Electric Vehicles in Morocco: Developing a Survey to Identify Public Sentiments

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Abstract

To combat the impacts of climate change and fossil fuel use, Morocco is exploring sustainable practices such as electric vehicles (EVs). Our project, sponsored by the International University of Rabat, developed a survey using two theories to predict consumer behavior. It will help identify the barriers to EV adoption. To test its effectiveness and make refinements before distribution to the Rabat-Salé-Kénitra (RSK) region, we conducted a pilot study and used social listening to gauge public opinions. With this data, we trialed analysis techniques and solidified topics of focus for the RSK survey. We concluded that we needed to slightly adjust survey format, content, and analysis. We then provided detailed next steps for the study, including recommendations on distribution and analysis.

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Authorship

The information presented in this report reflects the understanding, ideas, and contributions of all four members of this team, Abbey Blauser, Rhys Forster, Elizabeth Hicks, and Rebecca Marion. A detailed list of authorship for each section is provided below.

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Abbreviations

EV: Electric Vehicles
UIR: Université Internationale de Rabat || International University of Rabat
RSK: Rabat-Salé-Kenitra
DOI: Diffusion of Innovations
TPB: Theory of Planned Behavior
TFEC: Total Final Energy Consumption
IEA: International Energy Agency
PICs: Perceived Innovation Characteristics
API: Application Programming Interface
MSA: Moroccan Standard Arabic

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Executive Summary

Background: The global dependence on non-renewable energies and fossil fuels is damaging the environment irreversibly. In order to combat these effects and maintain the current state of modern life, there is a rising need for sustainable practices. Many countries, including Morocco, are promoting sustainability to transition their populations away from fossil fuels, especially for transportation. One option of growing interest in this field is electric vehicles (EVs). Electric vehicles provide a fuel and emission-free alternative to more commonly used petroleum vehicles. While there is support for EVs in Morocco, they are still not popular in the country. There are several important barriers to consider before electric vehicles can successfully be integrated into Moroccan society. These barriers are often social, economic, and infrastructural in nature. The International University of Rabat (UIR) is coordinating a project, RSK-e-mobility, which will identify the most pressing barriers in Morocco and address the best way to overcome them. This project is working to build a research and development platform for electric vehicles in the Rabat-Sale-Kenitra (RSK) region to improve Morocco's transition to EVs. Working with UIR, our

Methods: The goal of this project was to develop an effective survey that will assess public opinions of electric vehicles in Morocco. To accomplish this goal, we established and completed three objectives. First, we conducted a literature review to understand potential barriers to electric vehicle purchase, applications of the Diffusion of Innovations and the Theory of Planned Behavior, and survey techniques. Second, we developed a survey using those social theories and conducted a pilot study at UIR to test its effectiveness and make refinements before distribution. Finally, we utilized social listening to gauge public opinions regarding electric vehicles to further solidify the content of that survey.

Results and Conclusions: Through those methods, we received feedback on the survey and solidified analysis techniques and topics of focus. We trialed analysis on the pilot data collected, but could not make inferences about the RSK region or the UIR population. However, through both the pilot and social listening studies, we confirmed focal points for the RSK survey and made adjustments accordingly. We concluded that we needed to rephrase statements within our

survey, and we also needed to add a statement to account for the topics we found to be most pressing.

Deliverables: Our team created and provided a variety of deliverables for this project, all accessible through a Google Drive alias that we gave to our sponsor. The drive folder contained the finalized survey for the RSK region formatted as a Google Form, an automated Google Sheets file for data analysis, a document regarding next steps, and a “how to” document. The next steps document explains our deliverables and lists our recommendations for distribution and analysis. The “how to” explains how to use the Google Forms sheet and how to analyze and interpret the results of the survey in terms of the two social theories.

Chapter 1: Introduction

Sustainable practices are essential to maintaining modern life. A global dependence on non-renewable energy to fuel advancing technology is damaging the climate irreversibly. To combat growing concerns, many countries, including Morocco, are promoting sustainability to transition their populations away from fossil fuels and towards alternative energy. One of the areas of growing interest in this field is electric vehicles (EVs). The Moroccan government is working to motivate the public to invest in electric vehicles (Ben Sassi et al., 2021). However, though there is support for them, EVs are still not popular among the public. Prior literature has identified several social, economic, and infrastructural barriers that prevent the widespread use of EVs in other developing countries (Higueras-Castillo et al., 2021). While there have been a limited number of studies conducted in Morocco on this subject, identifying which barriers apply to the country will allow progress to be made in the EV industry.

Morocco is trying to become a center for electric vehicle production, but widespread adoption by the population is still a challenge. The International University of Rabat (UIR) is coordinating a project, RSK-e-mobility, to address this issue. This project is working to build a research and development platform for electric vehicles in the Rabat-Salé-Kénitra (RSK) region to improve Morocco's transition to EVs. Working with UIR, our project developed a survey using two social theories, Diffusion of Innovations (DOI) and the Theory of Planned Behavior (TPB). We designed this survey to predict consumer purchase behavior regarding EVs, which will help identify barriers to widespread electric vehicle adoption. Social listening also informed adjustments to this survey by tracking online content about electric vehicles. Once we refined it, the survey could be later distributed throughout the entire RSK region.

The goal of this project was to develop an effective survey that will assess public opinions of electric vehicles in Morocco. To accomplish this goal, we established three objectives:

1. Understand Theory Applications and Survey Techniques Through Existing Literature
2. Develop a Survey Using Two Social Theories and Conduct a Pilot Study at UIR
3. Utilize Social Listening to Gauge Public Opinions on Electric Vehicles for Survey Refinement

In this report, we discuss our initial background research covering three overarching topics: Morocco's need for sustainable practices, electric vehicles and barriers to their widespread integration, and approaches to understanding consumer purchase behavior. We will then explain our methods to achieve our objectives, which will include additional research, survey creation and testing, and social listening. The next chapter consists of a literature review where we look into these topics and how they relate to our project.

Chapter 2: Literature Review

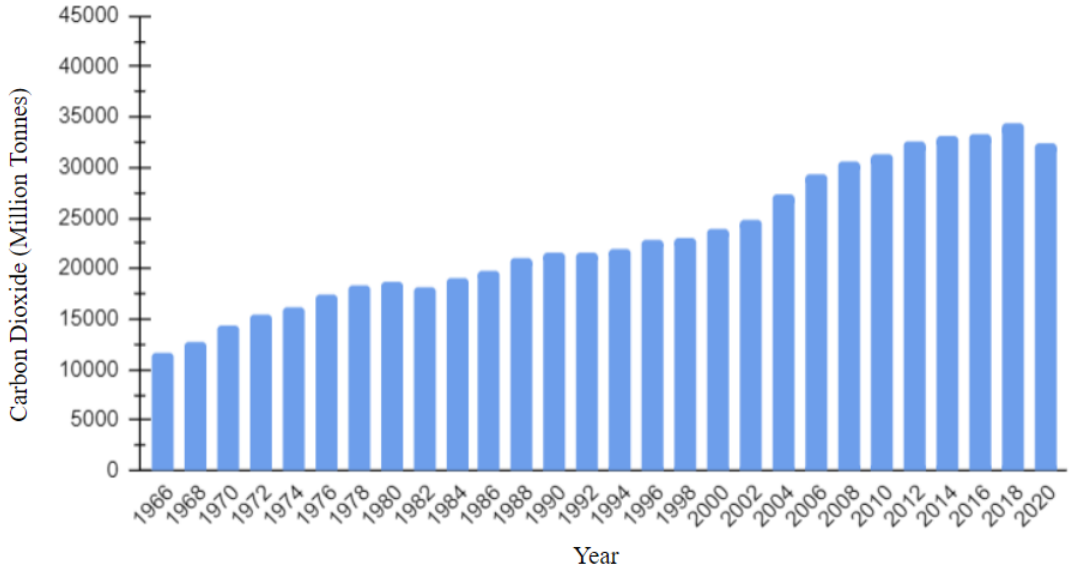
This chapter will discuss the information necessary for a complete understanding of Morocco's environmental and economic need to adopt electric vehicles (EVs). It will also discuss potential barriers to that adoption, and explore ways to identify them in the Moroccan context.

2.1 Climate Change

In the last century, the world has seen industrial and global development like it never has before. The Industrial Revolution in the west started a trend towards exponential growth in the fields of manufacturing and consumerism, with the rest of the world following suit quickly after (Simandan, 2020). With the emergence of industrialization, the world has also seen adverse side effects, in particular dependence on fossil fuels. As a result, there has been a dramatic increase in carbon dioxide levels in the atmosphere in recent years, as illustrated in Figure 1 below.

Figure 1

Global Carbon Dioxide Emissions Over Time



Note. This graph displays global carbon dioxide emissions every two years (bp, 2021).

A 2020 study from the World Meteorological Organization found that "levels of carbon dioxide were 18 percent higher from 2015 to 2019 than the previous five years" (UN, 2020). The ambient temperature of the planet is increasing drastically as a consequence of this. While not immediately apparent, the effects are devastating. Climate change is one of the leading causes for species extinction, which among many other things, has devastating impacts on human consumerism (Masson-Delmotte et al., 2018). While each region of the world is affected differently by climate change, this project will specifically focus on the impacts in Morocco.

2.2 Effects of Climate Change in Morocco

Due to climate change, Morocco is currently facing several environmental concerns including deforestation, drought, and desertification. Wildfires caused the loss of more than 2,000 acres of woodland in Morocco in 2019 (Berdikeeva, 2019). The intensity of the fires has escalated due to "higher than normal heat levels and droughts" (Berdikeeva, 2019). Wildfires release large amounts of carbon emissions, mostly in the form of carbon dioxide, that affect the climate and contribute to even more wildfires (Buis, 2021). Wildfires occur naturally to regulate ecosystems, but the increase in frequency makes it harder for the environment to recover before its next occurrence.

Drought is also a serious concern for people in Morocco. Geoenvironmental Disasters stated in their study of youth perspectives on climate issues that "drought is considered a first-rate threat in this region" (Karmaoui, 2019). The effects of climate change have increased drought, which, in turn, has led to desertification in the area (Karmaoui, 2019). The combination of drought and deforestation causes desertification, which is the process where regularly fertile land becomes desert. A lack of necessary water sources and the depletion of fertile land can be devastating to a population, especially to those who rely heavily on them for agricultural purposes. Due to these concerns, Morocco is in need of sustainable practices.

2.3 Demand for Sustainable Practices

In order to combat the effects of climate change both worldwide and in the Moroccan community, there is a rising demand for societal change. The concept of sustainability has become more popular as people start to understand the environmental impact of their choices.

Education about renewable sources of energy is also more common, and sustainable practices have become societal norms to varying degrees. The concepts of sustainability and alternative energy will be discussed generally, before moving into their applications in Morocco.

2.3.1 Sustainability

Sustainability is essential for the preservation of an ecological future. In order to ensure that current levels of consumerism and development can continue, it is crucial to protect the natural world and the systems it provides. As stated by the United States Environmental Protection Agency, "to pursue sustainability is to create and maintain the conditions under which humans and nature can exist in productive harmony to support present and future generations" (2021). The desire for environmental sustainability has been present in the public conscience for decades. In the United States, it was introduced in 1969 in the National Environmental Protection Act, which outlined the policy to actively seek harmony between humans and nature (EPA, 2021). The concept of sustainable practices is not new, and their implementation becomes more pressing the longer climate change goes unaddressed.

2.3.2 Alternative Energy

There has been an increased global interest in shifting energy consumption from fossil fuels to renewable energy sources. However, there is still a lack of momentum which is preventing change. In a 2021 joint report, it was found that the Total Final Energy Consumption (TFEC) was only made up of 17 percent renewables, despite progress. The report continues: "The share of renewable sources in TFEC, excluding traditional uses of biomass, increased by 2.5 percentage points over the past decade" (IEA et al., 2021). This development has taken place over the last two centuries (*World Energy Balances: Overview*, 2021). Since then, the use of biofuels, solar energy, and wind energy in the United States has increased drastically, with these sources contributing 1.00% of the total US energy consumption in 2000 and 7.5% two decades later (U.S. Energy Information Administration, 2020). This demonstrates how there is interest in these policies, but not enough is being done to properly implement them.

The use of alternative forms of energy in daily activities is becoming more common, especially in the transportation industry. There has been a shift towards using alternative energy

as electricity over other nonrenewable power sources. The 2021 Global Energy Consumption Report states that "over the past decade, renewable energy in transport has nearly doubled, but its share has only increased by 1.3 percentage points. The growth is thanks to country-level policies to expand biofuels, electrify transport, and increase renewable energy generation" (IEA et.al., 2021). In other words, transportation technology is ready to transition to alternative fuel sources, but other obstacles still exist.

2.3.3 Applications in Morocco

The government has made notable efforts in Morocco to improve ecological sustainability. For example, while Morocco's tree population has significantly decreased, there have been initiatives to regrow in other regions of the country. Catanaso found that "Morocco lost about 5 percent of its remaining dense tree cover between 2001 and 2014, according to data from the University of Maryland. But the data, visualized on the forest monitoring platform Global Forest Watch, also show large areas of tree cover gain during the same period, indicating reforestation and afforestation — the planting of trees where they didn't originally occur" (2016). To summarize, Moroccan efforts to reverse deforestation have been successful in halting overall tree loss. This indicates that the sustainability mindset exists in Morocco as much as it does globally.

Morocco has also made substantial progress in renewable energy efforts. In 2009, Morocco set out to source 42% of its total installed power capacity from renewable methods by 2020, and in 2015 this number increased to 53% by 2030 (Alami, 2021; *Morocco Renewable Energy Target 2030 – Policies*, 2019). Although the country has been praised for its actions to decarbonize, it ultimately missed its original 2020 goal (Alami, 2021; *Morocco Renewable Energy Target 2030 – Policies*, 2019). To add to this, the International Energy Agency (IEA) energy balance report found that African countries have seen a decrease in biofuel use in recent years, "partly explained by the recent development of power generation from natural gas" (*World Energy Balances: Overview*, 2021). Once again, it is clear that the desire for the implementation of sustainable practices is present in Morocco, but there are still barriers preventing their incorporation.

The Moroccan government has initiated programs to bolster renewable energy efforts and combat these barriers. “The National Energy Strategy (NES) in Morocco is one of the most ambitious and comprehensive renewable energy strategies in the Middle East and North Africa (MENA) region,” writes Alaa Alhamwi, David Kleinhans, Stefan Weitemeyer, and Thomas Vogt in a 2015 case study. In Morocco’s efforts to move towards environmentally-friendly energy generation, “the country aims to add around 10 GW of RE capacities between 2018 and 2030, consisting of 4560 MW of solar, 4200 MW of wind, and 1330 MW of hydropower capacity” (*Morocco Renewable Energy Target 2030 – Policies*, 2019). In the past decade, Morocco has developed and improved its sustainable practices with a focus on sustainable forms of energy.

2.4 Electric Vehicles

Electric vehicles (EVs) have been introduced to society as a sustainable technology. The integration of electric vehicles provides an eco-friendly alternative to petroleum cars. They appeal to a large group of people for both their innovative technological components and their environmental benefits. Electric vehicle technology functions through the use of batteries, which can be fueled through alternative forms of energy. Alternative energy, such as solar and wind energy, can be sourced into the electrical grid and from there the electricity can be sent out to the vehicles. The EVs themselves charge using a plug and outlet at a specified electric vehicle charging station. Although electric vehicle batteries take a while to charge, the range of an electric vehicle after the charge is longer than that of its petrol counterpart (Alternative Fuels Data Center: All-Electric Vehicles, n.d.). EVs are a technology that meets future transportation needs in terms of both efficiency and sustainable impact.

Electric vehicle implementation has started to and will continue to have a variety of impacts on modern life. The positive outcomes of widespread EV adoption include creating “an indispensable way to cope with climate change challenges, reduce dependence on fossil oil consumption, develop economy, and sustain transportation” (Zhang et al., 2018). There are many upsides to this technology for any region, and the world as a whole is in need of a way to deal with the increasing global climate crisis. There are also many sustainable aspects of EVs, such as zero carbon dioxide exhaust emissions (AMI, 100% Ëlectrique, n.d.). However, there is some

debate as to the potential negative impacts of the manufacturing of batteries on the environment. It is important to consider all steps in the process when discussing the environmental impact of a vehicle, such as the pollution in all parts of the cycle of vehicle manufacturing (Larminie and Lowry, 2003). Additionally, there is still some concern as to whether the move to electric vehicles will hurt the automotive industry on a global scale. In the Moroccan context, this is a large topic of discussion.

2.5 Automotive Industry in Morocco

The Moroccan automotive industry is one of Africa's dominant vehicle suppliers (Khattabi & Karim, 2019). There is a large and growing demand for Moroccan cars, which is advantageous to the Moroccan economy. The industry has grown significantly in the last few years and shows no sign of slowing down (Khattabi & Karim, 2019). However, Morocco has few oil and petroleum resources and must import them (Ben Sassi et al., 2021). The importation of these energy sources poses a serious issue to Moroccans, as it is a large financial burden for the country. About 66% of the country's energy supply comes from fossil fuels. The automotive industry alone is responsible for 41% of the total energy consumption in Morocco (Ben Sassi et al., 2021; Chachdi et al., 2017). Due to the importation of petroleum, it is incredibly expensive to fuel an automobile. Diesel in Morocco is priced at over $4.00/gallon (Haddad, 2022). However, stakeholder interests are turning from petroleum to electric cars.

The trend toward electric vehicles exists both globally and within Morocco. According to recent statistics, global stock prices in electric vehicles are rising exponentially, with an expected value of $130 million by 2030 (Ben Sassi et al., 2021). In Morocco, the government is actively replacing 30% of its fleet with electric/hybrid vehicles (Ben Sassi et al., 2021). Morocco is a potential flagship for dispersing electric vehicles through Africa. Greenland Technologies, a company that makes industrial electric vehicles, signed a deal in 2022 to bring their electric vehicles to the continent of Africa, starting with Morocco (Haddad, 2022). The transition would significantly reduce the sales of petroleum, which would lower the cost of transportation for Moroccans. The cost of electricity is roughly $0.116/kWh in Morocco, which is very low in comparison to diesel prices (Haddad, 2022). The automotive industry is recognizing this benefit and beginning to make room for EVs, as seen by the introduction of new electric vehicle

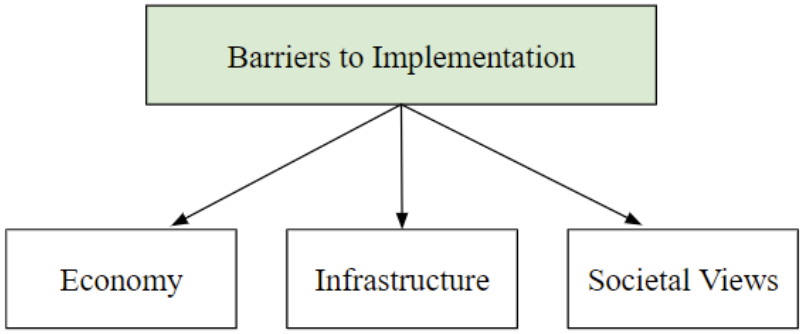
companies. Despite increasing interest in electric vehicles, there are still several factors preventing widespread expansion into Moroccan society.

2.6 Common Barriers Associated with Electric Vehicle Adoption

The adoption of technologies can be difficult due to socio-economic and cultural barriers that prevent consumers from using or wanting them. Several countries have taken the initiative to introduce electric vehicles into their societies, and from that data there are three common themes that relate to consumer purchase and smooth implementation: economic factors, proper infrastructure, and societal views. This breakdown can be seen in Figure 2 below.

Figure 2

A Breakdown of the Common Barriers Associated with Electric Vehicle Adoption



Exploring these barriers and how they have been alleviated in other countries provides insight into the barriers that might exist in Morocco.

2.6.1 Economy

Economic factors greatly impact the assimilation of electric vehicles into society. In many countries, the incentive to buy an electric vehicle is negated by the cost of one. Price is considered to be one of the strongest barriers to the purchase of EVs (Higueras-Castillo et al., 2021). The average price of an electric vehicle in Morocco is 65,316 MAD (~7,000 USD) (Tanchum, 2021). When considering an average salary in Morocco, 62,256 MAD yearly (~6,500 USD), this is a substantial expense (Eliason, 2019). Based on this, the average Moroccan would have difficulty obtaining an electric vehicle. The price per car has a serious influence on

purchase trends. If electric vehicles are perceived to be more expensive than petroleum cars, then users will deem the car inaccessible, leading to a lower chance of consumer purchase. Though fuel and maintenance costs of an EV are typically lower than those of a gasoline-powered vehicle, the initial price point limits the chance of purchasing more than expected benefits encourage it (Higueras-Castillo et al., 2021).

This can be counteracted with government intervention. Several governments have incentivized the purchase of electric vehicles, leading to an increase in EV purchases (Higueras-Castillo et al., 2021). These incentives have been implemented worldwide and range from tax incentives to free parking (Higueras-Castillo et al., 2021). For example, the Moroccan government offered several incentives, such as tax exemptions, in 2017, which rapidly increased the number of electric vehicles at the time (Ben Sassi et al., 2021). The number is expected to increase significantly in the next few years. This is a success for the EV industry in Morocco, but its effects on the automotive industry are yet to be seen.

Though it may seem likely that the Moroccan automotive industry would suffer from the adoption of electric vehicle technology, there is a lack of information regarding this. Research has instead shown that the automotive industry is expanding to include electric vehicles, and the government has shown its support for sustainability and EV adoption. With incentives in place, Moroccans should theoretically be rapidly purchasing electric vehicles, but they are not. According to the Moroccan Federation of Energy, in 2018 there were 1,300 hybrid and electric cars in Morocco (*Study on Sustainable Mobility in Morocco – Energy Federation*, 2019). By 2019, “the EV/HEV number almost doubled reaching 2,717 units according to the association of vehicle importers in Morocco (AIVAM)” (Ben Sassi et al., 2021). The Moroccan Federation of Energy predicted three scenarios of electric vehicle adoption in Morocco: optimized, moderated, and pessimistic. The model used to predict these scenarios demonstrated a lack of exponential growth until 2024, and only in the optimized and moderate models (Ben Sassi et al., 2021). The rapid uptick in electric vehicle purchases has not yet occurred. Some countries are unable to economically support new technology because they lack proper infrastructure.

2.6.2 Infrastructure

Many countries, including Morocco, lack the proper infrastructure to support electric vehicle technology. For practicality of use, enough charging stations must be installed so that those needing to charge their cars can when they need to. Studies show that increased numbers of charging stations directly correlate with increased EV adoption (Higueras-Castillo et al., 2021). Morocco is only in the initial stages of developing its charging infrastructure. The process of installing charging stations along roads and in major cities has just begun in Morocco, with both fast and normal charging ports (Ben Sassi et al., 2021). Fast charging options are essential because the amount of time required for charging is another limiting factor in the adoption of EVs (Higueras-Castillo et al., 2021). Users typically prefer quicker charging times, and a reduction in wait times could generate more interest in EV purchases (Higueras-Castillo et al., 2021).

However, some electric grids are strained by the fast charging and increased number of charging stations and need updating. It is up to the government to direct funds towards developing and updating infrastructure to keep up with current technology. Morocco is actively looking into how EVs will impact the electric grid, as they need constant recharging, which will significantly increase power demands. The Moroccan power grid must be prepared for this increase in demand (Chachdi et al., 2017). Overall, studies show that the installation of charging stations and convenient charging times will increase interest in electric vehicles, but that the electric grid may be strained by increased demand. The government needs to set money aside for the development of these technologies because, without the infrastructure, the public will not consider electric vehicles to be viable methods of transportation.

2.6.3 Societal Views

Public opinion regarding electric vehicles is dependent on practicality, perceived benefits, and general knowledge. A large number of potential customers are hesitant to purchase an electric vehicle due to perceptions. In a study on consumer perceptions and motivation, Zhang, Bai, and Shang demonstrate how perceptions regarding risks, economic benefits, and environmental benefits are interrelated and are all primary influencers of EV adoption (2018). These perceptions can push consumers toward or away from buying an electric vehicle. Charging

availability and time, range of travel, and noise level are all factors that have also impacted EV purchases. “With regard to the performance (range and charging time) of an EV, consumers in general are not satisfied” (Higueras-Castillo et al., 2021). Consumers want to ensure the product they are buying is practical, safe, and reliable.

Many people do not have extensive knowledge about electric vehicles, and it can cause them to misunderstand information regarding them. For example, a preliminary study in Morocco reported that “9 out of 10 Moroccan respondents think that the maintenance cost of the electric cars is very expensive”, even though that is actually incorrect (Chachdi et al., 2017). Electric vehicles are actually fairly easy to maintain, and owners really only need to complete an annual check for the battery. Many of the traditional maintenance operations are no longer required such as “drainage, chain of distribution, candles, exhaust pipes etc. Only elements such as brake pads / discs or tires are to be regularly changed, accompanied, of course, by the wipers and windscreen washer” (Chachdi et al., 2017). Misconceptions can cause consumers to be hesitant about purchase, so it is important to raise awareness regarding electric vehicle benefits and attributes.

Upon recognizing the common barriers in other countries, their translation into Moroccan society can start to be understood. Understanding public opinions in Morocco helps determine the most significant challenges limiting EV adoption there. One way to understand those opinions and challenges is through a survey of the general public.

2.7 Creating Effective Surveys

When creating a survey, there are several factors to consider to ensure it will be effective. Content choices regarding questions, response options, and phrasing can impact the results of the survey, so careful consideration must be given to those throughout the creation process. Aesthetic choices such as layout, question and answer format, or logistical choices such as length and time, all play a role in the user experience. A positive user experience is essential to successful data collection.

2.7.1 Survey Techniques

Before starting to create a survey, it is important to define its purpose and audience. To make sure the survey will gather the information needed, each question needs to align with the goal. Knowing the target population of the survey will influence many choices throughout the creation process. This audience should be considered when (1) phrasing survey items, (2) choosing the technology that will be used to conduct the survey, (3) inviting them to take the survey, and (4) forming the timeline of the survey (Quinn, n.d.). It is also important to note that there may be other audiences that are separate from those that will take the survey. For example, having an idea of who will be interested in the survey findings can impact what evidence is relevant and therefore what questions are asked (Quinn, n.d.). When there are multiple audiences for a survey, it is important to prioritize them before making content choices.

The survey's audience should also be taken into account when making choices about language and sampling. For example, if the target population speaks multiple languages, then the survey should be created to reflect that. Different sampling techniques are useful for different audiences. When creating the survey, it is important to think about what type of sample fits the purpose of the study. Does it need to be representative, stratified, etc.? These considerations can play a role in later steps of the process, such as distribution.

Additionally, valuing the participants of the survey is essential to its success. Anyone taking the survey is helping, "so give them a good reason to take [it], and make it as easy as possible for them to finish it" (Quinn, n.d.). Telling participants why it is important and the purpose behind it, or asking nicely and sending reminders can also increase the number of responses. Before they start the survey, tell them how long it will realistically take to complete it and include a progress bar so they can see how far along they are. Keeping the survey short is also crucial, as the longer the survey goes, the more likely it is that the respondent will not finish it (Quinn, n.d.). Make sure everything is easy to read and flows. "Assume that respondents are not going to be paying close attention while taking the survey" (Quinn, n.d.). Thinking about how the participant might feel while taking the survey will guide the creation process.

Asking the right questions and making sure each one counts will not only result in the data intended, but also keep the survey concise. Participants can become disinterested in the survey and discontinue taking it if it is too long or questions are repetitive (Quinn, n.d.). After

drafting a list of questions, reviewing and revising them will confirm each one is necessary and keeps the participant engaged. Equally important to asking the right questions is asking questions the right way. There are several steps to take when reviewing the survey that will ensure taking it is as easy for the participant as possible. First, make sure to use simple terms, or terms the audience will understand. Respondents might not share the same knowledge base, or all think in the same way, so sometimes explaining terms is necessary. “Especially for terms that are critical to the central purpose of [the] survey, provide definitions” (Quinn, n.d.). Second, check that each question is not asking multiple things, as this can confuse the participant and impact results. If both parts of the question are important, it can always be broken up into two questions. Third, ensure that the questions are not phrased in a way that could easily bias responses. “Phrase survey items as neutrally as possible” to get the participant to answer with what they truly believe (Quinn, n.d.). Avoid steering the participant’s answer in a particular direction. Finally, format and phrase the response options in a way that is easy to understand. “Even if a question is phrased very clearly and appropriately, a respondent could still get confused if the response options are badly phrased” (Quinn, n.d.). This ties back into knowing the target audience of the survey. Offering response options that will make sense to the intended audience will create less confusion and make their experience as smooth as possible (Quinn, n.d.). Choosing options that will be easy to analyze later is also something to keep in mind.

While ensuring the options are easy to understand, also check that all possible choices are covered and the response categories don’t overlap. “If response categories overlap, it won’t be clear to respondents which option is the best one to pick” (Quinn, n.d.). One response type to consider using is a balanced scale. Having the same number of response options on each side will prevent bias (Quinn, n.d.). If using a scale, consider the relevance and importance of including descriptors and a neutral response option. Without descriptors, respondents may not understand the options, especially if the scale is numeric. Using a verbal, descriptive scale, such as the five-point Likert scale, which spans from ‘Strongly disagree’ to ‘Strongly agree’ may help avoid confusion. As for including a neutral option, while sometimes helpful, it might not be “possible for [the participant] to be neutral on an issue” (Quinn, n.d.). Other phrasing such as ‘Neither disagree nor agree’ can be a better fit.

Once the researcher drafts the survey and reviews and revises both the questions and response options, they should look into what tools are available. Creating the survey online through platforms such as Qualtrics, SurveyMonkey, Google Forms, etc. can be helpful for organization and analysis, as well as make it look more professional. After the survey is set up, test it out prior to full distribution. This test can be conducted with made up data or a smaller, controlled population test such as a pilot study.

2.7.2 Pilot Studies

Researchers often conduct pilot studies to ensure the effectiveness of a survey before its large-scale implementation. Pilots are designed to test format, content, and distribution methods, and their results will help guide future applications. Feedback from a pilot study can inform recommendations on how to adjust the survey for later use. Conducting a pilot study consists of a very similar methodology to that of the larger study it is testing. Using the same tools and methods of data collection allow for the refinement of the steps before use on a more extensive scale. Through pilot studies, researchers can adapt their methodology to better reflect the next population.

Pilot studies utilize smaller sample sizes over large ones, as the point of this step is to test the survey, not get representative data. Researchers suggest using a sample that is 10% of the population's representative sample size (Connelly, 2008). For example, the overall population of the RSK region as of the 2014 census is 4,580,866 people (*Morocco,* n.d.). This is projected to be higher as of 2022, closer to 4,800,000 people. The sample size for this region can be calculated using a sample size calculator, using 95% confidence and a 2% margin of error (Qualtrics, 2020). With this combination of population, confidence level, and margin of error, the sample size needed to be representative of the RSK region is 2400 responses. For a pilot study, given the 10% suggestion, the researcher would gather 240 responses. While pilot studies are good for checking the effectiveness of a survey, having a strong theoretical framework behind the survey creation also increases reliability.

2.8 Social Theories

In studying human behavior, many researchers have found that using social theories as a basis for their surveys is a reliable method to explain and predict the behavior they are studying. Two social theories are useful in identifying public sentiments regarding a new technology: the Diffusion of Innovations and the Theory of Planned Behavior. When used together, the theories help identify common challenges to the acceptance of that technology.

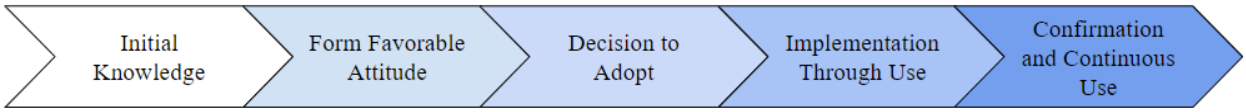
2.8.1 Diffusion of Innovations (DOI)

The Diffusion of Innovations (DOI) is used to predict and understand consumer attitudes towards innovative technologies. When applied to marketing and consumerism, it can be used to predict how customers will react to the incorporation of a new, more advanced product. The Diffusion of Innovations outlines the thoughts, opinions, and relationships a consumer will have with a new product. This can lead to a technology's eventual adoption.

The Diffusion of Innovations states that the innovation-decision process has five stages, each of which can be used to understand a consumer's relationship with a new technology, as well as predict their decisions regarding purchase (Moon, 2020). First, initial knowledge of the innovation is developed: consumers learn about a new product through advertisements, social media, or word of mouth (Moon, 2020). Next, the consumer forms a favorable attitude towards the innovation, which increases their desire for it (Moon, 2020). This attitude can come via persuasion from manufacturers or from a personal connection to the product. A consumer's personal background greatly affects this stage. The consumer can then make a decision to adopt the innovation (Moon, 2020). The process either continues with purchase or ends if the consumer rejects the product completely. If it continues, the innovation is then implemented and used for a period of time. This allows the consumer to shift their opinions towards approval or disapproval of the product (Moon, 2020). The duration of this step does not have a set length, and varies depending on the consumer and the product. Finally, the consumer can confirm their choice and continue to use the innovation, or change their decision and stop using it (Moon, 2020). These five stages are outlined below in Figure 3.

Figure 3

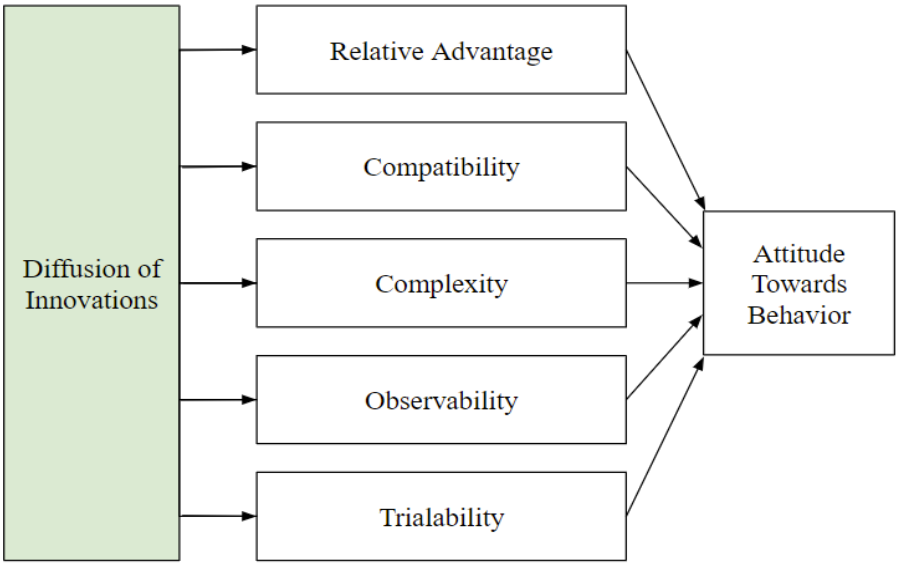
The Five Stages of the Innovation-Decision Process



Another component of the Diffusion of Innovations is the perceived innovation characteristics, or PICs. Moon states that "potential adopters form their attitudes toward innovation centered on their perceptions of the five PICs: relative advantage, compatibility, complexity, trialability, and observability" (2020). These factors play a large role in stages one, two, and five of DOI, as they are the means by which consumers develop their opinions. The *relative advantage* component illustrates to a consumer how a particular innovation compares and outperforms its competitors (LaMorte, 2019). This can persuade them to believe it is superior due to the innovative component that makes it unique. On a more personal level, *compatibility* pertains to a consumer's values, experiences, and needs, all of which are essential to the buying process and determining one product from another (LaMorte, 2019). Similarly, *complexity* evaluates how easy an innovation is to understand, use, and learn (LaMorte, 2019). Consumers look for *trialability* in order to test a product and see if it is useful to them, which is used most notably in stage four of DOI (LaMorte, 2019). And finally, stage five most predominantly uses *observability*, or the extent to which the innovation provides feasible results that other people can see (LaMorte, 2019). These characteristics, illustrated in Figure 4 below, are essential to applying DOI to any new product, electric vehicles included.

Figure 4

The Perceived Innovation Characteristics of the Diffusion of Innovations



In terms of electric vehicles, Diffusion of Innovations can be applied in a few ways. EVs are a new commodity, and have been marketed as such, making them one of the newest innovations in both the transportation industry and the environmentalist movement. More specific to the theory, so far EVs have mostly failed to pass the third stage of the DOI. While consumers have had opportunities to hear about electric vehicles, as well as experience them and form personal connections, not many have decided to adopt this new technology. EVs have had little opportunity to reach the fourth and fifth stages of DOI, with the ultimate goal being complete integration into society. However, electric vehicles do excel in the PIC of *relative advantage*. They have many marketable attributes such as their environmental benefits. The PIC that EVs are lacking most is *compatibility*: consumers are struggling to resonate with their incorporation. As a result, *observability* struggles to be achieved, as it is difficult for consumers to see results if they are unable to obtain the technology in the first place.

It will be essential to use the perceived innovation characteristics of the Diffusion of Innovations when determining how to encourage electric vehicle adoption. In doing so, consumer attitudes can be predicted, and neglected factors can be addressed.

2.8.2 Theory of Planned Behavior (TPB)

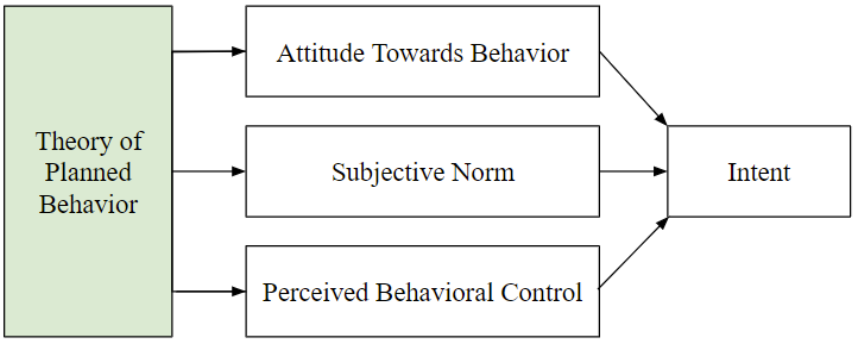
The Theory of Planned Behavior (TPB) is another social theory formed primarily by Icek Ajzen that can be used to predict an individual's intention to perform a behavior. This theory revolves around intent and argues that knowledge of intent can predict behavior. That intent can be identified via several variables. In understanding the intent behind an action, researchers can identify and study any barriers preventing it to encourage the consumer to pursue their intention. TPB can be applied to a variety of contexts and can be applied to understanding Moroccan consumers and their intentions to buy an electric vehicle.

As stated above, the model revolves around the intention to perform an action. Azjen assumes that intentions, "capture the motivational factors that influence a behavior" because "they are indications of how hard people are willing to try or how much of an effort they are planning to exert, in order to perform the behavior" (Ajzen, 1991). The greater the intention to perform an action, the more likely it is to occur. This theory does not work with subconscious behaviors (Ajzen, 1991). Understanding the intention behind an action allows for better implementation of strategies to continue or limit the intent to act.

This model utilizes three components to predict intention: *attitude toward the behavior*, *subjective norm*, and *perceived behavioral control*. *Attitude towards a behavior* refers to an individual's personal evaluation of the behavior, such as if it is deemed a 'good' behavior or a 'bad' behavior (Ajzen, 1991). *Subjective norm* is a societal factor referring to "the perceived social pressure to perform or not to perform the behavior" (Ajzen, 1991). Individual beliefs and perceived societal opinion can be entirely different. An individual and society could have opposing sentiments regarding a behavior, so the two belief structures are accounted for separately. *Perceived behavioral control* signifies the "perceived ease or difficulty of performing the behavior", including a reflection of past experiences and anticipated obstacles (Ajzen, 1991). The more positive attitude and subjective norm are in regard to a behavior, the greater the perceived control, and thus the intention to perform a behavior should be strong (Ajzen, 1991). The breakdown of these elements can be seen below in Figure 5, though the degree of influence of each of the three varies depending on the behavior and the context (Ajzen, 1991).

Figure 5

The Elements of the Theory of Planned Behavior



Although it is one of the three components used to predict intention, the Theory of Planned Behavior claims that *perceived behavioral control* has a more direct influence on behavior than *societal norms* and *attitudes*, which only influence intention (Ajzen, 1991). According to the theory, *perceived behavioral control* is slightly removed from the other two variables and can be placed in general relation to both intention and behavior (Ajzen, 1991). This is for two reasons. First, if the intention is held constant, the effort towards a behavior will likely increase with an increase in *perceived behavioral control* (Ajzen, 1991). Second, perceived behavioral control can frequently replace measures of actual control, depending on the accuracy of perceptions (Ajzen, 1991). This relation between variables is important to keep in mind when predicting sentiments.

The Theory of Planned Behavior can be implemented to predict behaviors in a variety of different contexts. Applied in the context of electric vehicles, it can help determine what potential barriers limit their adoption in Morocco.

2.8.3 Applications of the Theories

Once sufficient understanding of the theory elements is obtained, the researcher can apply the two theories together. The Theory of Planned Behavior has three set variables: *attitude towards a behavior*, *subjective norm*, and *perceived behavioral control*. When applying the theory to a study, three hypotheses are formed to relate the variables to their influence on intention. For example, a hypothesis may state “attitude towards a behavior is positively related to intention”. This is done to define the variables of TPB within the study and help in later steps

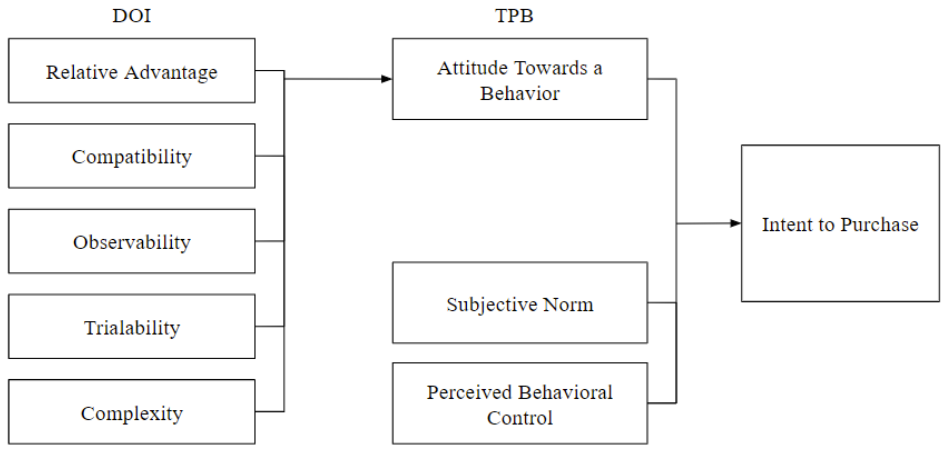
to quantify positive and negative emotions expressed by individuals. Researchers can then understand these emotions on a numerical scale in reference to a specific variable. From here, questions or statements are formed to extract information from individuals relating to the three hypotheses. Once that information is collected, the researcher can perform statistical analysis on the results to predict intention and behavior.

Meanwhile, the Diffusion of Innovations has five perceived innovation characteristics () perceived innovation characteristics, which affect attitude towards a behavior: *relative advantage*, *compatibility*, *complexity*, *trialability*, and *observability.* Applying this theory to a study results in the formation of five more hypotheses that will test the influence each variable has on a consumer's attitude. Hypotheses will state that a PIC will either positively or negatively affect the attitude of an individual. Once again, data can then be collected by forming statements to test the hypotheses and analyzing how individuals respond.

When applied together, the Theory of Planned Behavior and the Diffusion of Innovations can be used to identify public sentiments regarding a new technology, and then use those sentiments to help predict public intent to use and purchase the new technology. The variables from the Diffusions of Innovations are used to predict an individual's personal attitude towards the new technology. The results from DOI directly feed into one variable from the Theory of Planned Behavior, *attitude towards a behavior*, which can be seen in Figure 6 below.

Figure 6

Joint Model of the Theory of Planned Behavior and Diffusion of Innovations



Statements are created to address both sets of hypotheses. Using scaled responses to answer the statements addressing TPB and DOI variables allows for large sets of data. Positive and negative sentiments are assessed quantitatively, which simplifies analysis. For example, Likert the Likert scale is ‘Strongly agree’, ‘Agree’, ‘Neither disagree nor agree’, ‘Disagree’, and ‘Strongly disagree’. Numerical values would be assigned to each sentiment, 1, 0.5, 0, -0.5, and -1, respectively. Sentiments would then be weighed against each other and analyzed using statistical analysis. A statistical test on the results of the statement responses shows the correlation between the statement and the variable, and then the variable and the hypothesis. Using findings from our initial research, we made predictions about what we would see in our own survey responses. Based on prior studies, we expected to see concerns regarding infrastructure and economics.

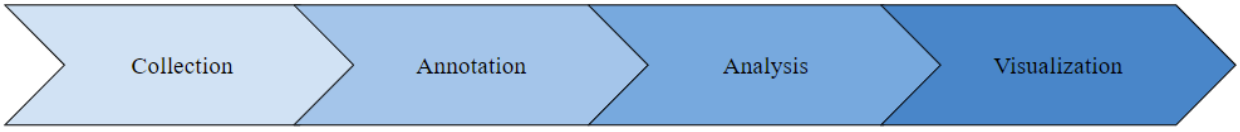
2.9 Social Listening

Another technique that can be useful to gauge public opinions on a specific topic is social listening. Social listening entails sifting through a variety of social media platforms for particular keywords to track conversations and popular sentiments (*Social Listening*, 2022). It is a method for understanding the online conversation about a particular brand, a topic in the news, or an innovative technology (*Social Listening*, 2022). Researchers can complete the process manually by looking for keywords in comments or posts on social media, or by training machine algorithms to do the same process. Social listening is a dynamic practice, meaning it can be conducted over a longer period of time instead of just one static point.

There are several steps to complete when conducting social listening, as illustrated in Figure 7 below.

Figure 7

The Social Listening Process



The first step is data collection, which involves choosing where content will be collected from and how that content will be collected. “Generally, there are two main methods in data

collection: keywords and sites" (Tran, 2021). It is important to select platforms and keywords that will result in relevant comments. Social media sites such as Facebook are the most common, but social listening can be applied anywhere users can comment. This means that researchers can use the technique on news sources too. For some implementations, the researcher can pull open-source code from the sites themselves and use it to collect information. "Most social listening tools connect with API (Application Programming Interface) in global social networks such as Facebook, YouTube, and Forums to collect the data" (Tran, 2021). APIs already conduct social listening for their respective companies, so utilizing this free-to-use code makes the process much simpler. However, not all data sources have their own APIs. In these instances, the researcher must write the code by hand to search for keywords within user responses.

Once they run the code on a certain source, the second step of social listening can occur, annotation. The researcher annotates the data the code collects with the desired labels and sorts it into an appropriate data set (A. Amalas, personal communication, April 6, 2022). This is when choosing a model for machine learning occurs. This can be one of two methods: supervised and unsupervised learning. The supervised learning model requires the researcher to provide the data and corresponding annotations to train it to recognize the desired information (A. Amalas, personal communication, April 6, 2022). These annotations are general labels that are used to better categorize the data. Data can be anything from social media comments to photos. As the name suggests, this model requires constant input from the researcher in order for the algorithm to learn what to look for on its own. The researcher must confirm that the results are indeed correct, which lets the intelligence learn what aspects to look for on its own (A. Amalas, personal communication, April 6, 2022). On the other hand, unsupervised learning only requires data input, meaning that the labeling process is skipped.

The third step of social listening is data analysis. This section may be divided into subsections, depending on what the project requires. Data analysis techniques are chosen by researchers to best fit the type of data they are gathering. For sentiment analysis, positive, negative, or neutral sentiments are assigned to comments retrieved from social media platforms (Tran, 2021). Researchers can then identify public opinions on a particular topic. Another useful process for data analysis is topic modeling, which involves grouping data together according to subject (A. Amalas, personal communication, April 6, 2022). From there, the researcher can

identify dominant topics and trends in the data they collected. This allows them to clearly see what subjects are most popular.

Once the researcher has completed the above steps, they can conduct additional analysis and the fourth step, visualization, can occur. For instance, exploratory analysis can result in graphics such as word clouds or flowcharts (A. Amalas, personal communication, April 6, 2022). Both graphics can be useful when presenting results and explaining the data analysis process. During this analysis it is also important to "clean" the data, meaning unnecessary aspects can be removed without losing any meaning (A. Amalas, personal communication, April 6, 2022). For example, anything irrelevant to the comment such as punctuation, numbers, or filler words can be removed. Doing this condenses the data and makes additional analysis and visualization easier. Researchers may also conduct predictive analysis in some cases, though it takes longer to complete.

For the purposes of this study, social listening was utilized to gauge public sentiments as well as recognize popular topics concerning electric vehicles. This was useful in understanding what barriers need to be referenced the most in the survey.

2.10 Conclusion

The need for sustainable practices in Morocco caused the need for this project. Potential socioeconomic and infrastructural barriers that could be present in Morocco were researched. A pilot study could be used to test the effectiveness of a methodology that was created. The Theory of Planned Behavior and the Diffusion of Innovations can be used together predict consumer behavior regarding a new technology. The knowledge gathered from the background can be used for the application of this project.

Chapter 3: Methodology

The goal of this project was to develop an effective survey that will assess public opinions of electric vehicles in Morocco. We established three main objectives that helped us achieve this goal.

1. Understand theory applications and survey techniques through existing literature
2. Develop a survey using two social theories and conduct a pilot study at UIR
3. Utilize social listening to gauge public opinions on electric vehicles for survey refinement

The completion of these objectives was a multifaceted process. First, we conducted additional research on the Diffusion of Innovations (DOI), the Theory of Planned Behavior (TPB), and a variety of survey techniques to ensure we had a strong understanding of these topics before starting on survey creation. More specifically, we learned how to apply the theories and techniques to the context of electric vehicle adoption. We achieved this through our literature review, seen previously in Chapter 2, thus completing our first objective. Once we gained that foundation, we developed a survey which could be used to identify opinions and barriers to EV adoption. In order to validate that the survey would be effective for the Rabat-Salé-Kenitra (RSK) region, we conducted a pilot study at the International University of Rabat (UIR). We also used social listening to gain insight into public sentiments online about electric vehicles in Morocco. This allowed us to further refine the survey for the RSK region. Using data from both the pilot study and social media, we provided recommendations for future applications of the survey.

3.1 Survey Development and Testing

Based on our literature review, we established an understanding of the Diffusion of Innovations, the Theory of Planned Behavior, and the common barriers associated with electric vehicle adoption. Using this knowledge, we created a survey to assess consumer behavior and public opinions towards electric vehicles in Morocco. In order to ensure that the survey would be effective when distributed throughout the entire RSK region, we conducted a pilot study within the UIR community.

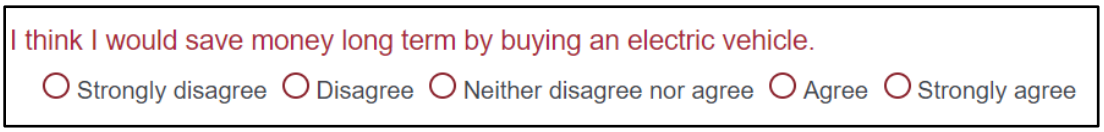
3.1.1 Survey Creation

To start our survey creation process, we first decided that the survey would be split into two main parts. The first part of the survey consisted of basic foundation questions to establish trends within the sample. These questions asked about employment status, number of vehicles owned, age range, and gender (see Appendix A). This would help categorize responses by similarities within the population. These questions had a multiple-choice response type. A 'Prefer not to answer' option was included in the responses of demographic questions for those that did not want to share their information for specific questions.

The second part of the survey was formed using eight variables, the three from the Theory of Planned Behavior, and the five from the Diffusion of Innovations. Before creating the survey, we formed hypotheses with positive and negative correlations between the components of the theories and attitude and intent and intent and behavior (see Appendix B). We then adapted these hypotheses into statements to test the correlations (see Appendix C). We started by forming a list of barriers based on the literature review that we wanted to address in the statements. Once we had identified these barriers, we brainstormed which concepts fit under the different hypotheses and formed statements. These statements helped us understand the connection between intent and behavior regarding EV purchase. For the statement portion of the survey, the response type was a multiple-choice scale known as the Likert scale. Participants were able to respond to the statements with options ranging from 'Strongly disagree' to 'Strongly agree', with a 'Neither disagree nor agree' option as the middle ground as seen in Figure 8 below.

Figure 8

Sample Survey Statement with Likert Scale Response Options



The survey also included feedback questions, where we asked the participants their opinions on the survey. This included the questions shown in Table 1 below.

Table 1

User Experience Feedback Questions

The terminology used was:	○ Hard to understand ○ Neither hard nor easy to understand ○ Easy to understand
Taking the survey was:	○ Hard ○ Neither hard nor easy ○ Easy
The length of the survey was:	○ Too long ○ The right length ○ Too short

The survey interface was also taken into consideration. We wanted to make sure the survey could be taken on both laptops and phones. This decision dictated choices like response style and question layout. Once the survey was put into Qualtrics, we tested it on our cohort for feedback on usability and the user experience. In addition to using the actual feedback questions in the survey, we gathered verbal feedback. We then adjusted the user interface appropriately.

3.1.2 Collection of Pilot Survey Data

Once the survey was finalized, we conducted a pilot study on the UIR campus to test and validate it. For the larger RSK population, the representative sample size required was 2400 responses (Qualtrics, 2020). Since our target sample for the pilot study needed to be 10% of the

sample size of the larger region to be representative, we needed 240 responses (Connelly, 2008). Conducting the pilot study helped us ensure the region-wide study would be as effective as possible.

For this study, we phrased the foundation questions to reflect the population we would be surveying. For the UIR population, we included questions to identify the participant's association to the UIR community (see Appendix D). In this study, the survey was distributed to students, staff and faculty at UIR to gather responses. We had the communications department send out the survey over email, and also went to classes with our survey's QR code and asked students to take the survey there. We also got responses by interacting with students around campus and asking them to take our survey.

We received assistance from several PhD students at UIR in the translation of the survey, so we could distribute it in both English and French on campus, as well as Moroccan Standard Arabic (MSA) for the larger study. Participants could take the survey in either French or English for the pilot study, whichever they felt most comfortable using. While surveying, we received consent from the participants using the form in Appendix E. We told all participants that the survey was not mandatory, and clarified that they could discontinue at any time. We did not require or ask that participants provide us any identifying information.

After testing the survey through the pilot study, we trialed a variety of analysis techniques to refine it and guide us in our suggestions for the RSK study.

3.1.3 Conversion of Data from Qualitative to Quantitative

After collecting survey data from the UIR pilot study, we sorted the data by prompt in Qualtrics, then exported it to Excel for analysis. From there, we condensed the separate French and English responses and displayed them together, as seen below in Figure 9 below.

Figure 9

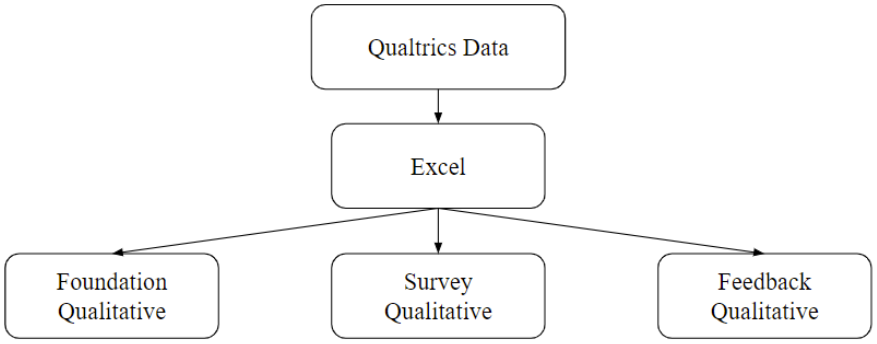
Organization of the Combined English and French Data in Excel

Language:	Are you a member of the UIR community?	What college are you associated with at UIR?	What is your gender?
	Yes, I am a student	College of Health Sciences	
	No, I am not affiliated with UIR	College of Doctoral Studies	
Français	Oui, je suis un/une étudiant(e)	College of Management	Préfère ne pas répondre
Français	Oui, je suis un/une étudiant(e)	College of Engineering & Architecture	Homme
English	Yes, I am a student	College of Engineering & Architecture	Female

We started by dividing the combined data into three sheets on Excel: “Foundation Qualitative”, “Survey Qualitative”, and “Feedback Qualitative”. The “Foundation Qualitative” sheet included responses to the foundation questions, whereas “Survey Qualitative” and “Feedback Qualitative” contained data pertaining to the survey responses and feedback questions, respectively. Figure 10 below shows the breakdown into these qualitative sheets. This isolated the different types of collected data, which improved overall presentation of it and simplified analysis.

Figure 10

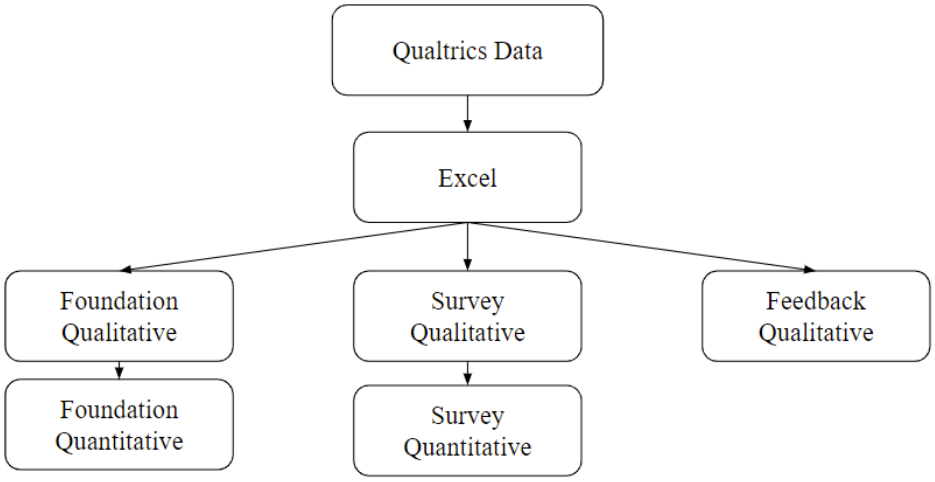
Initial Breakdown of Data into Qualitative Sheets



To quantify responses from “Foundation Qualitative” and “Survey Qualitative”, we took the raw data responses from Qualtrics and assigned numbers to each qualitative answer, allowing for the uniform analysis of the English and French scales. The numerical data was organized into two more sheets: “Foundation Quantitative” and “Survey Quantitative”, which were used to perform further analysis. Figure 11 below shows the addition of these sheets into our Excel breakdown.

Figure 11

Adjusted Breakdown of Data to Include Quantitative Sheets



In “Foundation Quantitative”, we assigned numbers to the answer choices from “1” to “9”, in the order they appeared on Qualtrics. We aligned the English and French translations so that the same response in English or French would count as the same number assignment. Doing so erased the relevance of English and French in the responses, and unified the two surveys for analysis. Each foundation question had a key, detailing what each number meant in relation to the survey answers. This key was contained in several notes on the Excel sheet. From this, we created graphs to display the data collected from each foundation question.

In “Survey Quantitative”, numbers from -1 to +1 were assigned to the Likert scale that was used to acquire statement responses. We assigned “Strongly agree” a value of 1, “Agree” a value of 0.5, “Neither disagree nor agree” a value of 0, “Disagree” a value of -0.5, and “Strongly disagree” a value of -1. This specific scaling was not pertinent to our analysis techniques, but will be useful in future predictive analysis. It also helped maintain the general understanding of “Agree” and “Disagree” responses on a quantitative scale. This scale can be seen below in Figure 12.

Figure 12

Transition from Qualitative Scale to Quantitative Scale

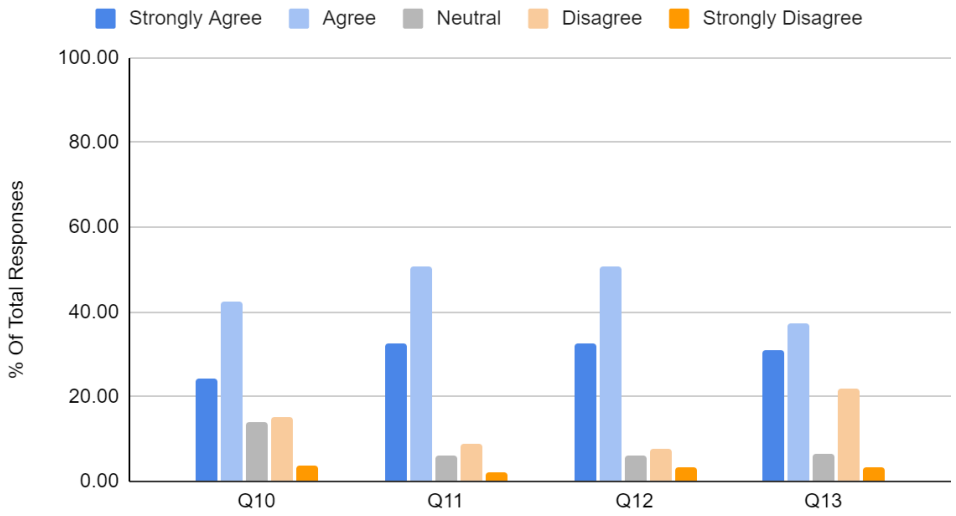
Strongly Disagree	Disagree	Neither Disagree Nor Agree	Agree	Strongly Agree
-1	-0.5	0	0.5	1

3.1.4 Descriptive and Correlation Analysis of Pilot Survey Data

Following the assignment of numerical values to survey responses, we performed two types of analysis on the statement data: descriptive analysis and correlation analysis. To perform descriptive analysis, we implemented a script that counted the number of occurrences of each quantitative response within a specific statement on the sheet “Survey Quantitative”, and then recorded that data on the “Survey Descriptive Analysis” sheet. The statements that fell under each hypothesis were graphed isolated from each other, but together on one chart, as seen in Figure 13. We labeled the bar graph charts with the five-point Likert scale, instead of labeling them as +1 and -1 to ease understanding of the results of the graphs. This analysis technique was useful in visualizing the most popular answers for each statement.

Figure 13

Example Distribution Table



To perform correlation analysis, we wrote a script in Excel to perform it automatically with the addition of new data. Correlation analysis predicts the likelihood of response selection, based on the data from responses to other statements. We conducted correlation analysis for each hypothesis, as well as for the intent statements, and compared the correlations of the correlations of the statements within the hypothesis to each other. A correlation of "1" between two statements means that they were responded to in parallel. A correlation of "-1" means that the two statements were answered inversely, and a correlation of 0 means that there was no correlation between responses to the two statements. The correlation analysis results were displayed in "Survey Correlation Analysis". An example of a correlation table is seen below in Figure 14.

Figure 14

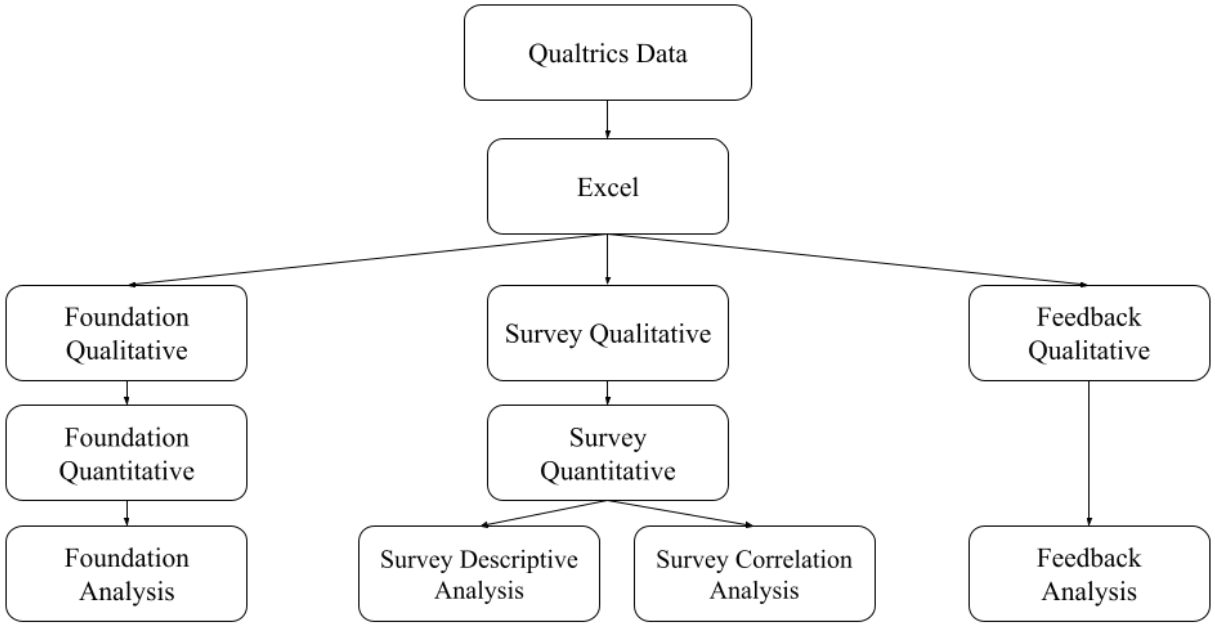
Example Correlation Table

	Q14	Q15	Q16	Q17
Q14	1			
Q15	0.4506877113	1		
Q16	0.04129371801	0.7633376945	1	
Q17	0.3101800302	0.9228001993	0.9413199842	1

The foundation questions were also analyzed using descriptive analysis in the sheet "Foundation Analysis". Here we could see patterns in the demographic data of our sample, as well as in our participant's familiarity with electric vehicles. Additionally, the feedback questions asked respondents about the quality of the survey using a multiple-choice format. We isolated the data we obtained from these responses from the larger data set on the "Feedback Qualitative" sheet, and analyzed it on the "Feedback Analysis" sheet. Any open response comments left at the end of our survey were compiled into one condensed list on the analysis sheet. The feedback questions were specific to the pilot study, and any questions regarding survey feedback were excluded from the RSK Survey. A full breakdown of the flow of data and analysis is seen in Figure 15 below.

Figure 15

Full Breakdown of Data in the Excel Sheet



We used the response data obtained in our pilot study at UIR to trial analysis techniques, and it served as a checkpoint to identify any potential issues in the survey.

3.2 Utilize Social Listening to Gauge Public Opinions on Electric Vehicles

As previously mentioned in the literature review, social listening entails sifting through social media platforms for particular keywords to observe trends in content. It is used to help interested parties understand the online conversation about a particular brand, a topic in the news, or an innovative technology. Opinions are often shared more openly and honestly on social media, so this method of data collection gathers unprompted reactions. Throughout this process, we worked closely with Asma Amalas, a PhD student at UIR. In the context of this project, we utilized social listening to gauge current sentiments online regarding electric vehicles in Morocco. This information allowed us to further refine our survey for the RSK region. This section will detail the process of social listening and the procedure we followed.

3.2.1 Keyword Selection

To begin the social listening process, we created a list of words and phrases relating to electric vehicles that we thought would be mentioned frequently in social media and news posts (see Appendix F). This list was based on concepts and themes we had seen consistently in prior literature. We divided this list into six categories: Electric Vehicle Types, Environmentalism, Sustainable Technologies, Projects, Economics, and Brands. We narrowed down the list as Asma started data collection and annotation. Some words were too general or pulled content that was not relevant to electric vehicles. Asma also translated the finalized keyword list into Arabic. This list can be seen in Appendix G.

3.2.2 Social Media Platform Selection

Before data collection could begin, we needed to choose what social media platforms would be the most beneficial for us to scrape content from. Our initial ideas consisted of Facebook, Instagram, and YouTube, but after speaking with Asma, we asked her to focus on Facebook, Hespress, and YouTube. However, due to Facebook's updated privacy policies and procedures to get access to their Application Programming Interface (API), we decided to eliminate it as a data source. Hespress is a popular Moroccan news platform, so pulling data from there provided content on current events surrounding EVs and people's opinions on those events. YouTube content provided more casual commentary.

3.2.3 Data Collection and Analysis

Once we had selected the keywords and platforms, we coordinated with Asma. She then entered the words and phrases into the desired platforms and started sifting through content. For Hespress, she wrote her own Python code to do this, while for YouTube, she used an API. After pulling this data, she used a graphical user interface called Doccano to manually sort and annotate each comment. We observed this process and assisted when we were able. The interface, with a sample comment, can be seen in Figure 16 below.

Figure 16

Sample Comment in Doccano in Annotation Phase

We then chose the main data analysis techniques we wanted to focus on, deciding on sentiment analysis and topic analysis. Sentiment analysis involved marking the comment as positive or negative, while topic analysis consisted of sorting the comments by subject. Asma thematically coded the comments based on five topics we gave her: infrastructure, economics, government initiatives, maintenance, and environment. We chose each of these categories based on our literature review. While annotating, Asma also discarded any irrelevant comments that got pulled. Once she had annotated all of the comments by sentiment and topic, Asma exported them into a data frame, as seen in Figure 17 below. Originally in Arabic, she translated it so that we could use the comments for further analysis.

Figure 17

Data Frame Organization of Sample Social Listening Comments

	Comment	Sentiment	Topic
0	Everyone should opt for these cars. Fuel prices are getting expensive.	Positive	['Economics']
1	Hopefully Morocco will invest in this initiative. The trend is cars is heading towards electricity.	Positive	['Government and Initiatives']
2	How much time does the battery take to fully charge and for how many kilometres does it last	Positive	['Maintenance']
3	How much time do you need to charge this car with electricity? I saw in a TV show that large corporates are debating this matter. Could you provide more details? I am intersted in buying one.	Positive	['Maintenance']
4	A truly interesting experience. It will certainly reduce pollution.	Positive	['Environment']
5	I heard that batteries are less effective with time. Even when freshly charged, they don't last for long. Here I have two problems, firstly cost-wise because batteries are expensive and secondly environment-wise because recycling old batteries is bad for the environment. Do you have further informations on this ?	Negative	['Economics', 'Environment']
6	For how many kilometres can you drive it after charging? Is it true that batteries are less performant in winter? Have you ever tried to drive it in Ifrane or other snowy places?	Positive	['Maintenance']
7	Great initiative but the problem that still makes people afraid of getting an electric car is the lack of charging stations and the short life of betteries.	Negative	['Infrastructure']
8	What is the price of this electric car ?	Positive	['Economics']

Note. This data frame was originally in Arabic but was translated into English for the purposes of this report.

Finally, she used the analyzed comments to visualize the results of the social listening study in Python. These visuals consisted of pie charts and bar graphs. To create a word cloud, she also cleaned the data in Python, meaning that all numbers, punctuation, and filler words were removed. These graphics helped us to see what we should focus on adjusting in our survey. Once visualization and interpretation were complete, so was the social listening process. In summary, social listening helped us gain insight into public opinions and sentiments regarding electric vehicles in Morocco. This insight allowed us to refine our survey.

3.3 Limitations and Ethical Considerations

The biggest limitation we considered when working on this project was its timing. From the beginning of this project, we were very aware of the fact that we were only in Morocco for seven weeks, and as such would be greatly limited to this time frame. Understanding this enabled us to generate a timeline that gave our pilot study enough time to accumulate an adequate number of responses, while still giving us enough time to analyze the data we collected and formulate recommendations based on our findings.

Another factor that we considered for this project was the privacy of our participants. It was important to protect the personal information of those involved in our study. In order to relieve any concerns, no names were taken, a summary of how the data will be used in our report was provided, and a consent form was included in the survey.

On another note, we needed to consider if our sample would be representative. When conducting our study, it was important to consider the sufficient sample size, as surveying too few people results in non-representative data, but too many responses is unnecessary. Thus, we limited the pilot survey to the UIR community, as this was a good population to test our survey on.

Finally, something we had to consider was the language barrier. In the social listening study, comments were posted online in Darija, MSA, and French, all of which we were not fluent in. Comments needed to be analyzed by someone who not only knew those languages, but also understood the cultural context behind them. To address the language and cultural barrier of the posts, we worked with Asma throughout the entire social listening process. We additionally determined that our survey would reach a wider population if offered in French and English for

the pilot study, with the addition of MSA for the survey for the RSK region. As none of us speak MSA or French, composing our survey in those languages required assistance. To alleviate our group limitation, we worked with PhD student Ihsane Gryech, Professor Anass Sebbar, and our advisor Professor Mohammed El Hamzaoui to translate. In doing so, we also made sure none of our questions were confusing or misconstrued when translated.

Similarly, we worded our statements intentionally, taking the elements of TPB and DOI into consideration while also not leading participants to a specific answer. If our statements or their translations were worded in a biased manner, then that would have skewed data collected in both the pilot study and larger studies conducted later. As a result, it was essential that each statement was worded properly in English, French, and MSA to ensure none caused bias. While working on this project, we took these ethical considerations and limitations into account.

3.4 Conclusion

Through the use of two social theories, we developed relevant user-specific questions and formed a survey to gauge public attitudes toward EVs. This survey was piloted at UIR to ensure it was effective. Conducting a pilot study also provided us the opportunity to test out different analysis techniques. While collecting and analyzing survey data, we also utilized social listening to observe current opinions on EVs in Morocco. This gave us a better understanding of the most common topics of discussion. The results of both the pilot study and social listening will be explained and discussed in depth in the next chapter.

Chapter 4: Results and Discussion

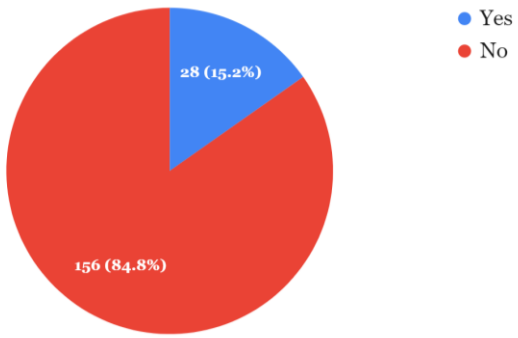
Our pilot study collected several types of data: foundation, survey, and feedback. When analyzing the foundation questions, we could see the demographic distribution within our sample. It was not representative as a pilot for the RSK region or of the UIR community. We analyzed survey data to ensure that statements were clearly phrased, and trialed different analysis techniques to refine them for use in the RSK study. Feedback questions allowed for a third layer of analysis regarding the effectiveness of our survey, where respondents directly communicated their opinions.

4.1 Definitions

In the foundation questions, we asked participants if they or their family owned an electric vehicle. A significant number of respondents (15.2%) reported that they did, as seen in Figure 18 below.

Figure 18

Electric Vehicle Ownership



Note. Response data from the foundation question "Do you or your family own an electric vehicle?"

Considering our background research on electric vehicles in Morocco, having 15.2% of our sample indicate direct access to an electric vehicle was an unexpectedly high percentage. While observing participant interactions with our survey, we noticed that many would quickly skip

through the beginning of the survey without reading it, including the stated definition of electric vehicles. Based on our definition, the question referenced in Figure 18 should exclude hybrid electric vehicles. It is possible that there is a higher percentage of "yes" responses to this question because respondents were confused and counted hybrid vehicles among electric vehicles.

In regard to the response data collected from survey statements, we trialed several analysis techniques to determine what was effective and produced useful information. This ensured our recommended techniques for our sponsor were practical and their use was straightforward. First, we ensured that the techniques we used were effective in conveying information about the sample.

4.2 Abandonment

Even at the start of our data analysis, we realized that there was a high abandonment rate of our survey. We received 285 responses from our pilot study at UIR, however, because we defined usable responses as fully completed, only 184 of them were usable for analysis. We had hoped for 240 complete responses in order to have a representative pilot study, and while we did not reach this number, we were still able to test our survey and make adjustments.

As a result of the abandonment, some questions were answered more than others. When looking at where many participants left the survey, we saw it was mainly in the following places: the beginning of the foundation questions, in between the foundation questions and survey statements, and partway through the survey statements. When considering why this occurred, we concluded that it was likely due to design and distribution. In terms of design, in the pilot we had multiple pages of foundation questions and the statements in a specific order. Statements about the same variable were in a row, which created some repetitiveness.

We also saw a large number of partial responses due to our distribution methods. We first distributed the survey via email to student inboxes, then through interactions with people on campus in both structured and unstructured settings. When comparing the number of complete responses from each of these methods, it was clear that the structured setting, having students take the survey in the classroom, resulted in many more usable responses than the unstructured environment of walking up to people, asking them to take the survey, and then leaving. The

unstructured interactions had a much larger number of partial responses, as we did not wait for them to complete the survey in front of us. Many people also did not know how to scan the QR code or did not have the software to support it on their phones. They also stated that they would go back to the survey, but without seeing them take it, we could not guarantee that. Due to this, we needed to consider what methods would be best for the RSK distribution.

4.3 Confusion on Survey Phrasing and Content

The phrasing and content of some of our survey also caused some confusion when we were trying to interpret the results of some of the statements. While developing the content of the survey, we based our statements around a set list of variables and their respective hypotheses. However, some statements we created did not correctly apply the variable definitions, or did not end up contributing anything unique to the data. For example, Hypothesis 8 is centered around the DOI variable 'Trialability'. In looking at the statements, two were posed regarding whether or not respondents would trial an electric vehicle, and only one about their access to test drive an electric vehicle. Their desire to trial an electric vehicle is less relevant to the variable than their access to and ease of trialing.

The data analysis of the survey statements was more complex than we had originally anticipated. Initially, we originally only graphed statements according to the five-point Likert scale, without any consideration for the phrasing of statements. Not all statements were phrased in the same way, and with subconscious color correlations in mind, interpretation of graphs was skewed. Some statements were phrased more positively, while others were phrased more negatively, but all statements were displayed on the same scale. For example, we initially analyzed agreement from Q28, "I know how to charge an electric vehicle", and Q29 "I think it is hard to charge an electric vehicle" equally, and displayed them according to the Likert scale. In Q28, people are agreeing that they know how to charge an electric vehicle, but in Q29, people are agreeing that they think charging an electric vehicle is difficult. These two graphs should therefore appear opposite in nature, but when we created the graphs, we did not keep the difference in phrasing in mind. This, in combination with the color choices described above, resulted in graphs that were unintentionally indicating positive sentiments, rather than simply reporting data.

In addition, we did not clearly define what “agree” and “disagree” would mean in relation to the variables. For example, in displaying data pertaining to Hypothesis 6: Complexity, we had variables displayed on the Likert scale in bar graphs. However, we did not clarify how we defined an “agreement” for statements about complexity. Without a definition, agreement could mean that respondents thought that electric vehicles were very complex or not complex as a technology. This made explaining the graph to other people more difficult.

Finally, our data analysis methods made it difficult for our team to simply explain our process to other people. Our original hypotheses related variables to each other and to intent, but we were not proving or disproving these relationships. Instead, we operated under the assumption that each relationship influences attitude/intent as described, to positively influence the intent to perform the behavior. If one of the variables appeared as negative in our results, it was inferred that it was limiting attitude/intention. In doing this we tested for null hypotheses. In our original attempts to explain our process, we did not mention this, causing people to think that we were proving or disproving our hypothesis. As a team, we needed to ensure others fully understood our process, especially our sponsor. Once they have a clear understanding of the theories and hypotheses we used to develop the survey, they can continue to use it. The results discussed from the pilot study and the results from social listening, which is discussed next, guided adjustments to our survey.

4.4 Topics of Focus

We utilized social listening to gauge current public opinions in Morocco on electric vehicles. Asma analyzed and visualized a total of 401 comments by Moroccans regarding electric vehicles (Amalas, 2022).

From the sentiment analysis, we saw more positive comments than negative, which indicated that people were generally not talking negatively about electric vehicles, and therefore are not necessarily opposed to them. This information served as a check for our survey, and coincided with what we expected: that while electric vehicles are still not very popular in the region, society is supportive of their implementation. From the topic analysis we saw that economics was discussed most often, closely followed by maintenance, while infrastructure was discussed the least. Based on our literature review, we had expected economics and

infrastructure to be the major topics of discussion, not maintenance, so this was an unexpected finding. From her joint sentiment and topic analysis, we observed that while economics and maintenance were discussed the most and had the highest number of negative comments, infrastructure had the third highest amount of them, even as the category least mentioned. That indicated that they brought up the most public concerns, so we needed to ensure they were emphasized in the survey for it to be able to judge the barriers to widespread adoption.

Within each topic, Asma also made note of several main concerns, which was helpful when looking at these three specific barriers and what we had in our survey. In terms of economics, she identified price of purchase, battery price, and electricity bills for home charging to be the main subjects of conversation online. For maintenance, battery life and range were often brought up in the comments, as well as access to mechanics. Because electric vehicles are a newer technology, there are less mechanics in the region that know how to deal with EV issues. The main concern regarding infrastructure was charging station availability. If people cannot access a charging station in their area, they are less likely to feel comfortable purchasing an electric vehicle. Based on these observations, we needed to make sure that all of these barriers were reflected in our survey statements, especially economics and maintenance. In reviewing the statements, there were several that fell under the economics and infrastructure categories, but only one pertaining to maintenance. This was something we kept in mind as we made our survey adjustments.

4.5 Conclusion

As discussed above, the data from the pilot study and social listening informed adjustments to our survey, and guided our recommendations for the RSK survey. We trialed several analysis techniques using the survey statement data, and ultimately suggested three methods for analysis. In analyzing, we observed a high abandonment rate, confusion based on color implications and phrasing, and gaps in our analysis. From the social listening study, it was clear that economics, maintenance, and infrastructure were the most discussed concerns online, but the original survey statements we developed lacked proper emphasis on them. Based on results from both studies, we decided to make adjustments to our survey and guided our revisions in the following areas: color scheme, phrasing of statements and hypotheses, additions to survey

content, and the formatting of the survey. These adjustments will be discussed in more detail in the next chapter.

Chapter 5: Conclusions and Deliverables

In this project, we concluded that we needed to make adjustments regarding survey format, survey content, survey analysis techniques, and hypothesis phrasing. From those, we refined the survey for our deliverables. We also developed deliverables that contained recommendations for next steps regarding distribution and analysis.

5.1 Adjustments

Once we created, distributed, and analyzed our pilot study, we reflected on any identifiable points of difficulty and confusion. Based on this, we made several changes to the survey and analysis techniques to collect and analyze data more effectively. These adjustments were made to ensure seamless implementation of the survey when applied to the population in the Rabat-Salé-Kenitra (RSK) region. This section will outline all adjustments and the thought process behind them.

5.1.1 Adjustments to Survey Format

After piloting our survey, we determined that a major point of concern in our results was the abandonment rate of the survey. To reduce abandonment, we placed all of the foundation questions on one page, instead of keeping them spread out over multiple pages as they were in the pilot. Additionally, we consistently did not receive responses to the same statements when respondents abandoned the pilot survey, because statements were displayed in a set order. Based on this, we randomized the statements portion of the survey to ensure a more thorough dataset in the RSK study. In randomizing the statement order, data can be gathered from all of the statements, even if the survey is abandoned. It also randomizes the topics, so there will be a more variety statement-to-statement as the survey is taken.

5.1.2 Adjustments to Survey Content

There were also issues with phrasing in the survey. In Hypothesis 8: Trialability, we had two statements that portrayed the same information. Because of this, we rephrased the statement “Prior to buying an electric vehicle, I would like to test drive it” to “It would be difficult for me

to test drive an electric vehicle". This better fit the definition of trialability, which is the ease with which a potential customer can try a product. This focuses more on the ease of test driving and less on the want to do so.

Furthermore, it is likely that participants incorrectly answered questions regarding their access to electric vehicles due to confusions about the survey's working definition of them. We reworded the foundation questions to include the phrase "excluding hybrids" in all questions that mentioned electric vehicles. The survey still begins with the definition of electric vehicles at the start of the survey, but the additional clarifications add further emphasis on the working definition of electric vehicles in the survey. The updated foundation questions can be seen in Appendix A in the color blue.

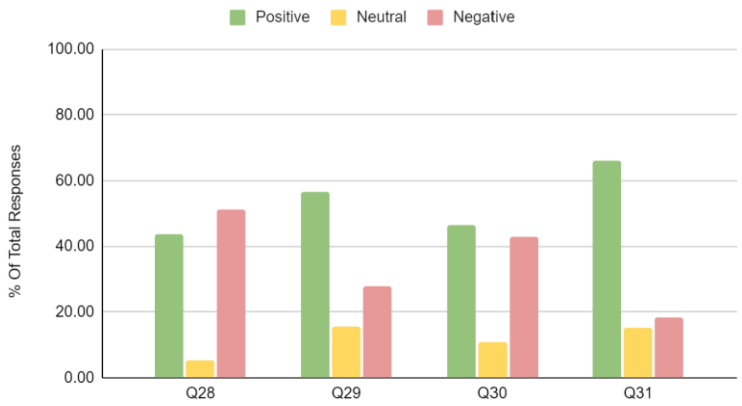
Based on the social listening study, we found that we did not have enough emphasis on the topic of maintenance in our survey. It was the second most talked about of the five social listening topics, and we only had one statement addressing it in our survey. We added a statement under Hypothesis 5: Compatibility, stating "I know where to go to fix an electric vehicle in need of repair". This statement collects data from the participant about their knowledge of accessible options for maintenance of an electric vehicle. Having this statement ensures the barrier of maintenance is being addressed in the survey. The updated list of survey statements can be seen in Appendix C in the color blue.

5.1.3 Adjustments to Survey Analysis

When testing a variety of analysis techniques, we decided to add a third element to our survey statement analysis, sentiment analysis. In adding this analysis, we emphasized the difference between distribution of responses and actual sentiment. Our survey statements were both positively and negatively phrased, but there was originally no analysis or graph that displayed data according to underlying sentiment instead of the Likert scale. To solve this, we graphed the sentiments for each statement, and then displayed statement sentiments by hypothesis, as seen in Figure 19. We intentionally displayed this data using red and green to capitalize on any implicit conclusions made about the data.

Figure 19

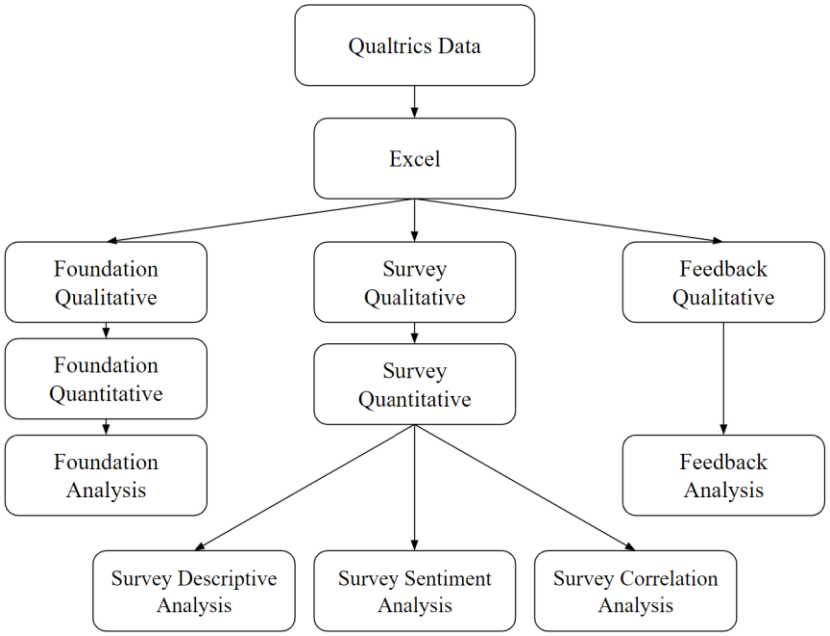
Example Sentiment Analysis Graph



To perform the sentiment analysis, we added another sheet to the automated Google Sheets document titled “Survey Sentiment Analysis”, as seen in Figure 20 below.

Figure 20

Updated Breakdown of Data and Google Sheet



We separated the data by statement, and further categorized the statements by hypothesis. We combined the “agreement” and “disagreement” responses for each statement, then manually went through each statement to define what each Likert scale response meant. We clearly indicated

whether or not an "agreement" response should be interpreted as should be interpreted as a positive or negative sentiment in relation to the statement it answered. For example, the first statement posed under Hypothesis 1 is "I think electric vehicles are a good investment". We defined an agreement with this statement as a positive sentiment, and disagreement as a negative sentiment. We then expressed the different sentiments as percentages of the total responses to the statement, as seen below in Figure 21 and graphed them, as seen above in Figure 21.

Figure 21

Example of Sentiment Data in Google Sheets

	H1
	Q10
Positive Sentiment	66.85
Neutral Sentiment	14.13
Negative Sentiment	19.02

Note. We displayed the percentage of each sentiment (right column) in relation to the total number of responses per statement.

We wanted to analyze the statements to show sentiments uniformly in relation to the statements and their hypotheses. This allowed for easy assessment of the variables that are influencing attitude and intent.

Additionally, we further clarified our data analysis methods by rewriting our hypotheses. Originally, we wrote that variables were positively or negatively related to attitude or intent. This created confusion around our analysis techniques, because it was assumed that we were testing the relationship between the variables and the intent or attitude, when instead we were testing our hypotheses against the null hypothesis. We assumed our hypotheses to be correct, and if data displayed the variable opposite from what we had expected, we assumed it was having an opposite effect on intent or attitude than the relationship as described in its hypothesis. For example, Hypothesis 1 was "Attitude towards electric vehicles is positively related to intent to adopt electric vehicles". We interpreted this to mean that a positive attitude about electric vehicles would positively influence intent to purchase an electric vehicle. Hypothetically, if results showed that people thought negatively of electric vehicles, we would interpret this to

mean that the negative attitude was negatively influencing intent to purchase an electric vehicle. To further clarify this understanding, we changed the phrasing “positively or negatively related to attitude or intent” to instead be “positively or negatively influences attitude or intent”. For example, with this phrasing, Hypothesis 1 was updated to read “Attitude towards electric vehicles positively influences the intent to adopt electric vehicles”. We believe that this shifts emphasis from relationships and correlations to the influence that each variable has on attitude or intent. We also changed the word “adopt” to “purchase”, and updated grammar to better define the action we were testing. For example, Hypothesis 1 now reads “Attitude towards electric vehicles positively influences the intent to purchase an electric vehicle”. We updated all eight hypotheses, which can be seen in Appendix H.

5.2 Deliverables

After finalizing survey content and analysis to reflect our findings, we updated our deliverables. Our primary deliverables were our survey and the automated Google Sheet for analysis. We created supplemental documents to explain our survey creation, content, and analysis, and then outlined our suggested next steps for the RSK survey. All deliverables and recommendations were provided to our sponsor via a Google Drive alias. More specifics regarding these deliverables are discussed in this section.

5.2.1 Itemized List of Deliverables

We created an alias and a Google Drive to seamlessly transfer our project to our sponsor. The project alias has complete ownership of the documents in the Google Drive, which we copied over from our files. The Google Drive contains a Google Form of our adjusted survey, the automated analysis Google Sheet, and several supporting documents. Originally, we had made the survey in Qualtrics and designed an automated Excel sheet for the data, but to make transference to our sponsor easier, we made the RSK survey and analysis sheet in Google applications instead. Adjusting the analysis sheet to Google Sheets also made the conversion of data from survey response to analysis easier. We included four types of documentation in the alias Google Drive to describe survey creation methods, use of our deliverables, and future steps and our recommendations to our sponsor. We included the table of deliverables seen on the

document titled “Next Steps” in Appendix I. More details about our recommendations for next steps will be discussed next.

5.2.2 Recommendations for Distribution

We gauged the effectiveness of our distribution methods through the pilot survey, and used this information to determine potential distribution techniques for the RSK survey. We quickly discerned from these interactions that QR codes would not be a reliable distribution method for the larger RSK region due to the confusion around the technology at UIR. If college students were unsure how to scan a QR code and required assistance, then the general public is not likely to use them to take the survey.

A structured form of distribution is likely to have the best success in terms of completed responses. When we watched people take the survey, they were more likely to finish it. For this, sending people to the RSK region and distributing the survey that way, where they ask the participant to take the survey and stay with them when they take it would yield the highest completion rate.

Additionally, sharing the RSK survey link on social media, then asking participants to share it on their social media after survey completion could be an effective way to continually distribute the survey. This snowball collection method presents the opportunity to gather a lot of responses in a short amount of time. We want to collect data from various perspectives and positions in society to make inferences on behavior and intent for the entire population. Those taking the survey should not just be those interested in electric vehicles, since that would bias data. There are some downsides, one being the potential for all the responses to come from like-minded individuals. However, using social media also presents the opportunity to reach different areas of the population at the same time. Reaching out to various groups and organizations within the region and arranging to share the survey on their pages would be a good way to start the snowball effect. If the survey is shared from an organization or leader, people will be more encouraged to engage with the survey because it would be coming from a reliable source. This way, the communication networks formed by social media can be taken advantage of in distribution, while engaging the participants through a trustworthy source.

Something to consider about social media distribution is that younger generations have more social media presence than older generations, which could limit the survey's audience. Generally speaking, older people would be less likely to be able to take the survey electronically, due to lack of access to or knowledge of technology. Another consideration is the abandonment rate. Social media is a casual setting, and people will likely feel less pressured to complete the survey. Overall, the goal of survey distribution is to reach a large group of diverse individuals, and social media is an easy way to do this quickly, but a structured form of distribution would provide a lower abandonment rate with more usable responses.

5.2.3 Recommendations for Analysis

Our analysis began by performing basic descriptive analysis, followed by sentiment and correlation analysis. These were all performed in the automated Google Sheets document for our pilot study data. We were not able to conduct any other forms of analysis past this due to time and means, but there are a few methods that we suggest conducting in future iterations of this study. These future analyses methods can also be conducted in the provided automated Google Sheets file. The first of which is reliability analysis, which is a common analysis test that can be performed in Excel. Reliability analysis, more specifically internal consistency reliability, will measure how well our survey delivers valid and dependable results among different inputs. This is useful to this analysis due to the numerous instances of summation in the descriptive analysis section. Performing reliability analysis would ensure that the statements being posed are answered in a satisfactory manner. Similarly, we also recommend conducting a discriminant validity test. This ensures that if two responses are not supposed to be related to each other that the data supports this. The pairing of these tests would confirm that the data produced by our survey is both reliable and valid for the wider RSK region.

Another simple but effective test that we recommend would be collinearity analysis, particularly a multicollinearity test. The principle of multicollinearity is that two variables have strong correlation with each other, which can be determined from the collinearity test described earlier. From there, it is possible to perform a basic predictive analysis: if two variables are deemed to be collinear, then one variable's response can be predicted from it. This is useful for

making educated assumptions based on the data, which can lead to further predictive analysis methods.

We also recommend performing a p-value test, which determines how likely it is that the null is true for a set hypothesis. The lower the p-value, the greater the statistical significance of the data. If the p-value of the data is found to be very low, this means that the data fits the hypothesis well, and can be replicated. Similar to reliability and validity, this test would serve as an affirmation that the hypotheses are supported by the data.

Finally, we recommend more advanced predictive analysis techniques that require technology other than Excel or Google Sheets. In more detail, predictive analysis aims to infer the likelihood of future events based on the data of the past. While there are many methods for conducting predictive analysis, including data mining, decision trees, and path analysis, we recommend using AI and machine learning to make the future analysis easier. We believe that by teaching a machine learning algorithm with the data collected from the larger RSK region survey, combined with the collinear analysis, it will be possible to make broad conclusions on the entire population of Morocco regarding electric vehicle sentiments.

5.3 Conclusion

Based on our results and findings, we concluded that our survey needed to be adjusted in terms of format, content, and analysis. We made refinements to it by changing the number of pages, randomizing the order of the statements, rephrasing a trialability statement, adding a compatibility statement about maintenance, and adding a third analysis technique called sentiment analysis. We also rephrased our hypotheses to avoid confusion. Once we made these adjustments, we finalized our deliverables consisting of the refined survey for the RSK region, the automated sheet that performs analysis, and several documents explaining how to use those and what to do next. It is our hope that these deliverables will make for a successful RSK study.

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Appendix A

RSK Survey Foundation Questions

English

- What is your gender?
  - Male
  - Female
  - Prefer not to answer
- How old are you?
  - 18-25
  - 26-35
  - 36-45
  - 46-55
  - 56-65
  - 66-75
  - 76+
- What is your employment status?
  - Employed
  - Student
  - Unemployed
  - Retired
- Where do you live?
  - Rabat
  - Sale
  - Kenitra
  - Other
- How familiar are you with electric vehicles (excluding hybrids)?
  - I have heard of them, and I am familiar with them
  - I have heard of them, but I am not familiar with them
  - I had not heard of them until now
- How do you commute?
  - I drive my own vehicle
  - Someone else drives me
  - I take the bus
  - I take the tram
  - I walk
  - I do not commute
- Do you own a vehicle?
  - Yes, I own a vehicle
  - No, but my family owns a vehicle

    - No, my family does not have a vehicle
- How many cars do you and/or your family own?
    - 0
    - 1
    - 2
    - 3+
- Are any of them an electric vehicle (excluding hybrids)?
    - Yes
    - No
- If yes, how many?
    - 1
    - 2
    - 3+
    - N/A

French

- Quel est votre sexe?
    - Homme
    - Femme
    - Préfère ne pas répondre
- Quel âge avez-vous?
    - 18-25
    - 26-35
    - 36-45
    - 46-55
    - 56-65
    - 66-75
    - 76+
- Quel est votre statut professionnel?
    - Employé(e)
    - Étudiant(e)
    - Sans emploi
    - Retraité
- Où habitez-vous?
    - Rabat
    - Sale
    - Kenitra
    - Autre
- Êtes-vous familier avec les véhicules électriques (hors hybrides)?
    - J'en ai entendu parler et je les connais

    - J'en ai entendu parler, mais je ne les connais pas
    - Je n'en avais pas entendu parler jusqu'à présent
- Comment vous déplacez-vous ?
    - Je conduis mon propre véhicule
    - Quelqu'un d'autre me conduit
    - Je prends le bus
    - Je prends le tram
    - Je marche
    - Je ne me déplace pas
- Possédez-vous un véhicule?
    - Oui, je possède un véhicule
    - Non, mais ma famille possède un véhicule
    - Non, je ne possède pas de véhicule
- Combien de véhicules vous et/ou votre famille possédez-vous?
    - 0
    - 1
    - 2
    - 3+
- Est-ce que vous ou un membre de votre famille possédez un véhicule électrique (hors hybrides)?
    - Oui
    - Non
- Si oui, combien?
    - 1
    - 2
    - 3+
    - N/A

Moroccan Standard Arabic (MSA)

- ما هو جنسك؟
    - ذكر
    - أنثى
    - أفضل عدم الإجابة
- كم عمرك؟
    - 18-25
    - 26-35
    - 36-45
    - 46-55
    - 56-65
    - 66-75

- 76+
- ما هو وضعك الوظيفي؟
  - عامل
  - طالب
  - عاطل عن العمل
  - متقاعد
- أين تقطن؟
  - الرباط
  - سلا
  - القنيطرة
  - آخر
- ما مدى معرفتك بالسيارات الكهربائية ؟
  - لقد سمعت عنهم ، وأنا على دراية بهم
  - لقد سمعت عنهم ، لكني لست على دراية بهم
  - لم أسمع بهم حتى الآن
- كيف تتنقل إلى العمل / المدرسة؟
  - أقود سيارتي الخاصة
  - شخص آخر يوصلني
  - أستقل الحافلة
  - أستقل الترام
  - أمشي
  - أنا لا أتنقل للعمل
- هل تملك سيارة؟
  - نعم ، أنا أملك سيارة
  - لا ، لكن عائلتي تمتلك سيارة
  - لا ، عائلتي لا تملك سيارة
- كم عدد السيارات التي تمتلكها أنت و / أو عائلتك؟
  - 0
  - 1
  - 2
  - 3+
- هل أي منهم مركبة كهربائية ؟
  - نعم
  - لا
- إذا كانت الإجابة بنعم ، فكم عددها؟
  - 1
  - 2
  - 3+

Appendix B

Initial Theory Hypotheses for Survey

First three hypotheses are for TPB. They state the correlations between the variable and the intention/behavior.

H1: Attitude towards electric vehicle adoption is positively related to the intention to purchase an electric vehicle.

H2: Subjective norm is positively related to the intention to purchase an electric vehicle.

H3: Perceived behavioral control (PBC) is positively related to intention to purchase an electric vehicle.

Next five hypotheses are for DOI. They state the correlations between the variable and the attitude towards the topic.

H4: Relative advantage is positively related to attitudes towards electric vehicles.

H5: Compatibility is positively related to attitudes towards electric vehicles.

H6: Complexity is negatively related to attitudes towards electric vehicles.

H7: Observability is positively related to attitudes towards electric vehicles.

H8: Trialability is positively related to attitudes towards electric vehicles.

Appendix C

Survey Statements

Strongly Disagree	Disagree	Neither Disagree Nor Agree	Agree	Strongly Agree

English

Please indicate to what extent you agree or disagree with the following statements.

H1: Attitude towards electric vehicle adoption is positively related to the intention to purchase an electric vehicle.

1. Using an electric vehicle is preferable to me.
2. I think that electric vehicles are a good investment.
3. I think that there is a need for electric vehicles.
4. I think that electric vehicles should be more popular than they are.

H2: Subjective norm is positively related to the intention to purchase an electric vehicle.

5. The people important to me would approve if I bought an electric vehicle.
6. If people around me had electric vehicles, it would make me want to buy one.
7. The people important to me prefer that I buy an electric vehicle over a petroleum one.
8. If I bought an electric vehicle, the people important to me would also buy an electric vehicle.

H3: Perceived behavioral control (PBC) is positively related to intention to purchase an electric vehicle.

9. I could buy an electric vehicle if I wanted to.
10. I think I know where I can buy an electric vehicle.
11. I have the time, resources, and opportunity to buy an electric vehicle.

H4: Relative advantage is positively related to attitudes towards electric vehicles.

12. I think I would save money long term by buying an electric vehicle.
13. I think an electric vehicle would be easier for me to maintain than a petroleum one.
14. Using an electric vehicle would be beneficial for the environment.
15. Fuel costs affect my desire for an electric vehicle.

H5: Compatibility is positively related to attitudes towards electric vehicles.

16. I can easily find an electric vehicle charging station in my area.
17. I would be able to do my daily activities with an electric vehicle as my transportation.
18. I would feel comfortable traveling long distances in an electric vehicle.
19. I know where to go to fix an electric vehicle in need of repair.*

H6: Complexity is negatively related to attitudes towards electric vehicles.

20. I know how to charge an electric vehicle.
21. I think it is hard to charge an electric vehicle.
22. I think operating an electric vehicle would be similar to operating a petroleum one.

23. The concept behind electric vehicles is difficult for me to understand.

H7: Observability is positively related to attitudes towards electric vehicles.

24. People close to me would notice if I started using an electric car.
25. Electric vehicles stand out from other vehicles on the street.
26. I see electric vehicles often in my daily life.
27. I often see advertisements for electric vehicles.

H8: Trialability is positively related to attitudes towards electric vehicles.

28. Prior to buying an electric vehicle, I would like to test drive it.
29. It would be difficult for me to test drive an electric vehicle.*
30. I have access to test drive an electric vehicle.

Intention:

31. I plan to buy an electric vehicle in the near future.
32. I want to buy an electric vehicle in the near future.
33. I am willing to buy an electric vehicle in the future.

French

Veuillez indiquer dans quelle mesure vous êtes d'accord ou pas d'accord avec les affirmations suivantes.

1. L'utilisation d'un véhicule électrique m'est préférable.
2. Je pense que les véhicules électriques sont un bon investissement.
3. Je pense qu'il y a un besoin de véhicules électriques.
4. Je pense que les véhicules électriques devraient être plus populaires.
5. Les personnes importantes pour moi approuveraient si j'achetais un véhicule électrique.
6. Si les gens autour de moi avaient des véhicules électriques, ça me donnerait envie d'en acheter un.
7. Les personnes importantes pour moi préfèrent que j'achète un véhicule électrique plutôt qu'un véhicule à carburant.
8. Si j'achetais un véhicule électrique, les personnes importantes pour moi achèteraient également un véhicule électrique.
9. Je pourrais acheter un véhicule électrique si je le voulais.
10. Je pense savoir où j' peux acheter un véhicule électrique.
11. J'ai le temps, les ressources et la possibilité d'acheter un véhicule électrique.
12. Je pense que j'économiserais de l'argent à long terme en achetant un véhicule électrique.
13. Je pense qu'un véhicule électrique serait plus facile à entretenir pour moi qu'un véhicule à carburant.
14. L'utilisation d'un véhicule électrique serait bénéfique pour l'environnement.
15. Les frais de carburant affectent mon désir d'avoir un véhicule électrique.
16. Je peux facilement trouver une borne de recharge pour véhicules électriques dans ma région.

17. Je pourrais mener mes activités quotidiennes avec un véhicule électrique comme moyen de transport.
18. Je me sentirais à l'aise pour parcourir de longues distances dans un véhicule électrique.
19. Je sais où aller pour réparer un véhicule électrique qui a besoin d'être réparé.*
20. Je sais recharger un véhicule électrique.
21. Je pense qu'il est difficile de recharger un véhicule électrique.
22. Je pense que conduire un véhicule électrique serait similaire à conduire un véhicule à carburant.
23. Le concept derrière les véhicules électriques est difficile à comprendre pour moi.
24. Mes proches remarqueraient si je commençais à utiliser une voiture électrique.
25. Les véhicules électriques se démarquent des autres véhicules dans la rue.
26. Je vois souvent des véhicules électriques dans ma vie quotidienne.
27. Je vois souvent des publicités pour des véhicules électriques.
28. Avant d'acheter un véhicule électrique, j'aimerais faire un essai de conduite.
29. Il me serait difficile d'essayer un véhicule électrique.*
30. J'ai accès à un essai routier d'un véhicule électrique.
31. J'ai l'intention d'acheter un véhicule électrique dans un futur proche.
32. Je souhaite acheter prochainement un véhicule électrique.
33. Je suis prêt à acheter un véhicule électrique à l'avenir.

Modern Standard Arabic (MSA)

.يرجى توضيح مدى موافقتك أو معارضتك للعبارات التالية

1. استخدام السيارة الكهربائية هو الأفضل بالنسبة لي.
2. أعتقد أن السيارات الكهربائية استثمار جيد.
3. أعتقد أن هناك حاجة للمركبات الكهربائية.
4. أعتقد أن السيارات الكهربائية يجب أن تكون أكثر شهرة مما هي عليه الآن.
5. سيوافق الأشخاص المهمون بالنسبة لي إذا اشتريت سيارة كهربائية.
6. إذا كان الناس من حولي يمتلكون سيارات كهربائية، فإن ذلك سيجعلني أرغب في شراء واحدة.
7. الأشخاص المهمون بالنسبة لي يفضلون شراء سيارة كهربائية على السيارة البترولية.
8. إذا اشتريت سيارة كهربائية، فإن الأشخاص المهمين بالنسبة لي سيشترون أيضًا سيارة كهربائية.
9. يمكنني شراء سيارة كهربائية إذا أردت ذلك.
10. أعتقد أنني أعرف من أين يمكنني شراء سيارة كهربائية.
11. لدي الوقت والموارد والفرصة لشراء سيارة كهربائية.
12. أعتقد أنني سأوفر المال على المدى الطويل بشراء سيارة كهربائية.
13. أعتقد أن صيانة السيارة الكهربائية سيكون أسهل بالنسبة لي من صيانة المركبات البترولية.
14. استخدام سيارة كهربائية سيكون مفيدًا للبيئة.
15. تؤثر تكاليف الوقود على رغبتي في الحصول على سيارة كهربائية.
16. يمكنني العثور بسهولة على محطة لشحن السيارات الكهربائية في منطقتي.
17. سأكون قادرًا على القيام بنشاطاتي اليومية باستخدام سيارة كهربائية كوسيلة للنقل.
18. سأكون مرتاحا إذا سافرت لمسافات طويلة في مركبة كهربائية.

19.أعرف إلى أين أذهب لإصلاح سيارة كهربائية بحاجة إلى الإصلاح.*
20. أعرف كيف أشحن سيارة كهربائية.
21. أعتقد أنه من الصعب شحن سيارة كهربائية.
22. أعتقد أن تشغيل مركبة كهربائية سيكون مماثلاً لتشغيل مركبة بترولية.
23. يصعب علي فهم التقنية وراء السيارات الكهربائية.
24. الأشخاص المقربون مني سيلاحظون إذا بدأت في استخدام سيارة كهربائية.
25. تبرز المركبات الكهربائية عن غيرها من المركبات في الشارع.
26. كثيراً ما أرى السيارات الكهربائية في حياتي اليومية.
27. كثيرا ما أشاهد إعلانات للمركبات الكهربائية.
28. قبل شراء مركبة كهربائية، أود اختبار قيادتها.
29. سيكون من الصعب بالنسبة لي اختبار قيادة سيارة كهربائية.*
30. بإمكاني الذهاب لاختبار قيادة مركبة كهربائية.
31. أخطط لشراء سيارة كهربائية في المستقبل القريب.
32. أود شراء سيارة كهربائية في المستقبل القريب.
33. أنا على استعداد لشراء سيارة كهربائية في المستقبل.

Statements that were changed or added are noted with a *.

Appendix D

UIR Pilot Survey Foundation Questions

English

- Are you a member of the UIR community?
    - Yes, I am a student
    - Yes, I am a part of the faculty/staff
    - No, I am not affiliated with UIR
- What college are you associated with at UIR?
    - College of Engineering & Architecture
    - College of Management
    - College of Health Sciences
    - College of Law & Political and Social Sciences
    - College of Doctoral Studies
    - I am not associated with a particular college
    - I am not affiliated with UIR
- What is your gender?
    - Male
    - Female
    - Prefer not to answer
- How old are you?
    - 18-25
    - 26-30
    - 31-35
    - 36-40
    - 41-45
    - 46-50
    - 51-55
    - 56-60
    - 61+
- How do you commute?
    - I drive my own vehicle
    - Someone else drives me
    - I take the bus
    - I take the tram
    - I walk
    - I do not commute
- Do you own a vehicle?
    - Yes, I own a vehicle

    - No, but my family owns a vehicle
    - No, I do not own a vehicle
- Do you or any of your family members own an electric vehicle / hybrid?
    - Yes
    - No

French

- Vous êtes membre de la communauté UIR?
    - Oui, je suis un/une étudiant(e)
    - Oui, je fais partie du collège/personnel
    - Non, je ne suis pas affilié à l'UIR
- À quel collège êtes-vous associé à l'UIR ?
    - College of Engineering & Architecture
    - College of Management
    - College of Health Sciences
    - College of Law & Political and Social Sciences
    - College of Doctoral Studies
    - Je ne suis pas associé à un collège en particulier
    - Je ne suis pas affilié à l'UIR
- Quel est votre sexe ?
    - Homme
    - Femme
    - Préfère ne pas répondre
- Quel âge avez-vous?
    - 18-25
    - 26-30
    - 31-35
    - 36-40
    - 41-45
    - 46-50
    - 51-55
    - 56-60
    - 61+
- Comment vous rendez-vous au travail/à l'Université ?
    - Je conduis mon propre véhicule
    - Quelqu'un d'autre me conduit
    - Je prends le bus
    - Je prends le tram
    - Je marche

    - Je ne fais pas la navette
- Possédez-vous un véhicule?
    - Oui, je possède un véhicule
    - Non, mais ma famille possède un véhicule
    - Non, je ne possède pas de véhicule
- Êtes-vous familier avec les véhicules électriques ?
    - J'en ai entendu parler et je les connais
    - J'en ai entendu parler, mais je ne les connais pas
    - Je n'en avais pas entendu parler jusqu'à présent
- Est-ce que vous ou un membre de votre famille possédez un véhicule électrique ?
    - Oui
    - Non

Appendix E

Survey Consent Form

English

Worcester Polytechnic Institute

Informed Consent to Participate in Research

Study Title: UIR Electric Vehicle Study

Researchers: Abbey Blauser, Rhys Forster, Elizabeth Hicks, Rebecca Marion

We're inviting you to take a survey for research. This survey is completely voluntary. If you start the survey, you can always change your mind and stop at any time.

What is the purpose of this study?

We are distributing this survey to gather information on public opinions and behaviors toward electric vehicles to propose recommendations on how to better integrate them into Moroccan life.

What will I do?

The survey will ask questions regarding topics, such as public opinion towards electric vehicles, barriers to purchase, and collecting some demographic questions to categorize responses. No questions asking name or contact information will be asked.

Who can see my data?

Our team will have access to survey responses on Qualtrics. This is so we can analyze the data and conduct the study. Our sponsor will also have access to the compiled responses, as a summary. We will share our findings in presentations and publications. When we do, the results will be aggregate data with no individual responses.

Questions about the research, complaints, or problems:

Contact our team at gr-ElectricVehicleStudy-D22@wpi.edu.

Please print or save this screen if you want to be able to access the information later.

IRB #: 22-0531 IRB Approval Date: 3/10/2022

Agreement to Participate

Your participation is completely voluntary, and you can withdraw at any time.

If you would like to take the survey, click the button below to start.

French

Institut Polytechnique de Worcester

Formulaire de consentement éclairé pour participer à la recherche

Titre de l'étude : Étude sur les véhicules électriques
Chercheurs: Abbey Blauser, Rhys Forster, Elizabeth Hicks, Rebecca Marion

Nous vous invitons à répondre à un sondage dans le cadre d'une recherche qui vise à mieux comprendre l'utilisation des véhicules électriques au Maroc. Cette enquête est entièrement volontaire. Si vous commencez l'enquête, vous pouvez toujours changer d'avis et vous arrêter à tout moment.

Quel est le but de cette étude?
Nous distribuons cette enquête pour recueillir des informations sur les opinions et les comportements du public Marocain à l'égard des véhicules électriques afin de proposer des recommandations pour mieux les intégrer dans la vie quotidienne.

Que vais-je faire?
L'enquête posera des questions sur des sujets tels que l'opinion publique à l'égard des véhicules électriques, les obstacles à l'achat et la collecte de certaines questions démographiques pour catégoriser les réponses. Aucune question demandant le nom ou les coordonnées ne sera posée.

Qui peut voir mes données?
Notre équipe aura accès aux réponses aux enquêtes sur Qualtrics. C'est ainsi que nous pouvons analyser les données et mener l'étude. Notre parrain aura également accès aux réponses compilées, sous forme de résumé. Nous partagerons nos découvertes dans des présentations et des publications. Lorsque nous le ferons, les résultats seront des données agrégées et non pas des réponses individuelles.

Questions, renseignements, ou plaintes:
Si vous avez besoin de renseignements ou une question à poser, vous pouvez nous joindre à l'adresse email suivante : gr-ElectricVehicleStudy-D22@wpi.edu.

Veuillez imprimer ou garder une prise d'écran si vous souhaitez pouvoir accéder aux informations ultérieurement.
Numéro IRB : 22-0531 Date d'approbation de la IRB: 3/10/2022
Accord de participation
Votre participation est entièrement volontaire et vous pouvez vous retirer à tout moment.
Si vous souhaitez répondre au sondage, cliquez sur le bouton ci-dessous pour commencer.

Appendix F

Initial Social Listening Keywords

Brainstormed Keywords

Electric Vehicle Types

Electric Vehicles
EVs
Electric Cars
BEVs (Battery Electric Vehicles)
PHEVs (Plug-in Hybrid Electric Vehicle)
HEVs (Hybrid Electric Vehicles)
Automobile
Rabat EVs
Salé EVs
Kenitra EVs

Environmentalism

Alternate Fuels
Sustainability
Alternative energy
Renewable energy
Environmentalism
Green Tech
Green Technology
Green Transportation
Pollution
Solar
Wind
Zero Emission
Renewables
Renewable Energy Storage

Sustainable Technologies

Charging Station
Hydrogen Fuel Cells
EV Charging
Fuel Cell
EV Dock
Hybrid

Projects

E-mobility
Electric Mobility
RSK e-mobility

Economics

EV Costs
EV Infrastructure
Battery Costs
Expensive Maintenance

Brands

Tesla
BMW
Citroën
Ami
Chery EQ1
Opel
Stellantis

Appendix G

Finalized Social Listening Keywords and Their Arabic Translations

electric vehicle	سيارة كهربائية
electric motorcycle / bicycles	دراجات كهربائية
hybrid electric vehicle	سيارة كهربائية هجينة
electric bus	حافلة كهربائية
hydrogen fuel	وقود الهيدروجين
charging station	محطة شحن
electric motor	محرك كهربائي
Dacia Spring	داسيا سبرينغ
Renault Zoe	رونو زوي
Tesla	تسلا / تيسلا
Citroën	سيتروين

Appendix H

Adapted Theory Hypotheses for Survey

The first three hypotheses are for TPB. They state the correlations between the variable and the intention/behavior.

H1: Attitude towards electric vehicle adoption positively influences the intention to adopt an electric vehicle.

H2: Subjective norm positively influences the intention to adopt an electric vehicle.

H3: Perceived behavioral control (PBC) positively influences the intention to adopt an electric vehicle.

The next five hypotheses are for DOI. They state the correlations between the variable and the attitude towards the topic.

H4: Relative advantage positively influences attitudes towards electric vehicles.

H5: Compatibility positively influences attitudes toward electric vehicles.

H6: Complexity negatively influences attitudes towards electric vehicles.

H7: Observability positively influences attitudes towards electric vehicles.

H8: Trialability positively influences attitudes towards electric vehicles.

Appendix I

Itemized List of Deliverables

Name	Purpose	Format
Next Steps	A document explaining the process of applying the D22 UIR/WPI Electric Vehicle Study IQP. Also details any changes from the UIR Pilot Study to the RSK Survey, and all recommendations we have for future applications. This includes recommendations about survey layout, survey syntax, distribution techniques, and analysis.	Google Doc
EV Survey	A survey that can be used to gauge public opinions on Electric Vehicles using a number of foundation questions and statements. These statements are based on hypotheses derived from social theories found in prior literature.	Google Form
Automatic Document	A tool to automatically analyze the data coming from the Google Forms survey	Google Sheet
How to Use the Deliverables	A document explaining how to analyze hypotheses data, use the automated document, and interpretations of the survey.	Google Doc
Survey Translations	A folder containing copies of the Definition of EVs, Foundation Questions, and Survey Statements translated into English, French, and MSA. These documents are all the same, just in their respective language.	Folder, contains Google Docs
Theories and Hypotheses	A document detailing the two social theories used in this study, as well as the survey statements sorted into their appropriate hypothesis.	Google Doc