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An Exploration of the Factors Influencing EV Adoption in Sweden

How Consumer Perceptions are Impacted upon Adoption of EV

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Abstract

Background: Electric vehicle adoption is one of the most prominent discussions currently facing the automotive industry, as this is an inevitable change towards a more sustainable future of transportation. Traditionally, car manufacturers adapt to consumer needs changing, thus prompting high relevance for understanding the consumer perspective and purchasing influences.

Purpose: This study aims to build a deeper understanding of the importance of internal and external factors on the EV consumer decision-making process, as well as to explore how the perception of such factors change upon adoption of electric vehicles.

Method: The study follows a positivism approach by conducting deductive research. A conceptual framework is developed based on review of research literature of rational choice theory, the consumer decision-making model, and factors impacting EV consumers, and constructing a model from the findings. Quantitative survey data is then collected following the model presented, and results are obtained using SPSS. Finally, the analysis applies the social identity theory, innovation diffusion theory, and theory of planned behavior for further evaluative discussions.

Conclusion: The findings show that internal factors such as environmental awareness and fears and anxieties have a vital impact on consumers' decisions of EV adoption and evaluation of EV alternatives, while social influences have a relatively small impact on the decision. The findings suggest a link between the theory of planned behavior and changing perceptions upon adoption of EV, in which factors relating to attitudes and perceived behavioral control are more susceptible to changing, while factors relating to subjective norms are not.

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1 Introduction

The reader is introduced to key concepts and notable challenges through the background and problem discussion, followed by the purpose statement. The research questions are then formulated along with a presentation of the perspective, delimitations, and key definitions the reader should be aware of.

One of the most prominent challenges faced by society is the transportation sector, as it is considered one of the main contributors to greenhouse gas emissions (Pevec, et al., 2019). The increasing amount of personal fossil fueled vehicles in the world is one of the central discussion points, with alternative fuels, such as biogas and battery electric becoming more and more common in the past 20 years (Asadi, et al., 2021). In 2015, the Swedish government made a commitment towards a sustainable future, making a large investment to become the first fossil free nation in the world (Stahl, 2015). As part of this commitment, that Sweden and other nations are making towards a more sustainable future, comes the regulations for new vehicles. For instance, the State of California adopted regulations to mandate a percentage of cars to be zero-emission, for example battery electric vehicles (Nieuwenhuis, et al., 2017).

Making adaptations, and taking their responsibility in this time of change, many car brands are going all electric within the next 10 years (Maclean, 2021). Brands are presenting plans of phasing out internal combustion engines (ICE) already in 2025, leaving their fleet of vehicles consisting of only plug-in hybrids (PHEV) and full battery electric (BEV) (Maclean, 2021). Some brands are even committing to phasing out fossil fuel vehicles completely by 2030, this includes popular brands such as Bentley, Ford (Europe), and Volvo (Maclean, 2021). However, these commitments are reliant on consumers being open to electric vehicle (EV) adoption and committing to change alongside the brands.

1.1 Background

Traditionally, car manufacturers have adapted to the consumers' needs, since consumer behavior is directly affected by their needs when purchasing a vehicle (Laya, et al., 2020). Many studies mainly examine the consumer lifestyle and purchasing attitude. According to Schweitzer, Hofmann, & Meinheit (2019), consumers' deliberation process when purchasing a car is continuously changing along with societal needs and trends changing, and manufacturers need to have strategic consumer foresight to predict changing needs. Previously, the need was to get the passenger from point A to point B, however, times are changing, and the needs are changing as well (Schweitzer, et al., 2019). Today, factors such as fuel efficiency, fuel economy, environmental friendliness, and engine type are more commonly debated topics (Schweitzer, et al., 2019). Furthermore, consumers have the tendency to change their preferences gradually, in order to express their car-buying criteria in a fundamental sense (Schweitzer, et al., 2019). Influential factors vary across consumer segments, for example, a younger consumer would want a sports car in a form of display, whereas others simply need a mode of transportation for commuting to work, or a family may need a SUV to fit three kids and luggage. A contributing factor that influences the choice of car today is the environmental factor, Schweitzer, et al. (2019) described the biggest difference that has been noticeable, alongside a need for technological advancement, is the wide-spread increase in environmental consideration. The awareness and concern for global warming points to the importance of low car fuel emissions as crucial when taking a step towards improving the environmental impact. Over the past 10 years, this concern has just grown larger (*The Global Electric Vehicle Market In 2022*, 2022).

The electromobility industry is increasingly trending in the transportation sector, as it conveys the effort of superior innovation regarding energy efficiency from an environmental perspective compared to conventional vehicles (Gomez Vilchez, et al., 2013). The electrification of the global vehicle fleet should be promoted to achieve the desirable environmental goal, in terms of decreasing oil imports, thus, implementing EVs to decrease CO2 emissions (Gomez Vilchez, et al., 2013). According to The Ministry of the Environment (2021), Sweden has been working on a long-term strategy to reduce their CO2 emissions. A notable growth in adoption can be attributable to the support of the

Swedish government since the government aims to reduce greenhouse gas emission to reach zero by 2045 (Ministry of the Environment, 2021).

According to the Swedish National Institute of Economic Research (2013), Sweden has set the target to implement a fossil fuel independent vehicle fleet by 2030 (as quoted in Egnér & Trosvik, 2018), which would reduce the greenhouse gas emissions, and forcing an increase in EV adoption. Sweden has focused on supporting eco-innovation products and ideas (Egnér & Trosvik, 2018), such policies would include purchase subsidies, public expenditure, tax exemption and reduction, free charging, and parking permissions (Whitehead, et al., 2014). To reduce the reliance on fossil fuels and, in consequence, ensure further improvements in the environment, it is crucial to comprehend that the lack of a sufficient EV charging infrastructure and the inability to "charge up" suggests the hesitance of consumers to adopt EV (Guo, et al., 2018). Studies have shown that when a country is providing more instruments, such as public charging and parking benefits, the adoption rate of EVs are higher (Egnér & Trosvik, 2018).

Currently, Sweden's EV market offers a wide range of vehicles and is classified in the basis of the vehicle type (hatchback, sedan, and SUV), propulsion technology (which is bifurcated into battery-electric cars and plug-in hybrid electric car), and battery type (NiMH and Li-Ion) (*Sweden Electric Car Market*, 2020). The numbers of electric vehicles that have been registered in the Swedish market during the month of May 2021 can be estimated to be 4,000 units, increasing from 800 units in May 2020 (*Sweden: newly registered electric cars 2020-2021*, 2022). Additionally, to achieve the desired goal in Sweden the adoption rate demands higher results, as the reason for the slow diffusion of adoption can be linked to limited knowledge of EVs creating barriers among the majority of consumers in the market (Egnér & Trosvik, 2018). One must also note that knowledge of EVs is relatively low in Sweden, with 11% of the population considered well-informed about EVs (Swedish Energy Agency, 2014, as quoted in Egnér & Trosvik, 2018). Hence, to ensure successful majority adoption of EVs, it is vital to comprehend the consumers' willingness to purchase an EV, which is influenced by personal attributes, social influence, and government awareness (Wang & Zhou, 2019).

1.2 Problem discussion

1.2.1 EV purchasing decision

Electric vehicles are in constant need to evolve technologically, however, it is not the only challenge when entering the market. Consumers seem to be more resistant when it comes to adopting new trends in the market, they especially tend to have higher anxiety when new trends have a higher level of technological advancement than what the market is already offering (Girardi & Chiagouris, 2018). According to the model of traditional consumer decision-making there are five stages of this process: need recognition, search, evaluation, purchase decision, and outcome (Darley, et al., 2010). The evaluation stage entails the following phases: cognitive belief (the need to change); attitude (what do you want to do regarding the problem); and intentions, which lead to actions. The results according to the model are consumption, satisfaction or dissatisfaction, and investment or disinvestment (Darley, et al., 2010). The internal factors have a significant role according to the model, yet the external influence shows great effect too in the decision-making processes (Darley, et al., 2010). Therefore, consumer behavior and the decision-making process are considered as the mainstream predictors to understanding how a consumer thinks and acts leading up to a purchase, both considering the external and internal influences.

Surveys and studies have been conducted to examine the socio-economic effect on the consumers' confidence (Mattar, et al., 2018). Notably, consumers from different groups agreed on the fact that emission standards and the purchasing costs were main barriers when making the decision of purchasing an EV (Mattar, et al., 2018). In some cases, the EV charging infrastructure has an impact on the owner's decision, for example due to the limited availability of charging stations in certain areas (Pevec, et al., 2019). Some consumers are more tech-minded and are concerned with "better batteries" or optimizing energy management in the vehicles, meaning the third aspect of this problem would be the materials (Rauh, et al., 2014). Moreover, the phenomenon of range anxiety has great effect on the consumers' confidence, however, an interesting result was mentioned that an experienced driver has less range anxiety in comparison to his peers (Rauh, et al., 2014). Most of the studies are conducted on a very specific sample of consumers which

can be challenging when studying human behaviors, however, there were helpful models and surveys that support these studies and results.

1.2.2 Factors influencing EV adoption

Ma, et al. (2017) analyze the factors of consumer behavior which determine the preferences in EVs, the results can be divided into two subgroups of external environmental factors, and internal or demographic factors. External factors, which are objective, include the availability of charging stations (infrastructure), charging costs, fuel prices (ICE), EV purchase subsidies, and government incentive policies. Internal or demographic factors, which are subjective, are acceptance of new products, environmental awareness, psychological needs, perception, and lifestyle (Li, et al., 2017). The most important factors, however, which have the most significant influence on the purchasing behavior are EV prices, car classification, and powertrain (mechanism transmitting drive from the engine to the axle) (Ma, et al., 2019).

The adoption of electric vehicles is dependent on the emotional and behavioral response in potential adopters, specifically towards the purchasing and use of the vehicle (Rezvani, et al., 2015). The impact of costs on the choice between electric and fossil fuel vehicles rely heavily on the balance between purchasing costs and running costs; a fossil fuel car is typically cheaper to purchase, the running costs of EVs tends to be cheaper as electricity is cheaper than gas (Noel, et al., 2020). The prices are also affected by eventual subsidies and tax policies, which are used in some countries as further advantages for EV buyers. Therefore, multiple tax and local incentives are offered to increase the EV adoption in Sweden, for instance, purchasing a battery and plug-in electric vehicle, an individual is eligible for a subsidy of $6500 (*Sweden Electric Car Market,* 2020*)*. The government also has control over the charging infrastructure aspect, which is a barrier to EV adoption and a major reason why countries with developed charging networks are miles ahead of those with poor infrastructure in EV adoption rates (Zhang, et al., 2019). The internal factors pose a more complicated concern for potential EV buyers, as the implications of such factors are not nearly as straightforward, rather individualistic, and complex.

1.2.3 Gap in research

In addition to previous research, this study will add a deeper understanding of the important factors influencing a consumer's decision, but also how consumers' perception of influential factors change upon adoption. The study will examine the perception of users compared to non-users, and their ability and willingness to adopt new innovative technology, such as EV as is the focus of this study.

1.3 Purpose

The purpose of this research is to examine the different types of consumer segments that are impacted by the external factors (environmental and monetary) and the internal factors (lifestyle and social) in the process of purchasing an EV. The consumer segments are divided into users of EV, potential users of EV, and non-users of EV. Therefore, the focus is to understand the level of importance of such factors in influencing the consumer purchasing decision, and how the perception of influential factors change upon adoption of EV, that is after a purchase has been made. The frameworks that will be studied to support the purpose are the identity theory, an essential motive of a consumer's actions and decisions; innovation diffusion theory, which explores how early adopters differ from the majority in accepting new technologies; as well as the consumer decision-making model, defining the five stages of decision-making in relation to the influential factors. The common factors (external & internal) are further determined using the theory of planned behavior and the rational choice theory, as it classifies the barriers and the willingness for EV adoption. Through the use of such theoretical frameworks, the aim of this exploratory research is to improve the current knowledge related to the factors affecting a consumer's intention of purchasing an EV, and the effect of experience and knowledge post-purchase on perception. Therefore, the following research questions have been formulated:

RQ 1: What factors influence the purchasing decision of an EV consumer?
RQ 2: How are consumer perceptions impacted upon adoption of EV?

1.4 Perspective

This research is heavily focused on the consumer perspective, in terms of a consumer's purchase, selection, consumption and satisfaction. The choice of such perspective would create an understanding about how consumers reflect and express their identity through the choice of a vehicle, and the intention of how internal and external factors influence their purchasing decision. Therefore, the study does not focus on the producer perspective, but only the consumer aspect, to achieve the purpose of this study.

1.5 Delimitations

When discussing the users this study will consider all consumers/drivers. It is important to differentiate between the customer and the consumer of the vehicle, sometimes this may be the same (e.g., in case of private purchase), while in some cases they may be two different parties (e.g., company cars). In the case of a company car purchase, the customer may be a leasing company or corporate company as they are the buyer and owner of the vehicle, while the consumer is the driver who will be in possession of the vehicle and drive it on a daily basis. Therefore, the study will focus on the consumer, which may be a private buyer and owner or a company car/leasing driver, as this party's perceptions and influences will be mostly like the private customer/consumer.

1.6 Definitions

Electric vehicle (EV) - Vehicles that are either partially or fully powered by electric power.

Battery electric vehicle (BEV) - Vehicles that are solely powered by electric power, there are no alternative fuel sources.

Internal combustion engine (ICE) - Conventional vehicles solely powered by a traditional internal combustion engine, which are powered by fossil fuels, such as gasoline or diesel.

Plug-in Hybrid Electric Vehicle (PHEV) - Hybrid vehicle which uses both a battery pack, which can be recharged by plugging into an external power source, and an internal combustion engine.

Driver / Consumer - Driver and consumer may be used interchangeably in this study. The consumer is defined as any driver of an EV, or any potential driver of an EV.

Early Adopter (EA) - A person being among the first to start using a new product or service.

2 Frame of Reference

The purpose of this chapter is to provide the reader with an overview of the theoretical background supporting the study. The chapter presents theories related to identity, adoption, and rational choice, and models such as consumer decision-making, and theory of planned behavior. Finally, a conceptual framework model is generated and presented.

2.1 Method of constructing frame of reference

The frame of reference was built through careful identification and evaluation of appropriate literature. The search for literature was conducted using the JU library database, Primo, and Google Scholar. The initial search was based on a general inquiry regarding factors impacting EV adoption and consumer decision-making, and the following keywords were used: “EV adoption”, “electric vehicles purchasing decision”, “consumer decision-making EV", and “factors influencing adoption of EV”. Following the initial search, deeper research into underlying validations was conducted, which successively constructed the frameworks used by applying the following keywords: “sustainable mindset”, “identity and decision-making”, “decision-making behavior”, and “technology adoption”.

To evaluate the literature, the criteria for what was considered appropriate sources included peer-reviewed articles and academic books, from a reasonable timeframe considering the content. The content can be divided into three categories of general theories, industry knowledge, and EV factors. For general theories the time frame is wider considering a theory can be defined a longer time ago and still be valid, thus articles within 20 years of 2022 (2002-2022) were accepted as appropriate. Evaluating articles related to industry knowledge, a more limited time frame was considered appropriate as this tends to change, and only more recent information is valid to research conducted today. Thus, articles relating to industry knowledge from within 10 years of 2022 (2012-2022) were used. Lastly, articles discussing EV adoption were limited to within 7 years of 2022 (2015-2022) due to the adoption of EV becoming more prevalent during these years. While limiting the time frame even further was considered, it would cause some interesting topics to be outside of the scope, and therefore a compromise was made.

2.2 Social identity theory

The primary motivator of actions is self-identity; according to social research on identity theory there have been changes in the common usage of the term “identity” (Stets & Burke, 2003). Main distinct usages can be divided into categories, one is the culture of people i.e., ethnicity, others perceive it as the social category, i.e., upper or middle class (Stets & Burke, 2003). Social identity theory distinguishes identity from a broader perspective as it is an individual's set of values that shapes their actions and behaviors (Stets & Burke, 2003). Furthermore, the theory emphasizes that identity is one’s self-expectations related to a role or performance while reflecting on the internal and external dynamics within the core of actions (Stets & Burke, 2003). Barbarossa (2015) specified actions within a situation or an action where an individual can express their values is a form of self-identity, Thus, consumers tend to be consistent in their consumption pattern reflecting their identity through their purchases.

2.2.1 Self-identity in cars

Consumers express their self-identity through the car choice since it affects their driving style and behaviors, and they tend to have a high level of admiration for their cars, as it reflects their identity (Wang, et al., 2020). The experience a consumer gets from driving is not only pure mobility, but also the satisfaction they get out of the experience, thus, consumers need to feel safe and comfortable (Wang, et al., 2020). Values perceived are more than utilities, it can also be symbolic; drivers tend to develop this attachment to their vehicles. As an example, families who drove the same cars for years then the brand becomes part of the generation cycle over years creating this sentimental value with consumers. Eventually the car reflects self-identity for both buyer and seller, hence, when purchasing a Volvo car, the consumer seeks the Scandinavian and minimalist design adding to the comfort and safety the car is known for (Wang, et al., 2020). Consumers’ self-identity can also be observed in their anxiety when it comes to new technology and innovation, they usually express themselves by resistance or avoidance of new trends in the market (Wang, et al., 2020).

2.2.2 Green identity

Making eco-friendly purchasing and consumption decisions can also be traced back to identity theory. Green self-identity may even be considered as one of the dominant

motivations for environmental consideration in everyday life and decisions (Barbarossa, et al., 2015). In other words, how a consumer will act in public is directly influenced by how their intentions be perceived to people in their surroundings. When a consumer with green self-identity considers buying a new car, their motivations and intentions for that car will not be the same as a consumer without green self-identity. In addition to the driving style and behaviors, a consumer with green self-identity will value the sustainability and environmental impact of their purchase (Barbarossa, et al., 2015).

2.2.2.1 Teleology & deontology

The definition of teleology is "*the extent to which consumers rely on the perceived consequences of a behavior*", while deontology can be defined as "*the internalized ethical, and moral principles*" (Barbarossa, et al., 2015). Thus, the teleological and deontological evaluations of non-eco-friendly behaviors will influence consumers with green self-identity to not purchase a new car due to the environmental consequences of consumption of that new car, as well as their green moral obligation to not consume that environmentally unfriendly product (Barbarossa, et al., 2015). Instead, consumers with green self-identity will look towards more eco-friendly alternatives to purchasing a new car, as their intention is to have a mode of transportation that does not negatively impact, or has the least possible impact, on the environment due to moral obligation and outward communication of one's self-identity.

2.2.3 EV identity

All consumers tend to reflect their self-identity through the vehicle that they drive, and EV drivers are no different. EV drivers will be defined by a social status and expression of self-identity, with the addition of the green self-identity theory, which plays a vital role in purchase intention (White & Sintov, 2017). For electric vehicles, the symbolic attributes have an even higher importance, and an impact on the adoption rates and purchases (White & Sintov, 2017). White & Sintov (2017) state that "*EVs can serve as highly visible symbols for consumers wishing to advertise environmentalist self-identities to others and may also reinforce existing environmentalist self-identities by acting as a symbol to oneself*". Furthermore, EVs can also show an affinity for technological innovation and early adoption of new technology, which may be what drives a purchasing decision for consumers wishing to communicate that self-identity (White & Sintov, 2017). This becomes meaningful when trying to understand which consumers would lean

towards EV adoption over sticking to what is old and well-known. As ICE may be more reliable and a safe choice, the aforementioned concepts are drivers of EV adoption. When purchasing an electric vehicle, the buyer will be affected by all the same factors as a buyer of an ICE vehicle, but with the addition of teleological and deontological evaluations which impact their decision, plus the fears and anxieties due to new technological advancements.

Barbarossa, et al. (2015) studies the intention of pro-environmental behavior and attitudes on the purchasing behaviors of electric vehicles, based on three European countries. The results suggested that green self-identity has a direct impact on the intention to adopt EVs, and an indirect link through environmental consequences and moral obligations, as previously described by teleology and deontology concepts. In this paper, the results from Barbarossa's study can infer great details in understanding the internal effects on adoption and purchasing intentions of electric vehicles. The differentiation between internal and external factors, and their respective importance will be further evaluated at a later point in this paper.

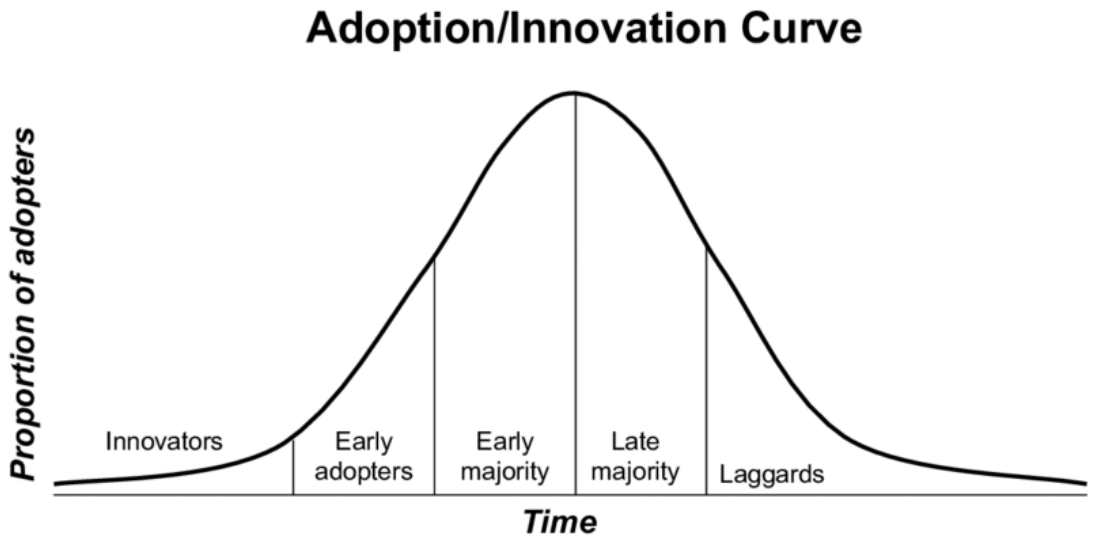
2.2.3.1 Innovation diffusion theory

The innovation diffusion theory was developed to describe the process of new technology, service or product entering the market followed by diffusion and ultimately adoption by the consumers (Girardi & Chiagouris, 2018). The theory proposes key elements that contribute to the diffusion process, innovation, communication, social system, and time; these elements together determine the success or failure of the market entry process (Girardi & Chiagouris, 2018). The theory suggests that some consumers are attracted to the market's innovativeness more than others, these categories are known to be receptive to innovation and adaptation of new technologies in the market faster than others in society (Girardi & Chiagouris, 2018). Furthermore, the theory presents a framework of individuals in the social system and their responsiveness to enter the new trends in the market (figure 1). Early adopters (EAs) have shown significant impact as marketers through communicating the new technology to their social circle and providing diffusion momentum, i.e., promoting the advancement in an early stage, followed by the majority developing an intention to try (Wang, et al., 2020). Naturally, EAs play a vital role in the diffusion process as they are more involved in the new product features in

comparison to the early and the late majority (Girardi & Chiagouris, 2018). While the advancement may have the potential to completely disrupt a market, it first needs to be proven to exceed existing product performance before it will be adopted (Wang, et al., 2020). EAs tend to be visionary and risk takers as they create their own subjective opinion according to personal experience (Girardi & Chiagouris, 2018). Wang, et al. (2020) explored the cause of "technology-identity concerns" as consumers will feel their identity is undermined by the radical technologies. EV is currently in the stage where EAs have promoted the innovative technology for some time, but there is still fear and anxiety present in the majority, leaving EV in the early majority stage where it is not fully adopted by the majority yet, but no longer brand new technology (figure 1).

The adoption process is affected directly by the role of EAs and their perceived perceptions after adopting new technology. According to Frattini, et al. (2013) EAs contributes to the innovation process by dissemination and labeled imitation. Firstly, dissemination is when EAs assert the propagation of their own perceived experience and opinion on advantages, and disadvantages of the new product. While labeled imitation occurs when EAs inadvertently communicate their experience to potential buyers leading these consumers to imitative purchasing behaviors, and eventually adopt the same technology (Frattini, et al., 2013). The post-purchase adoption process for EA plays a significant role for the majority due to the transmission of the characteristics and value of the adopters between EAs and the majority. Moreover, Frattini, et al. (2013) study suggests that EAs tend to spread information regarding the innovations and the value of money that has been invested in this technology. Thus, promoting the product through word-of-mouth process, and that's another reason to consider EAs as opinion leaders according to the diffusion theory (Frattini, et al., 2013).

Figure 1: Adoption/innovation curve



Source: Hovav, Page, & Schuff (2003, p. 245)

2.2.3.2 Identity control theory

Furthermore, the theory of identity control proposes a response to the fear and anxiety often presenting itself in relation to new technology adoption, which also considers the self-identity theory and one's natural instinct to protect self-esteem (Wang, et al., 2020). Wang, et al. (2020) illustrate the identity control theory as using a distancing coping strategy to regulate the feelings of fear and anxiety, utilizing a filter to decide what to engage with and what to avoid, thus identity will establish either acceptance or resistance to new technology. In the case of EVs, some consumers will avoid adoption, and choose ICE vehicles over PHEV or BEV in order to protect their self-identity and limit a possible threat to it.

2.3 Consumer decision-making

The consumer decision-making process can be defined and evaluated following a five-step process, starting with problem recognition, followed by search, alternative evaluation, purchase, and finally post-purchase evaluation of outcomes (Darley, et al., 2010). While these five steps represent the core actions or activities a consumer will go through, it is important to consider factors that will affect these steps along the way. According to Solomon, et al. (2006), consumer behavior is the study of processes that includes groups or individuals that select, purchase, use or dispose of products, services, ideas, or experiences to satisfy their needs and desires. Therefore, this research

paper will focus primarily on the five core processes of decision-making, from the perspective of one decision-maker, that is demonstrated by Darley, et al. (2010), and the generic influences (external and internal) factors that influence each step of the decision process regarding purchasing EVs.

A consumer purchase is considered a response to an issue, and a purchase decision is yet to be made, thus, the first step in the decision-making process is known as *problem recognition*. This process enables consumers to identify the gap between the current situation (actual state) and the needs/desires to reach the consumer's ideal situation (desired state) (Taylor & Fujita, 2018). According to Taylor (2017), the problem recognition that drives the purchasing process is as follows:

- Product depletion (e.g., the old car has to be replaced).
- Current dissatisfaction (e.g., the old car needed repairs too often, thus, not reliable).
- New needs (e.g., need a car for a different purpose, carrying more people, recreational activities, etc.).
- Higher expected satisfaction (e.g., the old car is working well, but the new models have better gas mileage).

Once a problem has been recognized, consumers tend to look for relevant information to resolve such a problem. This purchase decision-making process is known as *informational search*. Consumers tend to seek and integrate information about possible solutions, to generate a list with available purchasing choices (Taylor & Fujita, 2018). The perception of the consumer is affected in this process through the consumer's senses that could help or hinder perception, interpretation to derive meaning, and selection is gained in the aspect of internal and external factors. The search process of purchasing is shaped by the complexity of choice, (e.g., how brands are significantly perceived), the level of involvement, the value of the purchase, the time available to proceed with the purchase, and uncertain risks that might occur (Taylor & Fujita, 2018). Consumers process their search internally through the information that the consumer's memory bank assembles about different product alternatives. Whereas the external search process

involves family, friends, advertisements, direct experience, and online resources (Solomon, et al., 2006).

In addition, the main effort that is considered in the decision-making process occurs at the third stage which is known as *alternative evaluations.* The consumer can evaluate the options in an objective manner, such as the product function, features, price, charging options, vehicle's range, whereas in a subjective manner through feelings/emotions, quality, and aesthetics (Taylor & Fujita, 2018). To identify alternatives, a consumer should avoid habitual decision-making, which does not involve extended problem-solving (Taylor & Fujita, 2018). According to Taylor and Fujita (2018), it is vital to evaluate alternatives in terms of the following:

- Evoked set (i.e., a set with potential purchases)
- Inept set (i.e., set of products, the consumer will not consider purchasing)
- Inert set (i.e., set of products that consumers have no particular interest towards)

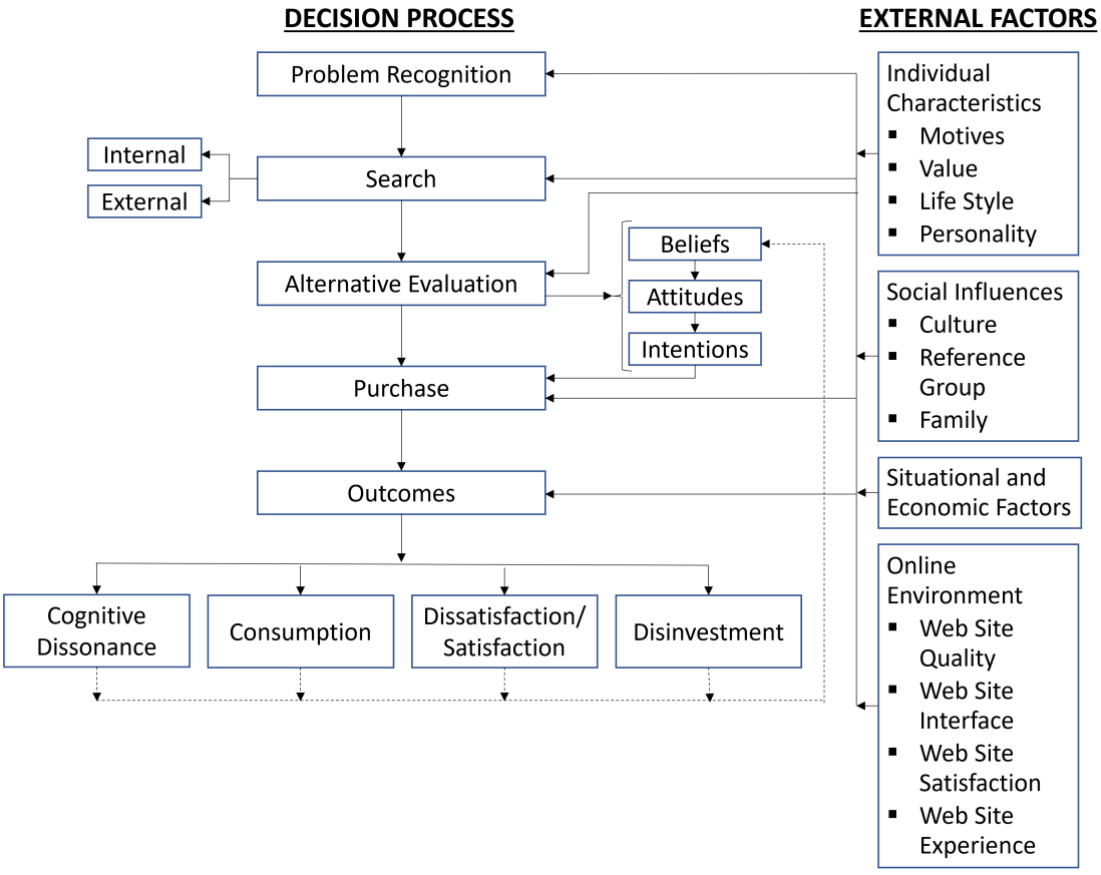
Moreover, after options have been evaluated and assembled, a choice is made from the evoked set, this process is known as the *purchasing* process. According to Darley, et al. (2010), the transition between evaluating the alternatives and purchasing the product is influenced by a set of factors. Internally, consumer beliefs, attitudes, and intentions, whereas externally, the quality of retail experience, promotions, technical policies, and governmental policies. However, the purchasing decision can be disrupted, if the product choice is not available (e.g., incentives for competing products), due to peer pressure, or lack of necessary funds (Taylor & Fujita, 2018).

The last step of the decision-making process is the *post-purchase* behavior, which suggests utilizing the purchased product and evaluating it over time, in order to check if it has met with the consumer's pre-purchase expectations (Taylor & Fujita, 2018). However, if a doubt occurs, the consumer purchase choice would lead to post-purchase dissonance (Khraim, 2020). The negative consumer experience is distinctly linked towards the inept set (unsatisfactory products), which led to adverse outcomes, such as charging behaviors and consumer mobility practices. Therefore, consumer satisfaction or

dissatisfaction is primarily contrasted with expectations, shaping a consumer's heuristics about the purchased product (Taylor & Fujita, 2018).

In this research paper, information search, evaluating alternatives, and post-purchase from the decision-making model will be used as a reference for the conceptual framework, survey, and analysis. The term *motivational factors* is used to refer to factors considered in the search process that a consumer undergoes in the process of purchasing an EV, as well as *alternative factors* is used to refer to the evaluating alternatives process, discussing how consumers evaluate alternative factors to complete the purchasing intention. Lastly, the post-purchase is the final stage, where focus is placed on the EV users' ownership experience, whether it led to positive or negative experience in terms of satisfaction.

Figure 2: Consumer decision-making process



Source: Adapted from Darley, Blankson & Luethge (2010, p. 96)

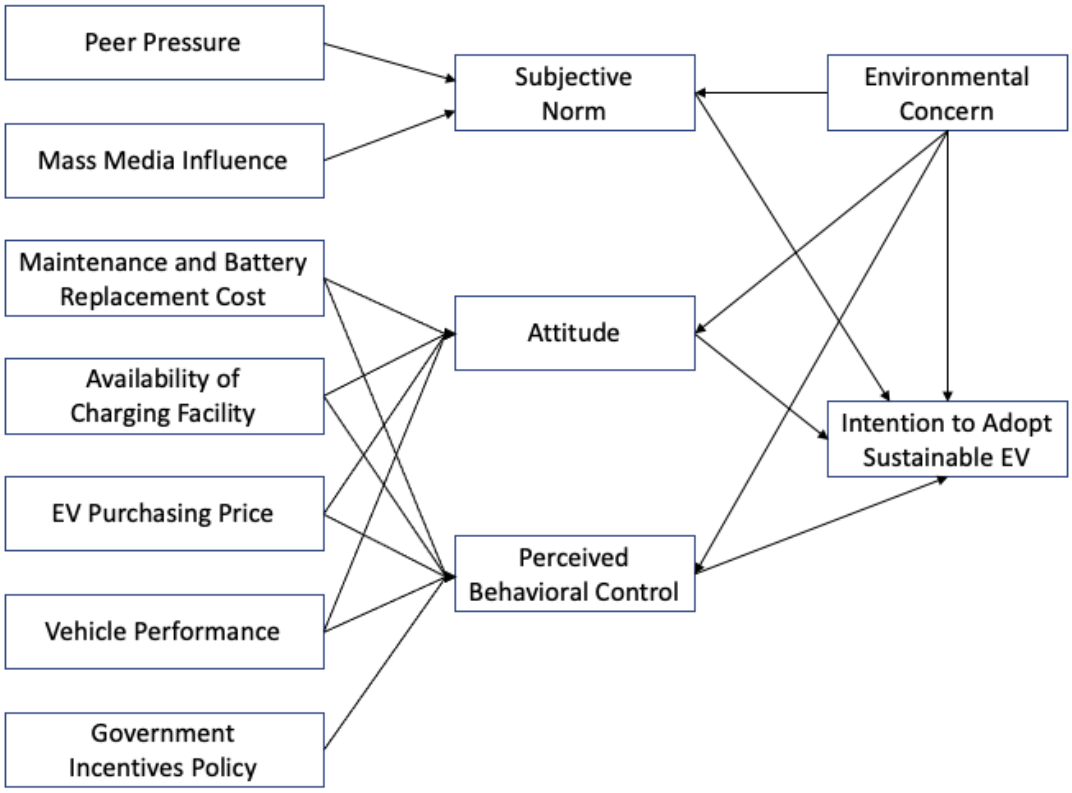
2.3.1 Theory of planned behavior

Previous studies on EV adoption and purchase intention have applied the theory of planned behavior (TPB) to explore buying behaviors in the electric age, thus highlighting the importance of this framework. Hasan (2021) uses an extended version of the TPB, which in addition to the original theory of behavioral intentions considers "consumers' overall satisfaction with EV use". The elements of the TPB which affect the decisions are social norms, attitudes or personal characteristics, and intention; in Hasan's research, the inconsistencies in his results could be resolved by these elements. While Hasan (2021) applies this to the repurchasing intent, it should also be valid for the initial purchasing decision when adapting the process for learning of the satisfaction of use, rendering it justified for the scope of this paper. Dutta and Hwang (2021) specifically explored the effect of consumers' intention for sustainable consumption and environmental concern on the TPB. The factors are categorized into *attitude* (i.e., the degree to which the performance of a behavior is determined as positively or negatively valued), the *subjective norm* (i.e., the perceived social pressure to engage in a behavior), and *perceived behavioral control* (i.e., the perceived ability to perform a behavior), these factors correspond to the main extensions of the TPB.

In the TPB model, consumer attitudes towards EV adoption are suggested as an important variable in behavioral intention. This is evident in a study that was conducted by Dinckinger and Kleinjen (2008), as consumers' willingness to purchase an EV knowingly that green vehicles have zero fuel consumption, increased their positive behavior (as quoted in Eneizan, 2019). Similarly, the subjective norm also contributes to a positive behavioral intention, this is shown in an individual's way of thinking if a certain behavior should be followed, there is a high level of intent to perform that behavior, which is due to a high degree of social pressure (Wang, et al., 2014). In other words, it is the individual perception towards social norms that develops an attitude, thus, attitude and subjective norms are interrelated. Moreover, perceived behavior control forecasts the intention of the TPB model, it suggests the easiness or difficulty that an individual perceives to perform a behavior (Eneizan, 2019). For instance, the concept of perceived mobility necessities (vehicle characteristics and infrastructure), suggests a vital determinant to positive behavior intention, as well as the perceived compatibility of an EV with personal needs, does increase the capability to adopt an EV through the effective control over the

features that influence a purchase intention (Haustein & Jensen, 2018). Therefore, the TPB model is significant through its ability to predict environmental-friendly behavioral intentions (Eneizan, 2019).

Figure 3: Theory of planned behavior



Source: Adapted from Dutta & Hwang (2021, p. 9)

2.3.2 Elimination-by-aspect

Elimination-by-aspect (EBA) theory interprets a process of an elimination type decision-making approach, in which a consumer limits the range of choice by eliminating a number of options based on a certain aspect or element (Erdem, et al, 2014). The aspect which stands for the base of the decision is typically one in which the eliminated product includes undesirable matter, or one in which it is lacking a desirable matter (Erdem, et al, 2014). The principle of EBA being to reduce alternatives by removing disfavored options until the most desirable option remains (Persson & Sandorf, 2018). It is important to gain a better understanding of the barriers that could hinder the purchase intention, in order to consider the options of eliminations. Such barriers can involve the lack of available infrastructure, the limited driving range, or the purchasing prices/costs. The aspects of

elimination can be involved in two types of sets: inept, and inert sets. These sets are considered as the third stage of the consumer decision-making model, which eliminates the influences of purchasing choices. Therefore, EBA is considered a mental shortcut that consumers utilize to decide on a purchase intention, to reduce information overload (Cuofano, 2021).

2.4 Factors influencing EV purchasing decision

To achieve the primary objective of this report, it is essential to classify the barrier that hurdles consumer adoption of EVs in terms of factors. Individual decision-making is considered as the foundation of microeconomic analysis (Wang & Zhou, 2019). The rational choice theory (RCT) is a research paradigm that is based on methodological individualism (Liebe & Preisendörfer, 2010). RCT predicts the ecological attitudes, perception, and behavior on the micro-level and sheds light on environmental outcomes, that often result from a social dilemma on the macro level (Liebe & Preisendörfer, 2010). Therefore, RCT is an appropriate theoretical lens that will be examined to study the individual consumption of EVs, in terms of determining the choice of options or factors that are preferred accordingly, to maximize utility (Wang & Zhou, 2019). Like the RCT, the theory of planned behavior (TPB), assumes that the consumer makes decisions referring to rational evaluations of stimuli and the possible outcomes (Wang & Zhou, 2019). Therefore, such frameworks are vital, as it creates an understanding of consumer behavior and the demonstration of broader factors that are based in the EV market (Adnan, et al., 2016).

2.4.1 Factors presented in previous research

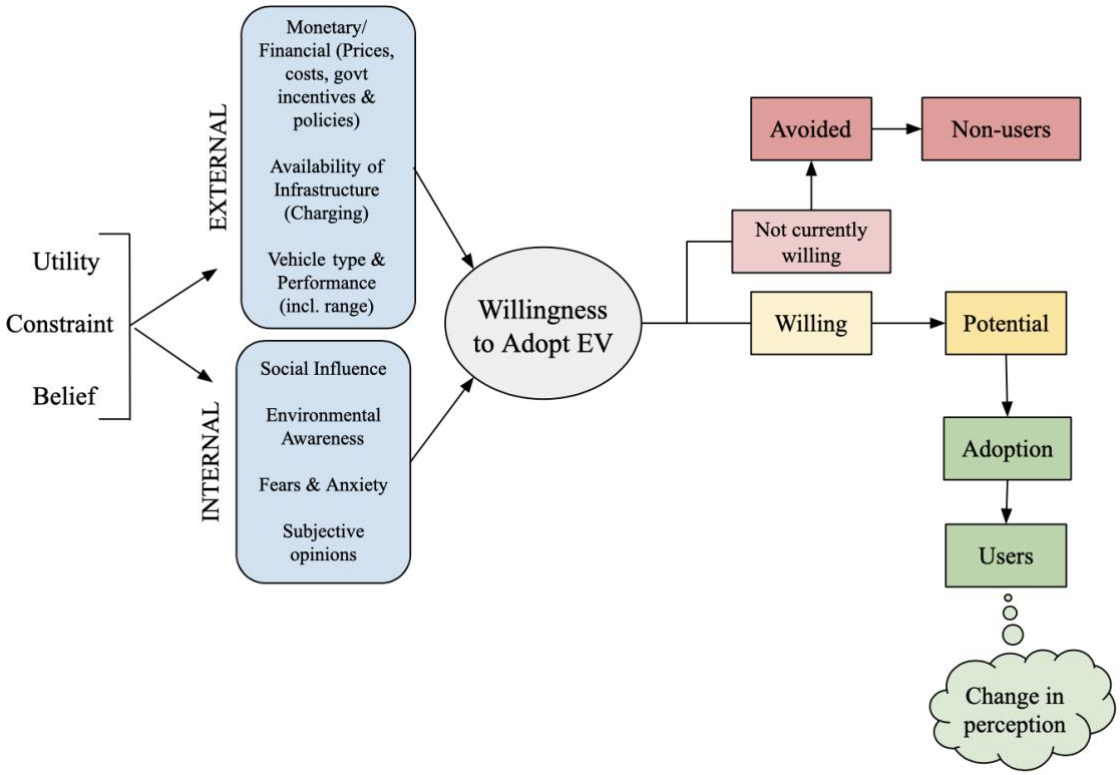
Different factors have been theorized to predict the willingness to purchase EVs, as the results can formulate effective strategies to popularize EVs among consumers. According to McKinsey (2014), there are three factors that are largely driven towards the adoption of EVs, they are government stimuli, technical developments, and consumer demand, as stimulation of EVs through policy support is a strong driver for growth (as quoted in Slot, 2017). For instance, regulatory measures, financial levers, regarding vehicle taxation, and parking fees systems, along with developing technical policies such as infrastructure in terms of driving range, and battery to be perceived as ease of use. These purchase incentives are perceived as effective in relation to pushing EV sales (Slot, 2017). On the

other hand, Simon (1997) emphasized that individuals systematically conduct a cost-benefit analysis, in terms of considering the attributes of vehicles and the maximization of personal advantage (as quoted in Slot, 2017). As a result, the RCT factors that are taken into consideration are utility, belief, and constraints. The utility is subjected to personal preferences, driving range, speed, noise, as these factors represent the rational consumption choice with the utility function (Slot, 2017). Secondly, the constraint is what limits consumers from purchasing an EV, for instance, budgets, the different EV prices, fuel prices, and the inconvenience of the infrastructure (Slot, 2017). Thus, constraints limit the set of a feasible action. Lastly, beliefs are linked to the individual's decision-making, as they provide a reason for action, it is also used interchangeably with desire (Wang & Zhou, 2019). Such factors of internal beliefs involve perceived social influence, emotions, and consumer intentions, whereas the external factors of beliefs are perceived within the familiarity or experience of adopting an EV, and environmental awareness (Wang & Zhou, 2019). Therefore, a conceptual framework of research has been conducted that summarizes McKinsey's (2014) model, and the framework of RCT and TPB have been taken into account, to determine the key factors of driving adoption, the relation between the mentioned-above factors and EV adoption that influence consumer behavior in terms of decision-making (as quoted in Slot, 2017).

2.5 Conceptual framework

As a result of the studied literature, a model of factors influencing EV adoption has been developed. The model describes the effect of internal and external factors, which have been derived from RCT, on willingness to adopt EV and the two possible outcomes (users and non-users) from the resulting willingness. Finally, the model demonstrates that users will have some change in perception of the factors influencing their future EV purchasing decisions, due to increased knowledge from first-hand experiences. The remainder of the study will be based on the model presented in the conceptual framework, to further the understanding of the factors' influence on willingness and the explicit change in perception of users.

Figure 4: Influence of factors on Search and Evaluating alternatives within consumer decision-making process on EV adoption



3 Methodology & Method

In this section, the methodology is presented, in terms of the research paradigm, research approach, and the research design. The sampling process is illustrated, and a presentation of the questionnaire structure follows, which is built on the consumer decision-making model in combination with the conceptual model presented in the previous chapter. Finally, a summary of the data collection, the implications of the research, and ethical considerations complete the chapter.

3.1 Research paradigm & approach

The aim of this research study is to build a deeper understanding of the important factors influencing an EV consumer's purchasing decision, and to find the change in importance of factors after a purchase of an EV. Thus, by gathering responses from potential EV consumers, as well as current EV drivers, and even consumers which have not yet considered purchasing an EV, the purpose is to understand if there is a difference among these segments, and if so, how significant it is. The results will present how consumers are affected by different stages of EV adoption, and the varying amount of knowledge of certain factors, thus creating value and prioritizing these factors when searching and evaluating EVs. Ultimately, the study will consider the differences that lead to an all-encompassing comprehension of how consumers are influenced by the factors in the decision-making process.

An initial question was derived from an observation of a problem/trend in the automotive market, leading to conduct deductive research to answer the proposed question. Positivism paradigm provides the research guidelines mainly used in natural science, and it is attributed to facts, objectivity, and quantitative methodology (Collis & Hussey, 2014). Through this paradigm the study provides an exploration of established relations among variables by linking them to a deductive theory. The researcher in this case measures a phenomenon to provide exploratory study based on quantitative data that lead to statistical analyses (Collis & Hussey, 2014). Deductive research typically develops a theoretical or conceptual structure which is tested through observation (Collis & Hussey, 2014). The research is built upon a strong foundation and through utilizing data available

from previous studies on the EV market and decision-making theories, a conceptual framework is generated. The conceptual framework presents the most frequently occurring and likely most influential factors impacting the adoption process and explores the outcomes. Finally, the framework is tested under empirical observation which is done through a quantitative research approach.

The quantitative approach was chosen for this research. Considering the wide variety of elements affecting consumers choices and behaviors, quantitative research will be beneficial to draw an accurate conclusion. A data collection process was designed to examine and evaluate the accuracy of the framework. Furthermore, the data was collected to capture different variables and the link between these elements in the decision-making process, specifically the steps *search* and *evaluating alternatives*.

A survey was conducted in the form of a questionnaire to complete the primary data collection. The questions of this survey were based on the conceptual framework to ensure the data collected will build the analysis and draw the conclusion of this study, to answer the research question. The questionnaire presented questions which encouraged the participants to reflect on their decision-making process and the importance of certain factors when considering vehicle alternatives. Surveys as a research method have proven efficient when conducting quantitative research, due to the high representativeness and convenience conveyed by this method. Conducting the survey allows reach to be widespread and ensures availability to all groups the research aims to study. In comparison, a focus group may have been fitting for the study of change in behavior from potential owners to post-purchase, however, there is a risk current owners struggle to remember and reflect on their pre-purchase decision-making justifications. Instead, the survey approach differentiates the current users from the potential buyers and compares them on the basis that they most likely have a similar knowledge level to understand the users' change in perception.

3.2 Sampling method

The initial plan for conducting a quantitative survey is to study the factors that influence a consumer's EV purchasing behavior in Sweden, as consumer preferences play a vital role in purchase decision-making. Therefore, the research will focus on the population of

Sweden. A non-probability sampling method was used in the form of voluntary response sampling, where a public survey is available to a large group and only answered on a voluntary basis. The risk using this type of sampling is that respondents voluntarily choosing to participate may be biased due to an interest in EVs as those are most likely to participate in a survey with "EV" in the title, thus possibly skewing results.

To further define the targeted consumer segments that the research aims to study, the following three groups are specified:

A. **Users** – Current owners and/or Drivers of an EV.
B. **Potential** – Future EV Users (currently considering buying or leasing an EV).
C. **Non-users** – Not currently a user but could consider EV in the future.

This categorization creates a sense of understanding of the differences between the types of consumers, to analyze the factors that are relevant accordingly. The questions asked in the first section are stated as follows:

Table 1: Questions from Section 1 of survey

Question	*If answer = "YES"*	*If answer = "NO"*
(1) Do you live in Sweden	The participant's answers are relevant to the study and included in the scope.	The participant is not included in the scope of the research and therefore remaining answers not relevant to study.
(2) Do you currently own/drive an Electric Vehicle?	The participant is included in Group A (Users).	The participant is not included in group A, but could be eligible for group B or C.
(3) Are you currently planning to buy/lease an Electric Vehicle?	The participant is included in Group B (Potential).	The participant is not included in group B, but could be eligible for group C.
(4) Would you be willing to buy/lease an Electric Vehicle?	The participant is included in Group C (Non-users).	The participant is not at all interested in buying or leasing an EV and therefore their answers will not be considered in this study.

Note: In the "No" section, it is assumed that the participant answered "Yes" to question 1 and "No" to any of the previous questions 2-4

When studying the decision-making process of a car purchase, it is important to consider the availability to certain groups as one needs both enough income and a driver's license to buy a car. To distribute the survey a social media network approach was chosen, as this would allow for a broader reach and the widest selection. The survey link was posted to LinkedIn and Facebook groups, where an age-appropriate audience could be reached. Instagram, TikTok and other such social media platforms were avoided as the audience tends to be younger which would not fit the study's nature. Therefore, LinkedIn offered the right type of audience, and directed Facebook groups such as car enthusiasts' pages, or family-oriented pages which ensured an older age more fitting to the study.

3.3 Data collection

Continuing to the main portion of the survey, where necessary data is gathered about each group's preferences, the survey is structured based on the consumer decision-making model. The chosen factors are used according to the conceptual framework, and the answers will be evaluated in terms of a scale of 1 to 6 from the least important to the most important factor. Starting with the main motivation for buying an EV, which is the search process (referred to as *motivational factors*). This process helps to understand how consumers tend to integrate and seek different factors before purchasing. In the second section the question was stated as follows: *"What is/would be your main motivation for buying an Electric Vehicle?"* The participant was then asked to choose the level of importance (1-6) for each of the following factors:

- Sustainability (Figure 4: Environmental awareness)
- Noise pollution (Figure 4: Environmental awareness / social influence)
- Running costs (Figure 4: Monetary/Financial costs)
- Price to purchase (Figure 4: Monetary/Financial costs)
- Conscious social image (Figure 4: Social influence)
- Government incentives (Figure 4: Monetary/Financial costs)
- Performance (Figure 4: Vehicle type & performance)
- Trusted recommendation (Figure 4: Social influence)
- Previous experience and/or test drive (Figure 4: Fears & anxiety)
- Safety & reliability (Figure 4: Fears & anxiety)

Moreover, the diversity of EVs has increased, due to serving various consumer segments, which enables consumers to assess the factors in an objective manner (Slot, 2017). Thus, the stage evaluating alternatives is used in the third section, to understand the importance of more specific factors for evaluating alternative vehicles identified in the search stage (referred to as *alternative factors*). The factors participants rated in the alternatives section is different from the motivational, as a consumer in this stage of the decision-making process would be comparing specific vehicles in an evaluative manner, while in the motivational section there is a more general enquiry. In the third section the question was stated as follows: *"How important do you find these factors when evaluating alternatives?"* The participant was then asked to choose the level of importance (1-6) for each of the following factors:

- Purchasing price (Figure 4: Monetary/Financial costs)
- Powertrains (Figure 4: Vehicle type & performance)
- Battery & range (Figure 4: Vehicle type & performance)
- Charging networks (Figure 4: Availability of charging infrastructure)
- Brand and social image (Figure 4: Social influence)
- Quality (Figure 4: Subjective opinions)
- Safety (Figure 4: Fears & anxiety)
- Aesthetics (Figure 4: Subjective opinions)
- Other features (Figure 4: Subjective opinions)

In addition, the last section of the survey focuses on the consumer's pre-purchase expectations, in terms of questioning whether the overall post-purchase experience has satisfied their expectations. This process is labeled as *outcomes*. In order to achieve results, the ratings are based on a scale of 1 to 6 from not satisfied to very satisfied. In the final section, which is only answered by the group A (users), the question is stated as follows: "How satisfied are you with the following factors after purchasing?" The participant was then asked to choose the level of satisfaction (1-6) for each of the following factors:

- Purchasing price (Figure 4: Monetary/Financial costs)

- Powertrains (Figure 4: Vehicle type & performance)
- Size of vehicle (Figure 4: Vehicle type & performance)
- Battery & range (Figure 4: Vehicle type & performance)
- Charging availability (Figure 4: Availability of charging infrastructure)
- Charging costs (Figure 4: Monetary/Financial costs)
- Quality (Figure 4: Subjective opinions)
- Safety (Figure 4: Fears & anxiety)
- Aesthetics (Figure 4: Subjective opinions)
- Other features (Figure 4: Subjective opinions)

3.4 Summary of data collected

The survey reached a total of 283 people, out of which 273 participant answers were usable. The remaining 10 participants were either not living in Sweden, not fitting into either of the pre-defined groups (i.e., answered "No" to all questions in section 1), or did not complete the survey. The answers were exported to an excel sheet to filter each participant into the corresponding group. The filtering was executed according to the following steps:

1) Filtered only "Yes" answers to the first question (Do you live in Sweden?)
   a) Removed any participants outside of scope
   b) Kept throughout all filters
2) Filtered only "Yes" answers to the second question (Do you currently own/drive an EV?)
   a) Remaining participants were defined as Group A (Users)
3) Filtered only "No" answers to the second question (Do you currently own/drive an EV?) & only "Yes" answers to the third question (Are you currently planning to buy/lease an Electric Vehicle?)
   a) Remaining participants were defined as Group B (Potential)
4) Filtered only "No" answers to the second question (Do you currently own/drive an EV?), only "No" answers to the third question (Are you currently planning to buy/lease an Electric Vehicle?) & only "Yes" answers to the fourth question (Would you be willing to buy/lease an Electric Vehicle?)
   a) Remaining participants were defined as Group C (Non-users)

As the survey managed to attract at least 30 participants within each of the groups studied, normal distribution can be assumed for analysis purposes. The number of participants per group are presented in the table below:

Table 2: Sample groups

Total amount of answers	283
Group A (Users)	**149**
Group B (Potential)	**88**
Group C (Non-users)	**36**
Not living in Sweden (outside scope)	7
Answered "No" to all (outside scope)	3

3.5 Implications

To achieve a trustworthy study, reliable measurement tools have been used to examine the credibility of the research findings; these measurements are reliability and validity. Replications tend to be significant in high positivist studies, however, it is not crucial in interpretivist research. Positivism paradigms tend to have high reliability and low validity (Collis & Hussey, 2014).

3.5.1 Reliability

Since the conducted study has been done through quantitative research, the focus will be on the reliability of the results. The study is reliable when the findings are accurate and consistent using precise data, meaning, repeating the research would obtain the same results (Collis & Hussey, 2014). In this research a survey method has been used, involved in shaping the structure and question formulation was three researchers plus an external professional from the automotive industry to ensure the questionnaire remained consistent and relatable, thus ensuring the results are reliable. The questions were phrased with a direct link to the subject to avoid confusion or interpretability for the most part, however, it is inevitable for some interpretation of the questions to occur. Participants were given the same information and there was always a possibility to communicate with the researchers to make sure the same knowledge is applied to all involved. The same method was applied through the whole process to gather the data from all target groups. Lastly,

as a high number of people participated in the study, and normal distribution could be assumed, the survey should yield reliable results.

3.5.2 Validity

Through examining the data and evaluating the results, measurements were applied to examine the validity of the study, which ensures the questions were appropriately stated to achieve an accurate result (Collis & Hussey, 2014). Considering the significance of reflecting variations in the results as accurately as possible, the survey captured the users, potential consumers, and non-users to be involved, which shows that the researchers targeted different groups of participants, and the results is not only limited to consumers that have a professional experience or highly involved in the community surrounding EVs. Developing the validity of a research questionnaire, it should be based on an established theory, therefore, to ensure validity the questionnaire was built on the conceptual framework. To produce an accurate study the target group was defined at an early stage (e.g., Swedish market), as the external validity is defined by the sample size (N=283) the number of participants should be wide enough to create generalized findings and an applicable study that can be useful to another researchers. Whereas to attain internal validity the researchers isolated the factors and divided the sample into groups, to examine the current users' status, and to provide reasons whether the perception differs from a potential user and a non-user, in terms of the willingness to purchase an EV.

3.6 Ethical consideration

Research ethics reflects the moral principles within the conducted study, thus, anonymity and confidentiality were ensured for all parties in this research. Collecting any unnecessary personal details that identify individuals, such as gender, age, or ethnicity, was avoided. The participants had the option to leave their email address if they wished to have a version of the research results shared with them after the conclusion of the study. Moreover, the respondents were not forced or pressured to participate in the survey and could exit it at any time, rather it was completely voluntary which enabled the individuals to participate according to their own comfort and time. The survey was presented in a very informative and structured context offering the respondent enough details before taking part in the questionnaire. Furthermore, the researchers treated each other and the participants with respect, by protecting the privacy of all involved and decreasing the case

of discomfort for those who participated in the research. Moreover, to ensure the ethical process through the whole research, the data presented in this study is very precise and accurate, the researchers have communicated their findings in a very transparent manner to avoid false reporting. Any data not presented in chapter 4 can be found in the appendix.

4 Empirical Findings

This section introduces the empirical findings that have been obtained from SPSS. The findings of the results will be explored through the use of descriptive statistics (means), factor analysis (for motivational & alternatives), and ANOVA tests. The structure of the chapter follows the survey, first presenting the findings of the motivational factors, followed by alternative factors, and finally the post-purchase satisfaction results.

4.1 Motivational factors

4.1.1 Means

The frequency distribution was tested to present the quantitative descriptions in a manageable form. The overall mean is useful in specifying the general perception of consumers, with the high participation rate, this result should produce a good indication of how consumers in Sweden value the factors. The *motivations* of the combined group segments (incl. users, potential, & non-users) and the factors influencing their decision-making, in terms of means are shown in the following table:

Table 3: Means for motivational factors

Descriptive Statistics

	N	Mean	Std. Deviation
Sustainability	273	5.22	1.106
Noise Pollution	273	3.56	1.569
Running Costs (i.e. charging price vs. fuel price)	273	4.97	1.103
Price to Purchase (or lease price)	273	3.70	1.342
Social Image (e.g. green/environmentally conscious)	273	3.31	1.657
Government Incentives (e.g. reduced taxes)	273	3.59	1.541
Performance (i.e. acceleration, driving range)	273	4.11	1.528
Type/Size of Vehicle (i. e. Sedan, SUV...)	273	3.89	1.390
Trusted Recommendation (i.e. family/friends)	273	3.33	1.501
Previous Experiences and/or Test Drive	273	4.05	1.458
Safety & Reliability	273	5.00	1.066
Valid N (listwise)	273		

The results have shown that sustainability, safety & reliability and running costs (i.e., charging and fuel prices) are the top three factors that are considered the main motivators for consumers to purchase an EV.

4.1.2 Factor analysis

The factor analysis has been conducted to measure the relationship between the studied factors (variables), in terms of finding the element that the different groups and sub-factors depend on. The aim is to explore the relations among the variables (*APA Dictionary of Psychology*, n.d.), which suggests the principal axis factoring is suitable for this analysis. The factors are grouped as the following:

Table 4: Motivational factors factor analysis

Rotated Factor Matrix[a]

	Factor		
	1	2	3
Sustainability			.480
Noise Pollution			.394
Running Costs (i.e. charging price vs. fuel price)		.438	
Price to Purchase (or lease price)		.483	
Social Image (e.g. green/environmentally conscious)			.523
Government Incentives (e.g. reduced taxes)		.728	
Performance (i.e. acceleration, driving range)	.342	.376	
Type/Size of Vehicle (i. e. Sedan, SUV...)	.356		
Trusted Recommendation (i.e. family/friends)	.526		
Previous Experiences and/or Test Drive	.556		
Safety & Reliability	.653		

Extraction Method: Principal Axis Factoring.
Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 5 iterations.

The principal axis factoring resulted in three factor groups. Factor 1 includes type/size of vehicle, trusted recommendation, previous experiences, and safety and reliability. Factor 2 includes running costs, price to purchase, government incentives, and performance. Factor 3 includes sustainability, noise pollution, and social image.

4.1.3 ANOVA factor scores

An ANOVA test was conducted to examine the difference between the groups (users, potential, non-users) in the purchasing decision to see if there is a significance or not. A 95% confidence level was used to minimize the margin of error, as a tight interval of 95% or higher is considered ideal (*Confidence Intervals*, 2019). The aim is to indicate whether there is a significant change in the perception of the grouped factors between the segment groups, in terms of purchasing an EV. Hence, the null hypothesis and the alternative hypothesis are the following:

H0 = The dependent motivational grouped factors have no significant change in perception between the groups.
H1= The dependent motivational grouped factors have a significant change in perception between the groups.

Table 5: Motivational factors ANOVA test (factor scores)

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
REGR factor score 1 for analysis 1	Between Groups	3.826	2	1.913	3.107	.046
	Within Groups	166.206	270	.616		
	Total	170.032	272			
REGR factor score 2 for analysis 1	Between Groups	3.691	2	1.846	2.927	.055
	Within Groups	170.230	270	.630		
	Total	173.921	272			
REGR factor score 3 for analysis 1	Between Groups	.716	2	.358	.716	.490
	Within Groups	134.985	270	.500		
	Total	135.701	272			

The null hypothesis (H0) is rejected when the significance is less than 0.05. The factor score for group 1 (type/size of vehicle, trusted recommendation, previous experiences, and safety & reliability) is significant as the null hypothesis is rejected ($0.046 < 0.05$), which means that these factors do change in perception between the groups (users, potential, non-users). The scores for group 2 (running costs, price to purchase, government incentives, and performance) is also determined as significant as the null hypothesis is rejected ($0.055 \approx 0.05$). However, the group 3 factor scores (sustainability, noise pollution, and social image) are not significant as the null hypothesis cannot be rejected ($0.490 > 0.05$).

4.2 Alternative factors

4.2.1 Means

The following table demonstrates the criteria that consumers find important when *evaluating alternatives*, the means of the groups are presented below:

Table 6: Means for alternative factors

Descriptive Statistics

	N	Mean	Std. Deviation
Purchasing Price (or lease price)	273	4.47	1.222
Powertrains (i.e. availability of different powertrains)	273	3.60	1.467
Type/Size of Vehicle (i. e. Sedan, SUV...)	273	4.15	1.312
Battery & Range	273	5.16	.929
Charging Networks (e.g. deals with charging networks, and availability of charging stations)	273	4.78	1.323
Brand & Social Image (i.e. social status that brand communicates)	273	2.93	1.480
Perceived Quality	273	4.59	1.046
Perceived Safety	273	4.82	1.210
Aesthetics (Physical looks)	273	3.97	1.388
Other Features (e.g. operative system and additional interior details)	273	3.96	1.448
Valid N (listwise)	273		

When evaluating the alternatives, consumers have chosen battery & range, perceived safety, and charging networks as the vital set that influence consumers' purchasing decisions which should be taken into account.

4.2.2 Factor analysis

Principal axis factoring is conducted to measure the relationship between *alternative factors*. The factor analysis of the important criteria is demonstrated below:

Table 7: Alternative factors factor analysis

Rotated Factor Matrix[a]

	Factor		
	1	2	3
Purchasing Price (or lease price)			.566
Powertrains (i.e. availability of different powertrains)			
Type/Size of Vehicle (i. e. Sedan, SUV...)			.407
Battery & Range		.461	.474
Charging Networks (e.g. deals with charging networks, and availability of charging stations)		.696	
Brand & Social Image (i.e. social status that brand communicates)	.609		
Perceived Quality	.417		.450
Perceived Safety	.379	.473	.353
Aesthetics (Physical looks)	.832		
Other Features (e.g. operative system and additional interior details)	.681		

Extraction Method: Principal Axis Factoring.
Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 5 iterations.

The principal axis factoring resulted in three factor groups. Factor 1 includes brand and social image, aesthetics, and other features. Factor 2 includes charging networks, perceived safety, and has some relation to battery and range. Factor 3 includes purchasing price, type/size of vehicle, battery and range, and perceived quality. Powertrains does not show any significant relationship to either of the factor groups.

4.2.3 ANOVA factor scores

An ANOVA test was conducted to see if there is a significant difference between the groups. Again, a 95% confidence level was used to minimize the margin of error. Hence, the null hypothesis and the alternative hypothesis are the following:

H0 = The dependent alternative grouped factors have no significant change in perception between the groups.

H1= The dependent alternative grouped factors have a significant change in perception between the groups.

Table 8: Alternative factors ANOVA test (factor scores)

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
REGR factor score 1 for analysis 2	Between Groups	3.871	2	1.936	2.470	.087
	Within Groups	211.621	270	.784		
	Total	215.493	272			
REGR factor score 2 for analysis 2	Between Groups	1.118	2	.559	.897	.409
	Within Groups	168.182	270	.623		
	Total	169.300	272			
REGR factor score 3 for analysis 2	Between Groups	4.778	2	2.389	4.220	.016
	Within Groups	152.843	270	.566		
	Total	157.621	272			

The null hypothesis (H0) is rejected when the significance is less than 0.05. The scores for group 1 (brand and social image, aesthetics, other features) and group 2 (charging networks, perceived safety) are not significant as the null hypothesis cannot be rejected (0.087 > 0.05 & 0.409 > 0.05), which means the factors do not change between the different group segments (users, potential, non-users). Whereas the factor score for group 3 (purchasing price, type/size of vehicle, battery and range, perceived quality) is significant as the null hypothesis is rejected (0.016 < 0.05), thus there is a change in perception.

4.3 Post-purchase satisfaction

The following table demonstrates the *post-purchase* experiences for EV users after purchasing/leasing an EV. The mean indicates the overall satisfaction that users have reported on a scale of 1-6.

Table 9: Means for post-purchase (users only)

Post-purchase factors	**The means for EV users**
Purchasing price	4.48
Powertrain	5.14
Size of vehicle	4.90

Battery & range	4.87
Charging availability	4.86
Charging costs	5.24
Quality	4.89
Safety	5.33
Aesthetics	4.85
Other features	4.91

A positive response on all the post-purchasing factors being illustrated by EV users, as the ownership experiences have been perceived satisfactory (> 4). The top three factors are safety, charging costs and powertrains.

5 Analysis

The analysis of the empirical findings is presented in this chapter, following the same structure of motivational and alternative factors consecutively, with the post-purchase results used as supporting evidence. This chapter analyzes the important factors and the grouped factors, in relation to the existing frame of reference and conceptual framework, to gain a deep understanding of the findings.

The analysis will be divided according to the two parts of the results, that is *motivational factor* analysis and *alternative factor* analysis. Within both the progression follows that of the research questions, first analyzing the results relating to understanding the importance of each factor, found through the resulting means presented in table 3 (means for motivational factors) and table 6 (means for alternative factors), and then analyzing the comparative results from the ANOVA and factor analysis to understand how the users (group A) differs.

First, it is important to note that all factors in the search section have a mean of over 3, ranging from 3.31 to 5.22 on the 1-6 scale of importance, and the factors within the evaluation section a mean ranging from 2.93 to 5.16. Hence, it is safe to assume that almost all factors that were extracted from the previous research are in fact important in the decision-making process, however many land in the medium zone and only three factors fall below the middle point of 3.5. A 3 or lower indicates the factor is considered not important to a varying extent, while a 4 or higher is considered important to a varying extent. Thus, in this analysis the factor's level of importance is discussed in terms of its relevance to the other factors studied, to simplify the data and to reduce the number of individual means into a fewer number of dimensions.

In the second part of the research, an ANOVA test exposed factors which displayed a significant change between the studied groups, and those which did not. The results are analyzed to understand which factors are susceptible to changing once a potential consumer becomes a user of an EV, by comparing the p-value to the significance level.

5.1 Motivational factors analysis

5.1.1 Factor importance

The results have shown that sustainability (5.22), safety & reliability (5.00), and running costs (4.97) are the top three factors that are considered the main motivators for purchasing an EV (table 3). The overall mean, across all three groups, shows a large gap between the top 3 factors (4.97 - 5.22) and the remaining factors (3.31 - 4.11). Notably, the only factors which reached an average of (or over) 5 out of 6 were both from the internal category, as sustainability falls within *Environmental Awareness* (figure 4) while safety and reliability falls within *Fears & Anxiety* (figure 4). The importance of sustainability, and a consumer's care for environmental aspects, lies rooted in their green identity. With the increasing knowledge of environmental impact across the world, green self-identity is becoming more prevalent among consumers. Arguably the most dominant reason for EV adoption is sustainability, which can be explained by the theories of teleology and deontology, as these explain how consumers are impacted by internalized moral principles and their understanding of consequences. As one's knowledge about the impact of fossil fueled cars increases, the likelihood that they adopt EV will be higher. Naturally, consumers will consider safety an important aspect of a vehicle of transportation, but the case of EVs has presented another angle of concern, which is battery safety. There is discussion of the lithium-ion (Li-Ion) batteries within EVs, although they are a safer fuel option compared to gasoline, the lack of knowledge causes uncertainty. Therefore, the internal motivational factors do play a vital role in the purchasing decision, as such risks cause some consumers to fear a battery driven vehicle. Additionally, it may be a barrier pushing EVs into the elimination (EBA) category of vehicle options, and thus causing those consumers to avoid adoption.

On the contrary, the internal factors trusted recommendation (3.33) and social image (3.31) scored the lowest average (table 3). The difference suggests that the internal factors which affect a person directly or affect a person's conscience have a higher power over their decision-making, while those affecting them indirectly have a lower impact. The *social influence* (figure 4) is thus of less importance in the decision-making process than the framework suggests. Although it is of less importance, social influences have an impact due to the development of the cognitive and the conscious ability depending on

the interaction between the complex and changing environments. This suggests that consumers' consciousness, in terms of internal personal preferences (trusted recommendations) and internal environmental beliefs (social image), should be defined to effectively deal with purchasing intention.

The external factors which, based on previous research studies, seem of high importance, are those of monetary value. However, the research suggests that purchasing price (3.70) and government incentives (3.59) are tertiary to the factors relating to the consumers' conscience and vehicle performance (table 3). Running costs (4.97) on the other hand showed quite a lot higher in importance than the other *monetary/financial* (figure 4) factors. The reason behind the high involvement of such factors is further evidence that the world is heading slowly to the depletion of fossil fuels. However, the increase in fuel prices might be a factor that influences consumers to purchase an EV, due to the evidence of oil crises over the years. Although the one-time purchase cost of an EV is high, this would be reduced through the daily driving costs that involve fossil fuels in electric vehicles (Wang, 2019), which leads to environmentally conscious behavior. Hence, adopting an EV reduces the risk of being a victim of sudden oil prices and reduces price sensitivity in terms of fuels.[1]

Further considering the reasoning behind the relatively moderate response to the external factors, one may wonder how such factors are not of highest importance when choosing a car. Once again this may lead back to an initial questioning regarding the true use or value of a car, and when considering the value of an EV to a consumer. Due to the external factors being less emphasized, this indicates that consumers' dominant motivation for decision-making is contributing to environmental impact. Green consumers focus on the value that a certain purchase would contribute to the philosophy and the conscious environmental protection. Overall, this suggests a typical EV consumer is more concerned with the effect of their purchase on personal and internally driven motivations, rather than the external motivations such as money and performance, and further the social influence of their decisions.

[1] This study was completed between February and May of 2022, during the time when electricity prices were increasing, but fuel prices were also increasing due to the political environment in Europe at the time.

5.1.2 Factor analysis

5.1.2.1 Factor 1

Based on the factor analysis, the first group of factors include safety & reliability (0.653), trusted recommendation (0.526), previous experience (0.556) and type/size of vehicle (0.356) (table 4). This result indicates that the recommendations from trusted family/friends or previous experience is what builds an understanding of the safety & reliability or of which type/size of vehicle is most fitting for their lifestyle. For example, if a trusted friend were to recommend vehicle A because it kept them safe in an accident, a consumer is more likely to purchase vehicle A. Similarly, if the consumer has experience from driving brand B vehicles, they have a predefined idea of the safety and reliability and are thus more (or less) likely to purchase a vehicle from brand B again.

There is a significant change in importance between the groups, as the p-value is lower than the significance level ($0.046 < 0.05$), as presented in table 5. Users (group A) see the importance of the first factor group as lower than potential (group B) and non-users (group C) (appendix 9), thus producing the question of what causes potential and non-users to overvalue the importance of the factors in comparison to the users. While all groups consider the factors to be of importance to their decision-making process, users consider them relatively less important. Preliminary research suggests the cause to be linked to theories of technology adoption, such as the innovation diffusion theory and identity control theory. The IDT and ICT present the reason why less experience with new technology (EV) makes them consider factors to be very important to their decision to adopt. According to IDT, the differences are caused by the uncertainty and fear of adopting a new technology, which leaves non-users considering their choices more critically, thus seeing a higher importance in each factor. To extend on the IDT, according to ICT one's natural instinct is to protect oneself from uncertainty, and thus being critical and avoiding things that are threats to one’s identity. For example, when not having enough personal experience, trusting others’ opinions becomes even more critical, which would be the case for non-users. Furthermore, doing extensive research into the safety and reliability, as well as the type of vehicles to match the consumer’s lifestyle will be required to eliminate as much uncertainty as possible to allow for adoption.

5.1.2.2 Factor 2

The second factor group includes the *monetary/financial* factors and *performance* of the vehicle, that is government incentives (0.728), purchasing price (0.483), running costs (0.438), and performance (0.376) (table 4). This indicates a relationship between the *monetary/financial* factors and the performance offering, suggesting that while all are relatively important, one can be outweighed by another. In the case of EVs, this can likely be explained by the difference between the purchasing cost and running costs, for EVs compared to fossil fuel vehicles. The purchasing price of EVs tend to be quite expensive, but the costs of charging (at home) is so cheap that the total cost of ownership over the vehicle's lifetime is less, making it a more economic option overall. According to the findings, purchasing price and running costs have a correlational impact. Furthermore, the performance of the vehicle should be balanced with the financial factors, a more expensive vehicle is only a viable option if it offers reasonable performance worthy of the price tag associated with it.

The results of the second factor analysis can be interpreted as either significant or not significant, as the p-value and significance indicate a small difference ($0.055 \approx 0.05$) (table 5). When considering the TPB model (figure 3), the second factor group links to attitude and perceived behavioral control as it involves factors such as performance, vehicle purchasing price, and government incentives. This suggests that upon adoption of EV consumers will have an increasingly positive valuation of EVs, therefore the perception of the financial factors becomes less important relative to the performance of the vehicle. This can further be confirmed by the results of the post-purchase satisfaction from the last section of the survey (table 9), which indicates an overwhelmingly positive perception of all factors upon usage. Meanwhile, non-users and potential users will find financial factors to be of higher importance compared to users due to the unknown performance abilities and uncertainties, previously described by the IDT and ICT. The theoretical links argue for determining the results as significant, thus there is a significant change between the groups for the second factor.

5.1.2.3 Factor 3

The third group of factors are those related to self-identity, as it includes sustainability (0.480), noise pollution (0.394), and social image (0.523) (table 4), all of which can affect or be affected by how one is seen or sees oneself and how one's choices impacts the society around them. The relationship between the factors presented by the third group can be explained by self-identity theory, more specifically green identity. Adopting EV will impact a consumer's identity through how others view them in relation to the car they drive and the impact they have on the environment. Some have a higher affinity for caring for environmental impact than others, and this is rooted in sustainable consciousness and knowledge. Furthermore, one's affinity for caring about others' opinions can be linked to the subjective norm as discussed in the TPB (figure 3), as this will explain the perceived social pressure to engage in certain behavior, such as environmental mindedness.

The result for the third factor group indicate there is no significant change between the groups perception of importance in the factors ($0.490 > 0.05$) (table 5) and will not be affected upon adoption. Sustainability, which is related to the green identity theory, suggests one either believes it is important or they do not, their adoption of EV may be due to other reasons or due to sustainable impact, but it won't change by driving an EV. Noise pollution and social image is similar to sustainability, whether this is important or not is not impacted by their adoption, as it is related to their intrinsic social identity, and the presence of green identity, or lack thereof. While such deep rooted and identity related attributes of a consumer may change at some point or to some extent, it is not impacted enough just from the adoption of EV.

5.2 Alternative factors analysis

5.2.1 Factor importance

When analyzing the factors' importance in the stage evaluating alternatives, the main factor which stands out is battery & range (5.16) as the single factor reaching an average of above 5 (table 6). Thus, it can be concluded that battery & range is the factor which participants considered to be most important. The evaluation stage in the decision-making process is typically where the consumer is weighing up alternative vehicles and comparing brand offerings to choose which vehicle fits them best. Hence, the battery and range factor is of major importance as this is also varied between brands, it has a big impact on the driving experience, and has a tendency to induce range anxiety. While battery & range is considered an external factor, due to its direct impact on the driving experience, one must acknowledge the importance of the internal aspect, such as lifestyle. In this case, range and charging falls into the constraint category of factors within RCT, as this is a reason some consumers are held back from purchasing an EV with lower range or lacking a well-developed charging network. It is even a concern which can cause some brands/vehicles to be eliminated (EBA), caused by the lack of appropriate infrastructure.

In addition, perceived safety (4.82) is the second most important factor in the evaluating stage (table 6). This can be demonstrated as an external belief, where it plays a vital role on consumers' rational choice of consumption (RCT). To determine the choice of safety, consumers tend to link the way they evaluate the importance of an EV with how it fits with their lifestyle. Therefore, perceived safety determines the dependability and reliability of an EV which emphasizes the choice of such behavior perceived from the studied groups.

Other factors that were somewhat important include perceived quality (4.59), purchasing price (4.47), type/size of vehicle (4.15), aesthetics (3.97), other features (3.96), and powertrains (3.60) (table 6). These factors fall into the evoked set (potential purchases) of evaluation, being rated as moderately important and thus have an impact on the decision-making process. Whereas the lowest mean, and thus the least important factor in the decision-making process according to consumers, were brand & social image (2.93). In terms of evaluation, it is safe to assume that these factors are involved in the

inept set, meaning that consumers tend to not include such factors into the decision-making process, which leads to the internal factors being perceived as less important in evaluating alternatives.

5.2.2 Factor analysis

5.2.2.1 Factor 1

The results of the factor analysis showed that the first group includes brand and social image (0.609), aesthetics (0.832), and other features (0.681) (table 7). These factors indicate the subjective aspect that a consumer perceives from a company, specifically, brand communication. For instance, the first group of factors is linked to how a brand communicates its social image, in terms of brand awareness and brand associations, and the way a brand aesthetically displays its physical product, to promote specific features, such as additional interior details. Consumers recognize the brand and can identify the purchasing reason through the grouped factors which emphasize brand attributes. Therefore, the grouped factors emphasize the brand purpose of what consumers would find valuable when evaluating important factors.

The ANOVA test suggests that there is no significant change in the subjective factors between the different segment groups ($0.087 > 0.05$) (table 8). In other words, it suggests that the 3 segment groups (users, potential, non-users) have the same perception of the subjective factors, and there is no change upon adoption. The possible reason for such an outcome can be explained using the TPB, which assumes that the individual consumer makes rational evaluations of stimuli, meaning consumers evaluate important factors that are influenced by personal attitudes (price and range) and perceived behavioral control (vehicle characteristics and quality), rather than subjective norms (brand & aesthetics). Therefore, this justifies that the subjective opinions of consumers, in terms of how they perceive a brand, are likely to change, however, how a consumer values the opinion in the decision-making process will not likely change upon adoption. Hence, the change in importance of subjective factors upon adoption of EV is not significant.

5.2.2.2 Factor 2

The second factor group includes charging networks (0.696) and perceived safety (0.472), with some relation to battery and range (0.461) (table 7). The mentioned factors are categorized as lifestyle factors, which means consumers would evaluate and perceive these factors according to the impact of their lifestyle. For instance, the need for well-developed charging infrastructure depends on the consumer's commuting habits, a consumer's lifestyle can explain how the consumer is more or less dependent on a better range and charging availability. For example, a consumer mainly driving within city limits, perhaps between their home, office, the kids' school, and the grocery store, will not need as much range or public charging opportunities as a consumer driving on longer road trips more frequently, as they can charge as home or at the office and that will likely last them for the rest of the trip. A more adventurous consumer, on the other hand, is dependent on the range and availability of functioning charging stations along their route. In addition, perceived safety is linked with their lifestyle in terms of how risk averse their situation requires them to be. A family will value safety as one of the main important factors as the vehicle needs to protect their kids in the event of an accident. Therefore, the grouped factors suggest the lifestyle factors that a consumer perceives as an important set when evaluating potential purchases.

In terms of the ANOVA test, there has been no significant change in the lifestyle factors between the groups ($0.409 > 0.05$) (table 8). The factor has a tendency towards attitude and perceived behavioral control (TPB) as these describe the degree to which the performance of a behavior is determined as positively or negatively valued (perceived safety) and the perceived ability to perform a behavior (charging networks). The relationship to such extensions of the TPB model suggests that the factor would be changing upon adoption, as the perception of vehicle safety and charging availability would be impacted upon start of usage. However, the results of the research suggest the opposite. These opposing suggestions indicate that while change can happen, the adoption of EV does not have an adequate impact to cause such a change. A consumer's lifestyle is open for changing, and change can happen quickly (e.g., through a job offer or pregnancy), however, it is not directly impacted by the car they drive, rather the opposite. The lifestyle factors will have a large impact on the decision-making process, in terms of

which vehicles will meet the consumer's needs, but it will not affect their lifestyle in a significant matter post-purchase.

5.2.2.3 Factor 3

The factor analysis presented the third factor group to include purchasing price (0.566), type/size of vehicle (0.407), battery and range (0.474), and perceived quality (0.450) (table 7). The relationship suggests the factors can be defined as the fundamental value of a vehicle, and the perception of the value is based on consumers' situational needs. This is simply explained as the correlation between the price of the car and the type and size, battery and range offered, and quality assumed. Consumers are willing to pay more for a larger vehicle, for example an estate car or SUV, or even for a sports car, which comes with high performance features. Comparatively, consumers are less likely to spend the same amount on a small vehicle with limited range capabilities, as the usage of the vehicle is more limited. These factors are typically viewed objectively from a management perspective, as in the design and research and development of a product the best possible is being pursued. However, from a consumer perspective there is a link to subjectivity and attitudes, which is mostly seen in the perception of quality. The commonality between the mentioned factors can be detailed as the components of the full vehicle offering, as the factor analysis suggested, they impact each other and the consumers' willingness to adopt an EV or not. This result indicates price barriers tend to be high to those who have limited experience with the vehicle being evaluated, such as non-users (group C) or potential users (group B). While users (group A), when evaluating alternatives, usually have lower price barriers as their experience of the vehicle affects the perceived quality shifting the consumer perspective to different attributes than price and possibly outweighing it.

The result of the ANOVA shows the importance of the third factor group does change upon adoption ($0.016 < 0.05$) (table 8), and thus there is a significant change. The TPB can be applied to the variables that lie within the attitudes as the importance of these external factors (purchasing price, type/size of vehicle, battery & range) evidently change upon adoption of EV. Notably, compared to other factors, potential users (group B) value the importance of the third factor the highest out of the segment groups studied (appendix 18). The interpretation in this case would be linked back to the IDT and ICT since the

theory describes the early majority as attentive, careful, and considerate to protect their identity when adopting new technology. They tend to stay longer in the evaluation stage to make sure that the innovation value is worth the price they are sacrificing. Comparatively, users (group A) find the importance lower due to the knowledge and usage impacting the perceived attitudes and behavioral control, and thus it can be assumed the valuation is becoming more positive. The post-purchase results support the statement that the perception of importance in regard to the third factor group changes, as the satisfaction analysis (table 9) implies users are positively viewing all the factors studied. Seeing as the user experience is positive and they feel satisfied with the factors, their perception of the importance will be impacted.

6 Conclusion

This chapter concludes the study by deducing final conclusions from the analysis to answer the research questions, and to achieve the purpose of this study.

Sweden's EV market share has been growing rapidly, as a result, trends in the electromobility industry are increasing. The goal of this research paper was to explore the factors that enable a consumer to complete a purchasing decision, along with whether the consumer's perception of the important factors after adopting an EV has changed or not.

6.1 What factors influence the purchasing decision of an EV consumer?

To answer this question the research was divided into two sections based on the consumer decision-making model: search (discussed as *motivational factors*) and evaluating alternatives (discussed as *alternative factors*). In terms of the *motivational factors*, the results have concluded that internal factors play a vital role in EV adoption, with factors relating to *environmental awareness* and *fears & anxiety* being the most important to consumers. Within the *alternative factors*, rational constraints and *fears & anxiety* once again demonstrated a significant influential impact on consumers' decision-making. Across both factor categories, social influences were deemed not as important, and monetary factors proved moderately important, acting as constraints to adoption decisions. The framework presented in this study can be determined as valid based on the findings as all factors were considered relatively important to the consumer segments studied.

6.2 How are consumer perceptions impacted upon adoption of EV?

It can be concluded that some factors (*motivational* and *alternative*) are more susceptible to changing than others, and this is dependent on the nature of the factor in question. Factors which could be linked to attitudes and perceived behavioral control within the TPB model were more likely to change upon adoption, as the increased knowledge and understanding of the technology impacts the valuation of such factors. On the contrary, those linked to subjectivity within the TPB model proved to not change upon adoption, as the subjective opinions of consumers impact the decision of which vehicle to purchase,

but the vehicle itself will not impact the subjective opinion. Also, factors related to a consumer's lifestyle are unlikely to change, and those related to intrinsic identity are even more unlikely to change. It should be noted that such factors can be impacted and changed, however, in the case of adopting EVs, the chance of such an impact is relatively small. The results did indicate that the lifestyle and intrinsic identity could act as a hindrance for susceptibility to change. Additionally, as the current model indicates a change in perception without specifications, the framework can be extended to include the role of the TPB model on the change in perception post-adoption. The addition of attitudes and perceived behavioral control, demonstrates the altered influences on the user purchasing decision.

Furthermore, it can be noted that overall, the difference between user's perception and other groups was that significant factors became relatively less important in the decision-making process. Non-users and potential users value these factors as more important due to uncertainty and being vary of change, causing barriers to adoption. Upon adoption, users have first-hand experience of the new technological advancement and become less scared and know what to expect in terms of satisfaction.

7 Discussion

This final chapter discusses the study's contribution and suggestions for future research. It concludes by explaining the strengths and limitations, followed by sustainability.

7.1 Contribution to research

Reviewing available literature on EV adoption and factors influencing consumer decisions proved a substantial amount of research already exists on the topic. The available research is more aimed at uncovering important factors and realizing barriers to EV adoption. The gap within EV research lies in the different consumer segments considering EV, such as potential adopters/buyers. This study contributes to research as it extends on factor importance by analyzing the varying importance between predetermined factors and introduces the concept of how consumer perceptions are changed post-adoption. Thus, the research builds upon existing literature as well as filling the gap in research.

Furthermore, the research results and conclusions can be applied to other industries or markets with some adaptations. In terms of other industries, the conclusive statements can be applied to other technological advancements and technology adoption within any industry, as the generalized theoretical understanding of consumer perception is the same. Similarly, the conclusions can be applied to the EV market of other countries where adoption of EV is less developed than in Sweden. The application will need to take into consideration aspects specific to the Swedish market and the typical Swedish consumer. Otherwise, it should see similar results in terms of understanding what impacts potential buyers early on.

7.2 Suggestions for future research

The conclusion of the study presents opportunities for further research to be conducted on the topic. The first research question found an interesting divide within the internal factors' importance, where factors linked to personal attitudes towards sustainability and fears were greatly influencing a purchasing decision, while social influences had a much more limited effect on the decision. Future research may be done into the psychological

perspective on consumers' purchasing decisions regarding internal factors, to possibly explain how and why this result was found in this study. Furthermore, a managerial perspective could be explored, in which research could investigate how companies use the presented data to align strategic decisions or marketing campaigns with the importance in consumers perception of factors affecting their fears and anxieties, such as safety and reliability (*motivational factors*), or battery and range (*alternative factors*).

The second research question's findings open a new window for discussions on changing perceptions of consumers post adoption of technology. Further research could be conducted to confirm if the same or similar changes in perception result after adoption of other new technological advancements within other industries, as the findings suggest a link to the TPB model. Another suggestion for future research, which stays within automotive, is a deeper examination of how driving experiences affect future purchasing decisions. To expand the study of perceived driving experience and the effect of this experience on consumers' decision-making process, the findings could be valuable for brands to understand how to retain customers and grow brand loyalty. Such research would extend on the findings of this study, by conducting qualitative interviews with drivers and gaining a deeper understanding on how individuals value satisfactory and unsatisfactory aspects, and how these contribute to future vehicle choices.

7.3 Strengths

The adoption of electric vehicles is a current and important topic, due to its environmental, social, and political links, resulting in a study that is relevant to a wide audience. Moreover, the study is largely based on primary research conducted for the purpose of the research, and it uses several theoretical models and peer-reviewed journals as supporting evidence to back up the results. The result is further supported by a large sample group (273) which led to a generalized and more accurate depiction of the studied consumer segment.

7.4 Limitations

Some limitations should be acknowledged within the study, as there are challenges that accompany quantitative research. Initially, the sampling group in this study included many participants who were early adopters, considering that early adopters are a majority

of the existing user-segment, and they are interested in such studies. Thus, participants might have created biases in this case due to their passion and personal preferences to get involved in new technology research. Moreover, EAs tend to be more interactive, as the survey was published in a variety of Facebook and LinkedIn groups, not consisting of only EV enthusiasts, however the interaction was higher in the groups that are known for being interested in the field.

Secondly, allowing the participants to read and interpret the questions within the first section of the survey to determine the groups left some room for interpretation, and possibly misunderstandings. Thus, it is difficult to precisely define the groups without error. The third question (Are you currently planning to buy/lease an Electric Vehicle?) is specifically difficult, seeing as an answer of "Yes" (which would put the participant in group B: Potential) can mean either they are actively in the decision-making process and doing thorough research, or that they have thought of buying an EV in the future at some point, depending on how the participant defines and interprets the question.

Lastly, the scope of this study was general regarding the area examined, the research did not specify a particular region or acknowledge population density differences (e.g., rural or city), it accounted only for the Swedish market as a whole entity. Therefore, the study did not cover the infrastructure differences within the country, rather the overall potential of adopting EVs in Sweden. In distinction to the practical limitations there have been analytic limitations to mention. When comparing the means among groups and factors, the users (149) category have provided the most accurate answers due to being an overwhelmingly larger sampling group than non-users (36). Since the study lacks knowledge about the potential and non-users' driving experience, an assumption was made that users are experienced drivers while potential and non-users have minor or no experience in comparison.

7.5 Sustainability

Sustainability and sustainable transportation are critical elements in this study, as the world is developing by lessening the dependency on fossil fuel, due to many factors as mentioned in this research, such as the increase in the fuel prices and air pollution. To minimize the environmental damage, many studies need to be conducted regarding the

future of the mobility system to cope with the new challenges presented by EVs. Therefore, this study covered many sustainability aspects as economic, social, and environmental, and factors influencing consumers in this industry. There have been many studies considering innovative, sustainable solutions, however, less is known regarding the consumer aspect in the equation. Thus, the research focuses on these elements, through understanding the consumers' approach to adopting new sustainable solutions to reduce the dependency on fossil fuels. The factors examined also ensure to include the social and economic dimensions as these dimensions are critical for the acceptance of new trends.

This study focuses on sustainability in terms of emissions, and it does not consider the sustainability issues regarding manufacturing of batteries. This issue is a separate discussion which is important for the producer perspective, but it was not taken into account due to scope limiting the study to the consumer perspective.

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9 Appendix

9.1 Supporting tables for motivational factors

Appendix 1: Means comparison between groups

Comparing Means	EV Users	Potential EV Users	Non-users
Sustainability	5.28	5.14	5.19
Noise Pollution	3.60	3.48	3.56
Running Costs	4.89	5.16	4.86
Price to Purchase	3.34	4.10	4.17
Social Image	3.34	3.25	3.33
Government Incentives	3.42	3.74	3.89
Performance	4.15	4.10	3.94
Type/Size of Vehicle	3.83	4.02	3.81
Trusted Recommendation	3.06	3.67	3.64
Previous Experience	3.94	4.15	4.25
Safety & Reliability	4.89	5.06	5.33

Appendix 2: Correlational matrix

Correlation Matrix

	Sustainability	Noise Pollution	Running Costs (i.e. charging price vs. fuel price)	Price to Purchase (or lease price)	Social Image (e.g. green/environmentally conscious)	Government Incentives (e.g. reduced taxes)	Performance (i.e. acceleration, driving range)	Type/Size of Vehicle (i.e. Sedan, SUV...)	Trusted Recommendation (i.e. family/friends)	Previous Experiences and/or Test Drive	Safety & Reliability
Sustainability	1.000	.171	-.179	-.131	.185	-.074	-.158	-.036	-.044	-.057	-.041
Noise Pollution	.171	1.000	.138	.109	.223	.112	.149	.088	.082	.056	.285
Running Costs (i.e. charging price vs. fuel price)	-.179	.138	1.000	.270	.105	.368	.222	.132	.196	.250	.250
Price to Purchase (or lease price)	-.131	.109	.270	1.000	.094	.428	.210	.192	.195	.229	.248
Social Image (e.g. green/environmentally conscious)	.185	.223	.105	.094	1.000	.265	.246	.132	.155	.038	.106
Government Incentives (e.g. reduced taxes)	-.074	.112	.368	.428	.265	1.000	.332	.223	.235	.233	.263
Performance (i.e. acceleration, driving range)	-.158	.149	.222	.210	.246	.332	1.000	.257	.241	.262	.296
Type/Size of Vehicle (i.e. Sedan, SUV...)	-.036	.088	.132	.192	.132	.223	.257	1.000	.263	.188	.293
Trusted Recommendation (i.e. family/friends)	-.044	.082	.196	.195	.155	.235	.241	.263	1.000	.374	.355
Previous Experiences and/or Test Drive	-.057	.056	.250	.229	.038	.233	.262	.188	.374	1.000	.374
Safety & Reliability	-.041	.285	.250	.248	.106	.263	.296	.293	.355	.374	1.000

Appendix 3: Communalities

Communalities

	Initial	Extraction
Sustainability	.142	.295
Noise Pollution	.159	.202
Running Costs (i.e. charging price vs. fuel price)	.212	.261
Price to Purchase (or lease price)	.231	.289
Social Image (e.g. green/environmentally conscious)	.183	.344
Government Incentives (e.g. reduced taxes)	.331	.582
Performance (i.e. acceleration, driving range)	.244	.270
Type/Size of Vehicle (i. e. Sedan, SUV...)	.152	.178
Trusted Recommendation (i.e. family/friends)	.234	.313
Previous Experiences and/or Test Drive	.249	.346
Safety & Reliability	.310	.476

Extraction Method: Principal Axis Factoring.

Appendix 4: KMO & Bartlett's test

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.772
Bartlett's Test of Sphericity	Approx. Chi-Square	452.590
	df	55
	Sig.	<.001

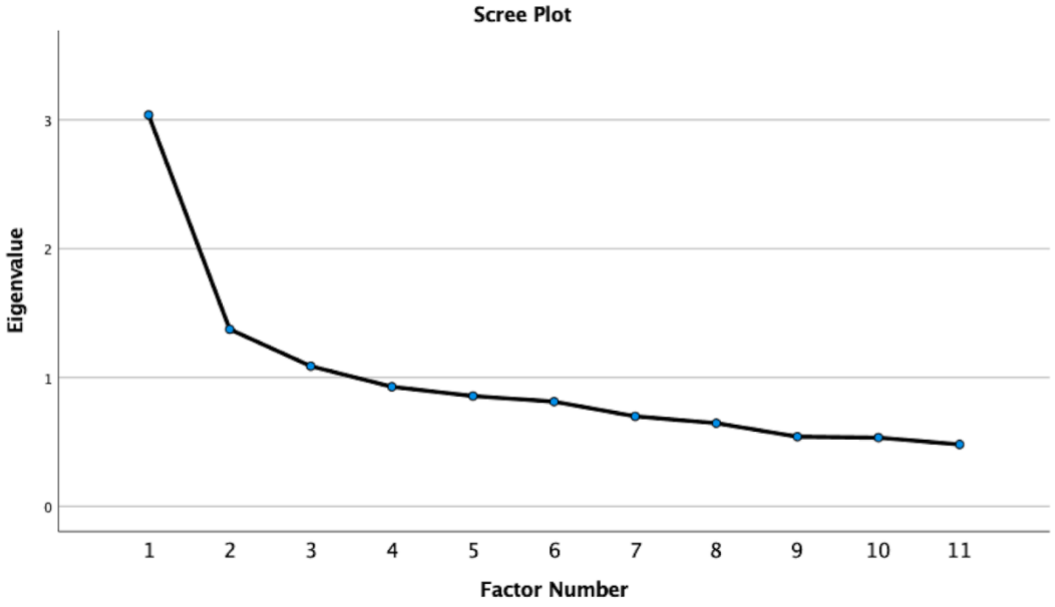
Appendix 5: Total variance explained

Total Variance Explained

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.038	27.622	27.622	2.396	21.782	21.782	1.460	13.268	13.268
2	1.375	12.501	40.123	.665	6.044	27.826	1.366	12.421	25.689
3	1.088	9.894	50.017	.494	4.494	32.320	.729	6.631	32.320
4	.929	8.441	58.459						
5	.856	7.785	66.244						
6	.813	7.391	73.635						
7	.699	6.356	79.991						
8	.646	5.872	85.862						
9	.541	4.916	90.778						
10	.534	4.852	95.630						
11	.481	4.370	100.000						

Extraction Method: Principal Axis Factoring.

Appendix 6: Scree plot



Appendix 7: Factor score coefficient matrix

Factor Score Coefficient Matrix

	Factor		
	1	2	3
Sustainability	-.014	-.153	.361
Noise Pollution	.047	-.012	.230
Running Costs (i.e. charging price vs. fuel price)	.043	.157	-.064
Price to Purchase (or lease price)	.023	.183	-.054
Social Image (e.g. green/environmentally conscious)	-.056	.096	.381
Government Incentives (e.g. reduced taxes)	-.128	.552	.076
Performance (i.e. acceleration, driving range)	.092	.108	.030
Type/Size of Vehicle (i. e. Sedan, SUV...)	.117	.020	.027
Trusted Recommendation (i.e. family/friends)	.245	-.030	.001
Previous Experiences and/or Test Drive	.277	-.025	-.090
Safety & Reliability	.410	-.087	.075

Extraction Method: Principal Axis Factoring.
Rotation Method: Varimax with Kaiser Normalization.
Factor Scores Method: Regression.

Appendix 8: Factor matrix

Factor Matrix[a]

	Factor		
	1	2	3
Sustainability		.522	
Noise Pollution		.353	
Running Costs (i.e. charging price vs. fuel price)	.474		
Price to Purchase (or lease price)	.491		
Social Image (e.g. green/environmentally conscious)	.316	.458	
Government Incentives (e.g. reduced taxes)	.644		-.408
Performance (i.e. acceleration, driving range)	.518		
Type/Size of Vehicle (i. e. Sedan, SUV...)	.411		
Trusted Recommendation (i.e. family/friends)	.507		
Previous Experiences and/or Test Drive	.510		
Safety & Reliability	.609		.320

Extraction Method: Principal Axis Factoring.

a. 3 factors extracted. 15 iterations required.

Appendix 9: ANOVA factor scores between groups

Descriptives

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
REGR factor score 1 for analysis 1	Group A	149	-.1062819	.80264945	.06575560	-.2362230	.0236592	-2.33507	1.66267
	Group B	88	.1077910	.77326059	.08242986	-.0560472	.2716293	-2.33325	1.44487
	Group C	36	.1763997	.73362594	.12227099	-.0718236	.4246230	-2.09397	1.45406
	Total	273	.0000000	.79064266	.04785187	-.0942071	.0942071	-2.33507	1.66267
REGR factor score 2 for analysis 1	Group A	149	-.1059097	.82662955	.06772013	-.2397330	.0279136	-1.99076	1.55790
	Group B	88	.1334745	.75063972	.08001846	-.0255708	.2925199	-1.45162	1.41794
	Group C	36	.1120775	.75740046	.12623341	-.1441900	.3683449	-2.36218	1.54222
	Total	273	.0000000	.79963473	.04839610	-.0952785	.0952785	-2.36218	1.55790
REGR factor score 3 for analysis 1	Group A	149	.0414432	.74780143	.06126228	-.0796186	.1625049	-2.27852	1.48405
	Group B	88	-.0722290	.68016910	.07250627	-.2163430	.0718851	-1.94711	1.18865
	Group C	36	.0050310	.58490582	.09748430	-.1928726	.2029347	-1.29964	.99628
	Total	273	.0000000	.70633005	.04274904	-.0841611	.0841611	-2.27852	1.48405

9.2 Supporting tables for alternative factors

Appendix 10: Means comparison between groups

Comparing means	EV Users	Potential EV Users	Non-users
Purchasing Price	4.16	4.85	4.83
Powertrains	3.50	3.70	3.75
Type/Size of vehicle	4.20	4.22	3.75
Battery & Range	5.14	5.30	4.92
Charging Networks	4.64	4.95	4.97
Brand & Social image	3.05	2.70	3.00
Perceived Quality	4.54	4.66	4.67
Perceived Safety	4.79	4.81	4.97
Aesthetics	4.07	3.90	3.75
Other features (operative systems, interior design)	4.12	3.90	3.44

Appendix 11: Correlational matrix

	Purchasing Price (or lease price)	Powertrains (i.e. availability of different powertrains)	Type/Size of Vehicle (i.e. Sedan, SUV...)	Battery & Range	Charging Networks (e. g. deals with charging networks, and availability of charging stations)	Brand & Social Image (i.e. social status that brand communicates)	Perceived Quality	Perceived Safety	Aesthetics (Physical looks)	Other Features (e. g. operative system and additional interior details)
Purchasing Price (or lease price)	1.000	.087	.216	.253	.000	-.083	.246	.127	.071	.011
Powertrains (i.e. availability of different powertrains)	.087	1.000	.141	.220	.188	.324	.152	.225	.191	.228
Type/Size of Vehicle (i. e. Sedan, SUV...)	.216	.141	1.000	.370	.097	.126	.215	.207	.267	.199
Battery & Range	.253	.220	.370	1.000	.399	.203	.347	.395	.286	.281
Charging Networks (e.g. deals with charging networks, and availability of charging stations)	.000	.188	.097	.399	1.000	.276	.244	.391	.171	.295
Brand & Social Image (i.e. social status that brand communicates)	-.083	.324	.126	.203	.276	1.000	.314	.317	.498	.460
Perceived Quality	.246	.152	.215	.347	.244	.314	1.000	.630	.453	.380
Perceived Safety	.127	.225	.207	.395	.391	.317	.630	1.000	.389	.390
Aesthetics (Physical looks)	.071	.191	.267	.286	.171	.498	.453	.389	1.000	.627
Other Features (e.g. operative system and additional interior details)	.011	.228	.199	.281	.295	.460	.380	.390	.627	1.000

Appendix 12: Communalities

Communalities

	Initial	Extraction
Purchasing Price (or lease price)	.161	.324
Powertrains (i.e. availability of different powertrains)	.150	.128
Type/Size of Vehicle (i. e. Sedan, SUV...)	.186	.209
Battery & Range	.351	.465
Charging Networks (e.g. deals with charging networks, and availability of charging stations)	.277	.507
Brand & Social Image (i.e. social status that brand communicates)	.366	.460
Perceived Quality	.481	.461
Perceived Safety	.486	.492
Aesthetics (Physical looks)	.508	.748
Other Features (e.g. operative system and additional interior details)	.458	.533

Extraction Method: Principal Axis Factoring.

Appendix 13: KMO & Bartlett's test

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.784
Bartlett's Test of Sphericity	Approx. Chi-Square	720.224
	df	45
	Sig.	<.001

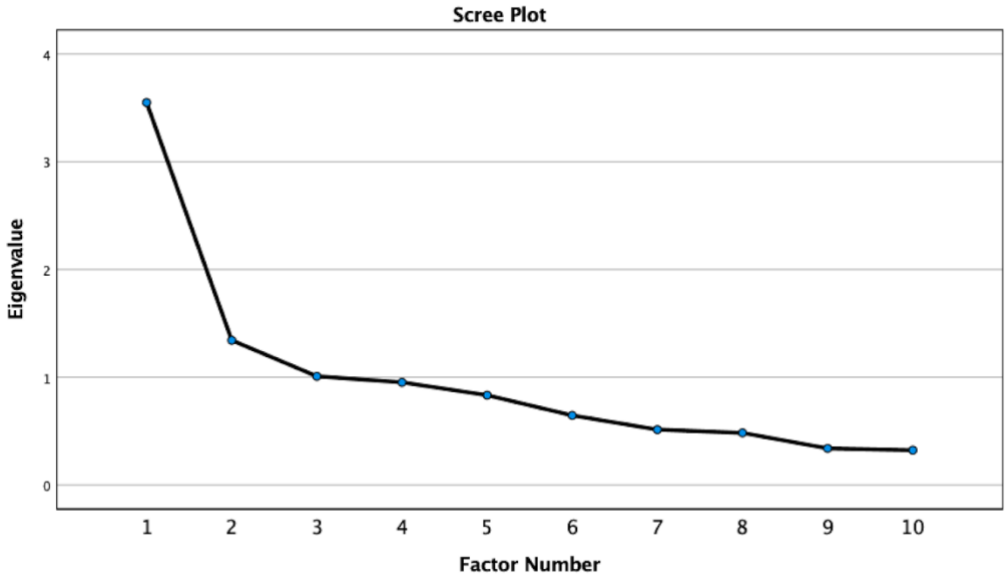
Appendix 14: Total variance explained

Total Variance Explained

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.550	35.499	35.499	3.047	30.475	30.475	1.987	19.874	19.874
2	1.344	13.436	48.935	.762	7.622	38.097	1.225	12.248	32.121
3	1.010	10.095	59.030	.517	5.172	43.269	1.115	11.148	43.269
4	.954	9.535	68.566						
5	.834	8.341	76.907						
6	.646	6.464	83.370						
7	.515	5.148	88.519						
8	.484	4.844	93.363						
9	.340	3.403	96.766						
10	.323	3.234	100.000						

Extraction Method: Principal Axis Factoring.

Appendix 15: Scree plot



Appendix 16: Factor score coefficient matrix

Factor Score Coefficient Matrix

	Factor		
	1	2	3
Purchasing Price (or lease price)	-.085	-.077	.361
Powertrains (i.e. availability of different powertrains)	.037	.062	.006
Type/Size of Vehicle (i. e. Sedan, SUV...)	-.014	-.011	.179
Battery & Range	-.092	.216	.277
Charging Networks (e.g. deals with charging networks, and availability of charging stations)	-.071	.502	-.142
Brand & Social Image (i.e. social status that brand communicates)	.203	.133	-.199
Perceived Quality	.041	.049	.229
Perceived Safety	.038	.219	.127
Aesthetics (Physical looks)	.598	-.322	.101
Other Features (e.g. operative system and additional interior details)	.225	.059	-.083

Extraction Method: Principal Axis Factoring.
Rotation Method: Varimax with Kaiser Normalization.
Factor Scores Method: Regression.

Appendix 17: Factor matrix

Factor Matrix[a]

	Factor		
	1	2	3
Purchasing Price (or lease price)		.456	
Powertrains (i.e. availability of different powertrains)	.347		
Type/Size of Vehicle (i. e. Sedan, SUV...)	.362		
Battery & Range	.566	.371	
Charging Networks (e.g. deals with charging networks, and availability of charging stations)	.485		-.508
Brand & Social Image (i.e. social status that brand communicates)	.575	-.345	
Perceived Quality	.652		
Perceived Safety	.677		
Aesthetics (Physical looks)	.734	-.331	.316
Other Features (e.g. operative system and additional interior details)	.673		

Extraction Method: Principal Axis Factoring.

a. 3 factors extracted. 18 iterations required.

Appendix 18: ANOVA factor scores between groups

Descriptives

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
REGR factor score 1 for analysis 2	Group A	149	.1079433	.89336277	.07318713	-.0366834	.2525701	-2.27121	1.66610
	Group B	88	-.1169971	.88823850	.09468654	-.3051968	.0712027	-2.32238	1.75627
	Group C	36	-.1607726	.84283433	.14047239	-.4459467	.1244015	-1.56693	1.12481
	Total	273	.0000000	.89008570	.05387044	-.1060560	.1060560	-2.32238	1.75627
REGR factor score 2 for analysis 2	Group A	149	-.0583670	.82446373	.06754270	-.1918397	.0751056	-2.38074	1.39826
	Group B	88	.0706499	.67848840	.07232711	-.0731080	.2144079	-2.13574	1.31610
	Group C	36	.0688747	.88689951	.14781659	-.2312089	.3689583	-2.73212	1.51379
	Total	273	.0000000	.78894015	.04774883	-.0940043	.0940043	-2.73212	1.51379
REGR factor score 3 for analysis 2	Group A	149	-.1085434	.75542304	.06188667	-.2308390	.0137523	-3.14939	1.20163
	Group B	88	.1853138	.64411119	.06866248	.0488396	.3217879	-1.66733	1.48067
	Group C	36	-.0037402	.96050811	.16008469	-.3287294	.3212489	-3.27169	1.43969
	Total	273	.0000000	.76124151	.04607243	-.0907039	.0907039	-3.27169	1.48067