternative transport. According to the results in AMOS, Normative Beliefs have not got very high influence on the Intention to use an alternative transport.

3) What are the reported control beliefs and their influence on the intention?

The reported control beliefs that were included in the model were as it follows: (a) the extent of the independence of taking a decision related to the mode of transport choice by the participant; (b) the extent of possibility to use alternative transport if the participant face some unexpected obligations that require time; (c) the time that is lost while comparing the time needed for traveling by alternative transport, and for traveling by car, and (d) the general possibility of using alternative transport by the participant. The variable control beliefs show high influence on the intention according to the AMOS output.

4) What are the reported moral norms and their influence on the intention?

As it was explained above in the study, the variable Moral Norms was separated into two variables that explain the personal understanding of the person, influenced by his/her characteristic, and the attitude towards the global environmental problems. The variable Personality consists of indicators that show: (a) how common it is for the participant to use alternative transport; (b) how common it is for the participant to use a car), and (c) the extent to which the job position is important for the participant`s mode of transport choice. This variable shows also high influence on the intention, along with the control beliefs. However, the reported indicators for the variable Attitude, namely: (a) the extent of exaggeration of the environmental issues according to the participant; (b) the responsibility taken by the participant for environmental issues; (c) the responsibility towards future generation); (d) the responsibility toward the environment in general, and (e) the extent of environmental engagement of the participant, are not so influential for the variable intention.

5) Is there a relation at all between the intention and the actual environmental behaviour in the case of the travel mode choice of the people who have adopted a station?

The relation between the intention and the actual behaviour is quite high and obvious with this repression coefficient of 0.947 resulted in AMOS after the estimates calculation, and some tries for model improvements.

The final conclusion reflects on the main research question: *What is the relation between the purchase of an AirBG sensor for air quality measurements and the travel mode choice of the adopters?* Unfortunately, as it was said, with this poor model, the conclusion for the relationship between these two variables cannot be quite strong. Nevertheless, it could be said that the factor hidden behind the background questions Transport_recently_used and Personal_understanding are influencing the Control Beliefs which in turn influence the Intention. On the other hand, the Causes (as a background factor) highly influences the Personality variable which in turn has significant impact on the Intention. Finally, the relation between the Intention and the Behaviour was shown as highly significant. Consequently, it can be concluded that all of the background factors that were revealed by the exploratory factor analysis and which are part of the background questions related to the preliminary purchase of an AirBG sensor for air quality measurements have impact on the actual behaviour via different beliefs and norms, more specifically – via control beliefs and moral norms (personality variable).

14. Reflection

Writing this bachelor thesis has greatly contributed to my knowledge and my skills as a whole. I learned how to do a complete study with my initial literature review and subsequent statistical analysis. Even though the model results from the overall work on this study was not satisfactory, I learned where and what mistakes could be made in AMOS and SPSS programs, which is extremely important for further research. I also managed to understand how important it is in a survey to think every question very carefully. The biggest challenge for me was undoubtedly the creation of the correct model in AMOS, which I think is obvious from the study. After hard work every day, many emails, and an extraordinary trip to the Netherlands for consultation, it became clear that the model is problematic and cannot achieve the expected result. The biggest obstacle, however, was that neither me nor my mentor was able to figure out exactly where the problem is.

Despite all this, I sincerely thank everyone who helped me to write this thesis, but mostly to prof. Huib Ernste, because without his help, responsiveness and concern to my research, there would be no result, even the one that is not so satisfying.

15. Appendix: Survey

Dear participants,

Before we start the survey, we would like to introduce you to the procedure we follow. Please, read carefully the text below and do not hesitate to ask your questions if you find it unclear.

Essence of the study

This study is conducted by a student at Radboud University, Nijmegen, the Netherlands, in cooperation with AirBG. The study is the main part of the bachelor thesis on "From Intention to Action: Smart Cities and Civil Science".

Purpose of the study

This questionnaire is about your choice of travel mode from home to work / university / school. The purpose of this study is to investigate the intention to use alternative transport such as a bus, bicycle or walking on people who have adopted an AirBG station for air quality measuring. This study can contribute to the optimization of AirBG services and to the transport services improve.

How is the study going?

You get a list of questions that could be answerd for about 10 minutes.

Volunteering

Your participation in the survey is entirely voluntary and you have the right to opt-out after reading this text or during the completion of the questionnaire without clarifying the reason for doing so.

Your anonymity is guaranteed

The received data is anonymous and the information is completely confidential. After the completion of the study, the data will be destroyed.

Further clarifications

Please answer the questions spontaneously. It is important for us to fill out as many questions as possible, but in case you do not have an answer, please, proceed to the next question.

If you have questions or comments about the survey / research, you can contact the student who writes the thesis: Plamena Terziradeva; e-mail: p.terziradeva@student.ru.nl or the mentor: Prof. Huib Ernste; e-mail: h.ernste@fm.ru.nl.

With respect,

Plamena S. Terziradeva and prof. Huib Ernste.

Background questions

BQ1 – To what extent have the following statements been important to your decision to adopt an AirBG Air Measurement Station?

- This action will help to protect the environment
  Not at all :__1__:__2__:__3__:__4__:__5__:__6__:__7__: __8 __:__9__:__10__: very much
- This action will contribute to fewer diseases of the population related to the contaminated air
  Not at all :__1__:__2__:__3__:__4__:__5__:__6__:__7__: __8 __:__9__:__10__: very much
- My friends / relatives told me to do it
  Not at all :__1__:__2__:__3__:__4__:__5__:__6__:__7__: __8 __:__9__:__10__: very much
- This action would provoke the municipality / government to take action because they will see that the population is active in terms of environmental issues
  Not at all :__1__:__2__:__3__:__4__:__5__:__6__:__7__: __8 __:__9__:__10__: very much

BQ2 - To what extent has sensor buying influenced your choice for home / work / university / school transportation?

Not at all :__1__:__2__:__3__:__4__:__5__:__6__:__7__: __8 __:__9__:__10__: very much

BQ3 - Do you think that the measures taken by the government / municipality related to the quality of the ambient air are sufficient (strategies, programs, displays with PM)?

Not at all :__1__:__2__:__3__:__4__:__5__:__6__:__7__: __8 __:__9__:__10__: very much

BQ4 - To what extent are the following actions relevant to you?

- I regularly sign petitions related to environmental protection and pollution problems
  Not at all :__1__:__2__:__3__:__4__:__5__:__6__:__7__: __8 __:__9__:__10__: very much
- I'm trying to convince people around me to drive less
  Not at all :__1__:__2__:__3__:__4__:__5__:__6__:__7__: __8 __:__9__:__10__: very much
- I actively support the fight against air pollution
  Not at all :__1__:__2__:__3__:__4__:__5__:__6__:__7__: __8 __:__9__:__10__: very much
- When I vote, I pay special attention to that part of the party's agenda dealing with environmental issues
  Not at all :__1__:__2__:__3__:__4__:__5__:__6__:__7__: __8 __:__9__:__10__: very much
- If I give up my car, it will only be to my detriment because I will still suffer from the polluting behavior of others
  Not at all :__1__:__2__:__3__:__4__:__5__:__6__:__7__: __8 __:__9__:__10__: very much

BQ5 - What was the last basic vehicle you used from home to work / university / school?

- Car
- Public transport
- Walking or bicycle

BQ6 - After purchasing the AirBG sensor, how often do you use the following vehicles?

- Car
- Alternative transport (public transport; bicycle; walking)

BQ7 - Before buying the AirBG sensor, how often have you used the following vehicles?

- Car

- Alternative transport (public transport; bicycle; walking)

BQ8 - In general, for you, the possible use of alternative transport (public transport, bicycle, walking) from home to work / university / school in the following 3 months would be:

Unpleasant:__1__:__2__:__3__:__4__:__5__:__6__:__7__: __ 8 __:__9__:__10__: Pleasant

BQ9 - How many times have you used your car from home to work / university / school last week?

- 0-2
- 2-4
- 4-6
- 6-8
- 8-10

BQ10 - How many times have you used alternative transport (public transport, bicycle, walking) from home to work / university / school last week?

- 0-2
- 2-4
- 4-6
- 6-8
- 8-10

Behavioral beliefs

BB1 - For you, the habit of using alternative transport (public transport, bicycle, walking) from home to work / university / school is:

Possible: __1__:__2__:__3__:__4__:__5__:__6__:__7__: __ 8 __:__9__:__10__: Impossible

BB2 - Which transport from the listed is most likely to be used if you do not use your personal car from home to work / university / school in the next 3 months?

- Public transport
- Bicycle
- Walking

BB3 - To what extent do you consider the characteristics listed are typical to the transport chosen by you in the previous question (for travel from home to work / university / school)?

- Slow
  Not characteristic at all :__1__:__2__:__3__:__4__:__5__:__6__:__7__: Definitely characteristic
- Way to avoid congestions
  Not characteristic at all :__1__:__2__:__3__:__4__:__5__:__6__:__7__: Definitely characteristic
- Reliable
  Not characteristic at all :__1__:__2__:__3__:__4__:__5__:__6__:__7__: Definitely characteristic
- Comfortable
  Not characteristic at all :__1__:__2__:__3__:__4__:__5__:__6__:__7__: Definitely characteristic
- Way to read, listen to music, work
  Not characteristic at all :__1__:__2__:__3__:__4__:__5__:__6__:__7__: Definitely characteristic

- Environmentally friendly
  Not characteristic at all :__1__:__2__:__3__:__4__:__5__:__6__:__7__: Definitely characteristic
- Will contribute to healthier population
  Not characteristic at all :__1__:__2__:__3__:__4__:__5__:__6__:__7__: Definitely characteristic
- Stress free
  Not characteristic at all :__1__:__2__:__3__:__4__:__5__:__6__:__7__: Definitely characteristic
- Weather independent
  Not characteristic at all :__1__:__2__:__3__:__4__:__5__:__6__:__7__: Definitely characteristic
- Opportunity for social contacts
  Not characteristic at all :__1__:__2__:__3__:__4__:__5__:__6__:__7__: Definitely characteristic
- Corresponds to my lifestyle
  Not characteristic at all :__1__:__2__:__3__:__4__:__5__:__6__:__7__: Definitely characteristic
- Well combined with other activities
  Not characteristic at all :__1__:__2__:__3__:__4__:__5__:__6__:__7__: Definitely characteristic
- Money saver
  Not characteristic at all :__1__:__2__:__3__:__4__:__5__:__6__:__7__: Definitely characteristic
- Time saver
  Not characteristic at all :__1__:__2__:__3__:__4__:__5__:__6__:__7__: Definitely characteristic

Normative beliefs

NB1 - Approximately what percentage of your colleagues / classmates and relatives travel with alternative transport (public transport, bicycle, walking) to work / university / school?

- 0-10 %
- 10-20 %
- 20-30 %
- 30-40 %
- 40-50 %
- 50-60 %
- 60-70 %
- 70-80%
- More than 80 %

NB2 - Approximately what percentage of your colleagues / classmates and relatives travels by car to work / university / school?

- 0-10 %
- 10-20 %
- 20-30 %
- 30-40 %
- 40-50 %
- 50-60 %
- 60-70 %
- 70-80%
- More than 80 %

NB3 - The next question is about people's reaction to your everyday environment. Please imagine that you use alternative transport (public transport, bicycle, walking) to work / university / school (if this is not the case). How will most of your friends, relatives and colleagues will respond to that?

Approval :__1__:__2__:__3__:__4__:__5__:__6__:__7__: Disapproval

The following questions are related to the most important people for you:

· The most important for you person (relative, wife/husband)

· The most important colleague / classmate

NB4 - How often do these people use alternative transport (public transport, bicycle, walking) for their trip to work / university / school?

- The most important for you person (relative, wife/husband)
  Approval :__1__:__2__:__3__:__4__:__5__:__6__:__7__: Disapproval
- The most important colleague / classmate
  Approval :__1__:__2__:__3__:__4__:__5__:__6__:__7__: Disapproval

NB5 - How will these people react if you use alternative transport (public transport, bicycle, on foot) for your travel from home to work / university / school?

- The most important for you person (relative, wife/husband)
  Always :__1__:__2__:__3__:__4__:__5__:__6__:__7__: Never
- The most important colleague / classmate
  Approval :__1__:__2__:__3__:__4__:__5__:__6__:__7__: Disapproval

NB6 - How did your AirBG adopter status affect your decision on what kind of transport to use from home to work / university / school?

No influence :__1__:__2__:__3__:__4__:__5__:__6__:__7__: Huge influence

Control beliefs

CB1 - To what extent is your decision solely on whether you are traveling by car or alternative transportation (public transport, bicycle, on foot)?

Absolutely independent: __1__:__2__:__3__:__4__:__5__:__6__:__7__: __8__:__9__:__10__: Absolutely dependent

CB2 - How long do you need if you drive from home to work / university / school (in minutes)?

CB3 - How long do you need if you use an alternative transport from home to work / university / school (in minutes)?

CB4 - To what extent do you think the following features are important for your decision whether to use alternative transport (public transport, bicycle, walking)?

- Safety
  Very important:__1__:__2__:__3__:__4__:__5__:__6__:__7__: Not important at all
- Comfortability
  Very important:__1__:__2__:__3__:__4__:__5__:__6__:__7__: Not important at all
- Fast

Very important:__1__:__2__:__3__:__4__:__5__:__6__:__7__: Not important at all

- Opportunity to read, listen to music, work
  Very important:__1__:__2__:__3__:__4__:__5__:__6__:__7__: Not important at all
- Stress free
  Very important:__1__:__2__:__3__:__4__:__5__:__6__:__7__: Not important at all
- Weather independent
  Very important:__1__:__2__:__3__:__4__:__5__:__6__:__7__: Not important at all
- Corresponds to my lifestyle
  Very important:__1__:__2__:__3__:__4__:__5__:__6__:__7__: Not important at all
- Money saver
  Very important:__1__:__2__:__3__:__4__:__5__:__6__:__7__: Not important at all
- Time saver
  Very important:__1__:__2__:__3__:__4__:__5__:__6__:__7__: Not important at all

CB5 - If you do not feel well and / or unexpected obligations require your time, would it make it more difficult to use alternative transport (public transport, bicycle, walking)?

To a great extend: __1__:__2__:__3__:__4__:__5__:__6__:__7__:__8__:__9__:__10__: To a minor extend

Moral norms

MN1 - To what extent do the following statements relate to your perceptions and way of thinking

- It is common for me to use alternative transport (public transport, bicycle, on foot) for travel from home to work / university / school
  Typical to me:__1__:__2__:__3__:__4__:__5__:__6__:__7__: Unusual to me
- It is common for me to use my private car for home / work / university / school travel
  Typical to me:__1__:__2__:__3__:__4__:__5__:__6__:__7__: Unusual to me
- A person in my position is expected to use a car for his / her journey from home to work / university / school
  Typical to me:__1__:__2__:__3__:__4__:__5__:__6__:__7__: Unusual to me
- For me, environmental issues such as global warming and biodiversity loss are greatly exaggerated
  Typical to me:__1__:__2__:__3__:__4__:__5__:__6__:__7__: Unusual to me
- In my view, global environmental problems can only be solved by the institutions responsible for them, without the involvement of citizens
  Typical to me:__1__:__2__:__3__:__4__:__5__:__6__:__7__: Unusual to me
- I feel responsible for my actions towards the environment as well as for future generations
  Typical to me:__1__:__2__:__3__:__4__:__5__:__6__:__7__: Unusual to me
- I think there is no problem with air quality in Bulgaria
  Typical to me:__1__:__2__:__3__:__4__:__5__:__6__:__7__: Unusual to me
- Overall, I am not engaged in environmental activities and I do not think they could change anything
  Typical to me:__1__:__2__:__3__:__4__:__5__:__6__:__7__: Unusual to me
- In my opinion, traffic is not a significant part of the air pollution problems
  Typical to me:__1__:__2__:__3__:__4__:__5__:__6__:__7__: Unusual to me
- When I see a devastated environment, I feel responsible for it as a citizen
  Typical to me:__1__:__2__:__3__:__4__:__5__:__6__:__7__: Unusual to me

- I basically use alternative transport (public transport, bicycle, walking) not because it will change something; environmental problems will still be solved
  Typical to me:__1__:__2__:__3__:__4__:__5__:__6__:__7__: Unusual to me

Intention

IN1 - The next time you travel from home to work / university / school, do you plan to use alternative transport (public transport, bicycle, walking)?

Absolutely possible: __1__:__2__:__3__:__4__:__5__:__6__:__7__: __8__:__9__:__10__: Absolutely impossible

IN2 - The next time you travel from home to work / university / school, do you plan to use your personal car?

Absolutely possible: __1__:__2__:__3__:__4__:__5__:__6__:__7__: __8__:__9__:__10__: Absolutely impossible

IN3 - How often do you intend to drive from home to work / university / school in the next 3 months?

Never: __1__:__2__:__3__:__4__:__5__:__6__:__7__: __8__:__9__:__10__: Always

IN4 - How often do you intend to use alternative transportation (public transport, bicycle, walking) from home to work / university / school in the next 3 months?

Never: __1__:__2__:__3__:__4__:__5__:__6__:__7__: __8__:__9__:__10__: Always

IN5 - Which transportation do you think you should most often use for your home / work / university / school trip in the next 3 months?

- Public transport
  Never: __1__:__2__:__3__:__4__:__5__:__6__:__7__: __8__:__9__:__10__: Always
- Car
  Never: __1__:__2__:__3__:__4__:__5__:__6__:__7__: __8__:__9__:__10__: Always
- Bicycle
  Never: __1__:__2__:__3__:__4__:__5__:__6__:__7__: __8__:__9__:__10__: Always
- Walking
  Never: __1__:__2__:__3__:__4__:__5__:__6__:__7__: __8__:__9__:__10__: Always

Q36 - What is your age?

Q37 – What is your education?

- I have no degree
- Primary
- Secondary
- Bachelor/Master degree
- PhD

We sincerely thank you for your participation, we appreciate your time! If you would like to receive a survey report, please leave an e-mail address:

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