The Adoption of Electric Vehicles in the Sultanate of Oman: A Conceptual Study

HAMED ABDULLAH SAID ALSALMI[1], SIVADASS THIRUCHELVAM[2]
[1]College of Management,
Universiti Tenaga Nasional (UNITEN),
Kajang, Selangor,
MALAYSIA

[2]College of Engineering,
Universiti Tenaga Nasional (UNITEN),
Kajang, Selangor,
MALAYSIA

Abstract: - This research aims to propose a conceptual framework that links Personal and Technological Factors with Electric Vehicle (EV) adoption in Oman, and to test the validity and reliability of the research model. Based on the Social Cognitive Theory, the framework contained Omani Social Norms, Perceived Usefulness (as Personal Factors), the Government's Personnel Information Technology IT Competencies, Electric Vehicles System Quality, and the Lack of charging infrastructure (as Technological Factors) as independent variables; with Electric Vehicles in Oman (as dependent variable). The researcher followed the quantitative research methodology by testing the score of Cronbach Alpha as a measurement of the Reliability of the scale, and Person correction as a measurement of the research model validity. The researcher used the mean of the survey questionnaire as a research instrument, on which the researcher developed a 26 items questionnaire and distributed 30 questionnaires. The findings of this study revealed that the scores of the Cronbach Alpha for all of the constructs achieved a satisfactory level of scale reliability. In addition, the Pearson Correlation between all Social Norms, Perceived Usefulness, Personnel IT Competencies, System Quality, and the Lack of charging infrastructure with the EV have all been found to be statistically significant.

Key-Words: - Social Norms, Perceived Usefulness, Personnel IT Competencies, System Quality, the Lack of charging, Electric Vehicles, Oman

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1 Introduction

In today's world, when decreasing oil reliance and minimizing carbon emissions are key goals, the electric vehicle (EV) business is one of the fastest-expanding industries. EVs are the most environmentally friendly alternative to conventional modes of transport. An electric vehicle is made up of three parts: a battery, a power wire, and a socket. Electric vehicles were first introduced in the nineteenth and twentieth centuries, but their popularity faded due to low oil costs, large driving ranges, and inexpensive pricing of regular vehicles, [1]. The goal these days is to have electric vehicles with batteries that can be recharged by renewable energy sources (RESs) like solar power, allowing EVs to be integrated into smart grids. A smart grid is an electric power grid that reacts intelligently to all of its linked components, such as suppliers and customers, to supply electric power services effectively, cheaply, and sustainably. Furthermore, when demand is low and output is high, EVs may be utilized to store extra energy and supply power back to the smart grid when supply exceeds need, [2].

However, a rapid rise in the number of electric vehicles on the road might produce grid congestion and voltage issues. Electric vehicle sales are increasing over the world as a result of their efficiency and ability to function as a distributed energy source. In 2015, over 800,000 electric vehicles (EVs) were sold in the United States alone, with 600,000 EVs sold in Japan. Following suit, Europe and China bought 200,000 electric vehicles to keep up with the trend, [3].

Many challenges, problems, uncertainties, and concerns have arisen as a consequence of the rapid expansion of electric vehicles. These issues are divided into three categories: (1) smart grid challenges, (2) electric vehicle adoption challenges, and (3) challenges connected to a regular and dependable supply of raw materials for the manufacture of EV components like batteries. First, from the standpoint of the smart grid, these issues include system overload, power losses, line reliability, renewable energy production, EV driver behavior, and smart grid fluctuations induced by uncontrolled EV battery recharging. Second, from the standpoint of adoption, driving EVs at high speeds while carrying an auxiliary load such as air conditioning (AC) or heating is seen as a big risk. The current adoption of electric vehicles as a mainstream transport system is hampered by their long recharging times and limited driving range. Similarly, repeated G2V (Grid-to-Vehicle) and V2G (Vehicle-to-Grid) charging and discharging cycles may wear out batteries and reduce battery life. Furthermore, the attitudes of EV drivers are a significant component of the risk connected with electric vehicles, [2]. Therefore, the main objective of this study is to validate a conceptual framework, the framework contained Omani Social Norms, Perceived Usefulness (as Personal Factors), the Government's Personnel Information Technology IT Competencies, Electric Vehicles System Quality, and the Lack of charging infrastructure (as Technological Factors) as independent variables; with Electric Vehicles in Oman (as dependent variable).

2 Literature Review

2.1 HEV/EV

The deployment of electric vehicles on the road is an excellent concept. Electric vehicles are divided into four groups. Mild-hybrid electric vehicles (MHEV), hybrid electric vehicles (HEV), plug-in hybrid electric vehicles (PHEV), and battery electric vehicles (BEV) are all available (BEV). The 48v electric vehicle is the mild hybrid's name. The ultimate electric vehicle delivers several functions and features, including voltage stabilization, recuperation, start-stop, fuel-saving, sailing electric parking, and fully battery-charged electric driving with an onboard charger, as the electric vehicle develops its upgrading and performance. Despite this, the MHEV satisfies the 95 g/km CO2 emissions per vehicle requirement. As charging infrastructure improves, the market will gradually accept electric vehicles. Plans for a dynamic induction charging system may see charging facilities set up at airports, parking lots, and taxi stops, [4].

Several obstacles in the form of plug-in electric vehicles (PEVs) lie in the way. PEVs have several drawbacks that make them difficult to implement. The cost of the battery system, its range limits, charging, and battery density are the factors to consider. Vehicle electrification solutions need meticulous development of an effective energy management system for the vehicle engine. High power and high voltage energy needs for battery energy storage in electric vehicles are met by power emulation by solar grid systems, [5]. Solar inverters with maximum power point tracking storage provide the best efficiency. The self-discharging mechanisms of lithium-ion batteries are being studied to have a better understanding of electric vehicle energy management. The key areas of research in electric vehicle technology include automotive energy, battery testing, power device modeling, and cell self-discharging technologies. One can increase the vehicle actuation throughput by improving the understanding of DC-to-DC converter design. The gasoline-electric hybrid vehicle (HEV), the full-electric vehicle (EV), and the light electric vehicle (LEV) are the three categories of electric vehicles (LEV). Compared to electric vehicles, LEVs use less power. According to the input voltage requirement, it is further divided into low and high-power varieties, [6]. Table 1 indicates the various types of light electric vehicles.

Table 1. Light electric vehicles

Light electric vehicles			
High power (10 kw > 30 kw)	High voltage (48–144 V)	Low power (1–10 kw)	Low voltage (24–72 V)
a. Low-speed electric vehicles b. E-golf carts c. E-forklifts d. Light utility vehicles e. E-motorbikes f. E-three wheelers		g. E-rickshaws h. E-bikes i. E-scooters	

2.2 Electric Vehicle Studies in Oman

Shortly, Oman intends to use cleaner and renewable energy. The Authority for Electricity Regulations is working on a clear framework for electric vehicles; without it, the government would be unable to approve charging stations at gas stations. According to some reports, the Sultanate presently has 12 charging stations, however, they were only placed in two sites for a Global EVRT event. It's unclear how many and what kind of electric vehicles have been deployed in Oman thus far. There is no central database, and the information is not accessible to the general public. The Sultanate of Oman's Authority for Electricity Regulation is working on laws to regulate electric vehicles. This government regulatory body is working to provide a framework for EV regulation and enforcement. So far, the sole action performed to promote electric vehicles in Oman has been a Global EVRT event conducted in January 2018. It included ten electric vehicles traveling from Abu Dhabi to Muscat. The promoters displayed EV charging stations at the only two stops on this road trip, one in Muscat and one in Sohar, both at IHG group hotels, [7].

The main entities (e.g., developers, government, System Operator) and their roles in the deployment of EVs in the jurisdiction in Oman are as follows:

- Authority for Electricity Regulation: The authority is currently working on the framework for EVs regulation and the introduction, management, and operation of charging stations. This government entity is likely to be the main regulator for the sector.
- Vehicle manufacturers: These companies can help the regulators to determine what operational and regulatory requirements need to be put in place to manage their enforcement.
- Charging station developers: These entities can be used by the regulator to know how the charging stations will be installed and what will be needed in terms of practical requirements for ongoing operation and management, including the different types of charges (i.e., fast chargers, home chargers, etc.).
- Petrol station companies: These entities will have input on how they want to provide charging stations and ancillary services for EVs.
- Governmental entities:
    i. The Ministry of Environment and Climate Affairs – This government ministry is likely to be key in forming the regulatory landscape and promoting the use of EVs within the jurisdiction. In addition to EVs, they will have input into the regulation of hybrids, petrol, and diesel cars.
    ii. Public Authority for Water and Electricity and NAMA Group SAOC – These two government bodies are often heavily involved with the policy drivers for energy and energy-related projects in the Sultanate. Even at a cursory level, each entity is likely to be consulted on the introduction of a framework for EVs.

The major challenges currently are finishing the framework for electric vehicles in the Sultanate of Oman - what it should contain, how it will look, who will be in charge of enforcement and legislative reform, and how the sector will create and function in the interim. One of the most important factors to examine is how the regulator will handle charging stations, including tariffs, distinct sites from gas stations/conjoined locations, yearly requirements, and government registrations (e.g., Mulkiya registration and renewal). Detailed information on whether to price the tariffs higher, cheaper, or equal to traditional gasoline or fuel automobiles will be required as part of this analysis. Refocusing emphasis on "greener" and more ecologically friendly vehicles would mark an utter sea-change at many levels, both in the public and commercial sectors, for a nation that is so highly reliant on its petroleum economy, [7], [8].

Due to various economic and environmental concerns, interest in electric and hybrid electric vehicles (EVs & HEVs) has risen quickly in recent years. Increasing fuel costs, climate change concerns, and environmental protection have opened the way for EVs and HEVs to gain significant market share, particularly in Europe, the United States, and East Asia, [9]. In these areas, EV sharing is also becoming increasingly prevalent and accepted. Although performance and comfort EVs from well-known manufacturers such as Tesla, Smart, BMW, and Mitsubishi are gaining more public attention and acceptance, the Gulf Arab states, which are considered one of the largest automotive markets for German vehicles with around €3.7 billion in turnover in 2012 have no real EV market, [10]. EV producers will need more precise and scientific information regarding the performance, potential, and acceptability of such technology in the Gulf Arab states to break into this vital market. Most oil-rich Gulf Arab governments are now becoming more interested in alternative vehicle technology and renewable energy in a bold endeavor. They want to diversify their energy resources in this move and maybe profit in the process. The number of Gulf Arab governments betting on green technology and renewable energy as essential components in the global economy and the environment have increased dramatically in recent years. For example, the United Arab Emirates' efforts to host the headquarters of the International Renewable Energy Agency (IRENA) in Abu Dhabi have resulted in the success of their efforts in the renewable energy industry and climate change challenges, [11]. Despite these efforts, the use of electric vehicles as green technology and the relationship between EVs and environmental consequences are not fully understood. This research project was established by the Research Institute of Automotive Engineering and Vehicle Engines Stuttgart (FKFS) in collaboration with

Dhofar University (DU) in Salalah, where several tests were conducted to study the performance of EVs in the Gulf Arab states in general and in Oman in particular. This will provide a thorough understanding of the many EV applications, as well as the fuel savings and environmental implications of utilizing both EVs and renewable energy charging stations, [10].

2.2.1 Salalah Driving Cycle (2015)

The objective test methodology used by Mohareb et al. (2015) is meant to define a driving cycle in Salalah, Oman, as depicted in Fig. 1. It is built up from three interdependent steps. In phase I, a 30-question questionnaire is produced and delivered to 320 applicants who reflect the population distribution of Salalah. The questionnaire translates the study objectives into precise questions to ascertain two key parameters: the driven route types and driving cycle, as well as information on people's attitudes and knowledge about EVs and climate change. Based on the survey results, a sample driving cycle for Salalah is created, as illustrated in Fig. 2. In phase II, utilizing a specially-designed measuring box, the essential data for the Salalah Driving Cycle (SaDC) driver profile is acquired (MessBox). In phase III, the gathered data, including temperatures, vehicle velocity, and solar irradiation, are utilized in a simulation model to analyze the performance and potential of electric vehicles in Gulf Arab nations, [10].

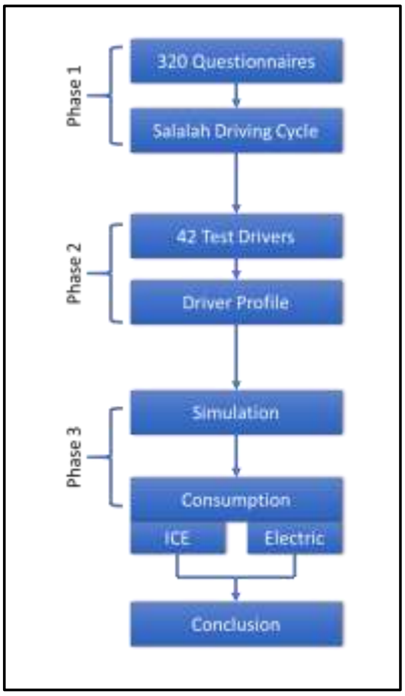

Fig. 1: Test methodology structure

In addition, Mohareb et al. (2015) used a scientific approach to analyze the quantitative data from the 320 questionnaires to determine the total daily average distance, the road type distribution in terms of Major Highway, Primary Street, and City Street, a representative driving cycle for Salalah, and the required numbers of test drivers. The Salalah Driving Cycle is about 36 kilometers long and consists of three kinds of roads: 41% Major Highway, 29% Primary Street, and 30% City Street. To investigate the profile of the prescribed driving cycle, a minimum of 42 distinct drivers are recruited. To gather valid data from the SaDC, a particular number of drivers is necessary. Table 2 shows the gender and age distribution of the test drivers based on the available volunteer drivers. The MessBox, which is explained in the following part, is used to capture data throughout each driving cycle for each test drive, [10].

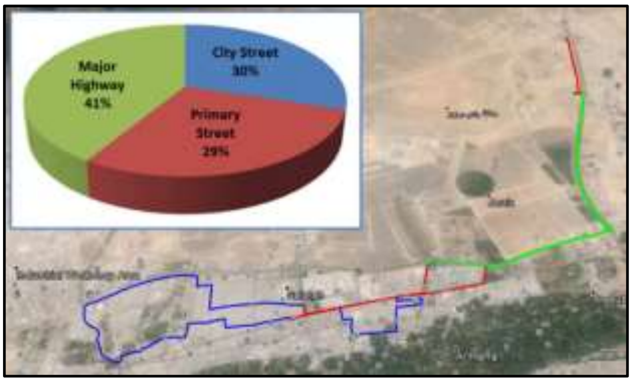

Fig. 2: Salalah Driving Cycle (SaDC) with road distribution

Table 2. Categorization of test drivers

Total test drivers	42	
Total per gender	41	1
Age groups (Year)	Male	Female
21 - 30	21	0
31 - 40	16	1
41 - 50	3	0
51 - 60	1	0
61 - 70	0	0

Mohareb et al. (2015)'s study delve into the possibilities for employing electric vehicles, the fuel savings potentials, and the environmental implications of using both electric vehicles and renewable energy charging stations. Despite the abundance of oil in the Gulf Arab nations, the measurements and simulation findings stimulate further research into using solar energy to power electric vehicles in the region. As a result, the irradiance of the sun is measured during the test drives. This information is fed into a computer model of a solar charging station, which is used to assess the viability of employing them. As a result, hazardous pollutants and operating expenses may be lowered even more. Many viable business cases for employing electric vehicles and solar charging stations for this region, which is regarded as one of the largest automobile markets, may be analyzed using the data gathered during the test drives and by using these trustworthy simulation models, [10].

2.2.2 Electrification of Transport in Oman (2020)

The electrification of vehicles is a promising pathway to decarbonize road transportation and combat climate change. A comprehensive public policy is required to ensure a successful smooth transition to clean and energy-efficient road transport vehicles. Based on the circumstances of Oman, the electric vehicles policy can be founded on four pillars, [12].

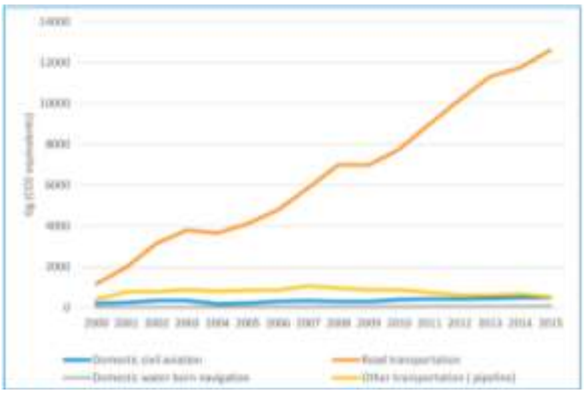

Fig. 3: The trend of transportation emissions per source categories in Oman, 2000–2015.

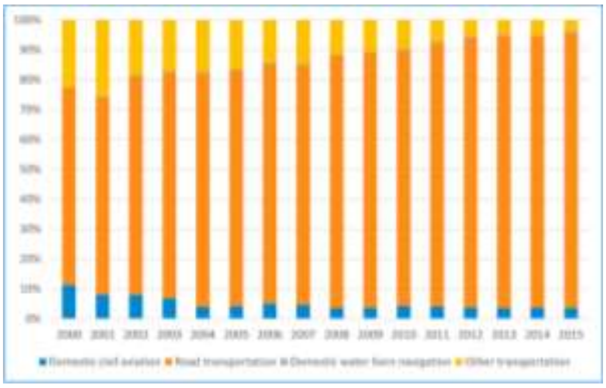

Fig. 4: The trend of shares contribution per emission categories of transportation in Oman, 2000–2015.

Integration of electric vehicles with renewable energy: The emission advantage of electric vehicles is highly dependent on charging power generation. Electric vehicles produce more GHG than gasoline-electric hybrid or internal combustion engine vehicles if they are not powered by renewable supply. Currently, Oman's entire electric sector runs on fossil fuels (97 percent natural gas and 3% diesel), and the country's electrical power consumption is growing at a rate of 5% per year, reaching 6170 MW in 2018. The electrification of road transportation will raise electrical power consumption by at least a factor of two, resulting in an increase in CO2 emissions owing to a shortage of clean energy in the national energy mix. The nation will see a tremendous surge in electric vehicles in the next years, but renewable energy deployment will remain poor. This impasse will inevitably raise future total GHG emissions, preventing the government from meeting its committed objective of reducing 2% of absolute GHG emissions by 2030 as part of the Paris Agreement's nationally defined contributions. The electrification of vehicles is required to significantly increase the contribution of renewable energies in the present energy mix to decarbonize road transport. With over 365 days of clear sky in all sections of the nation, Oman is listed among the best countries in the world in terms of solar density potential, which may reach 6.1 KWh/m2 per day during the summer season. The governorate of Dhofar, in the southern portion of Oman, is the lone exception, where the solar density drops somewhat due to the southeast summer monsoon. Despite the tremendous potential of solar radiation, which may easily be utilized to supply power demand, solar energy is currently confined to a few off-grid uses in Oman's isolated locations. In this setting, the top objective is to eliminate technological, financial, and regulatory barriers to on-grid solar energy deployment. The next stage is to delve more into how to scale up solar energy for road transport electrification in terms of power plant location, grid preparedness, transportation network, and charging stations. All of these concerns should be included in future strategic planning for supplying clean energy to electric vehicles, [13].

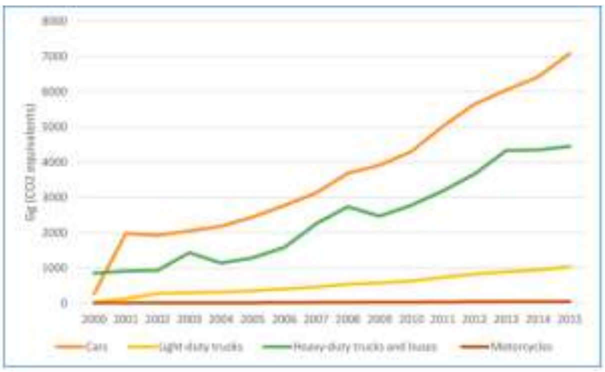

Fig. 5: Trends of road transportation emissions per source categories in Oman, 2000–2015.

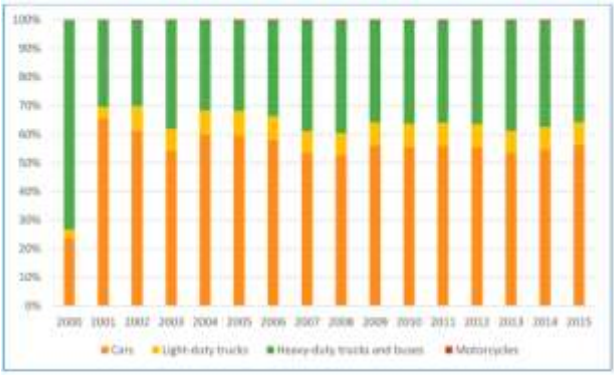

Fig. 6: The trend of shares contribution per emission categories of road transportation in Oman, 2000–2015.

Planning for charging stations: The adoption of electric vehicles in Oman necessitates a deeper dive into the best policies for future charging station distribution and the best approaches to integrate them with present urban patterns and power grid restrictions. Furthermore, an ideal approach for reducing the investment cost of charging stations as well as the renovation and extension of the power infrastructure must be developed. The rate of urbanization in Oman is fast, with many plans to grow and new cities forming, such as Duqum on the country's central-east coast, however, electric vehicle infrastructure is still not included in present or future urban plans. This will make determining the best locations for electric vehicle infrastructure a difficult and expensive task for city planners. Because today's urban plans will be the cities of the future, charging station planning should be included as an extra constraint in urban planners' techniques, [4], [14].

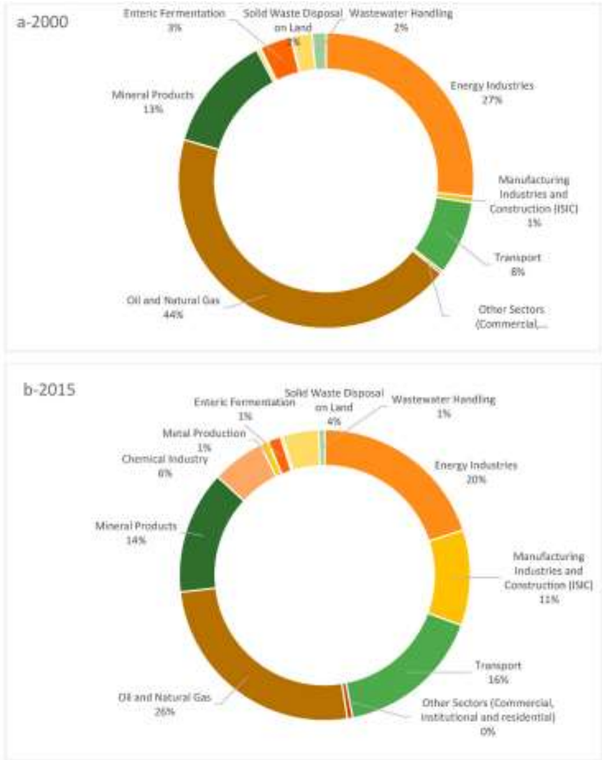

Fig. 7: Comparison of share contribution per source categories to the total GHG emission in Oman, a-2000, and b-2015.

Evaluating grid distribution with transportation network constraint: The predicted growth in electric vehicle charging stations will bring the power grid and transportation networks closer together. Both systems will regulate and have an inverse effect on the distribution of traffic flows of electric vehicles. To maintain the effectiveness of the linked transportation and power systems in Oman, an integrated, educated science policy concerning the management of future large-scale electrical vehicles is greatly necessary, [12].

Adopting Norway's Model to Speed Up Electric Vehicle Transition: Several developed nations have adopted directly funded purchase incentives to encourage the fast adoption of electric vehicles, including direct cash payments, tax deductions, and tax exemptions for each electric vehicle purchaser. Many analysts believe that Norway is the most advanced nation in terms of individual household adoption of electric vehicles. Norway has a population of 5368 people in 2018, and there were around 296,000 electric vehicles registered. Norway stands out as a suitable example to emulate because of its population-to-registered electric vehicle ratio. The Norway approach is founded on the complementarity of direct and indirect incentives to make electric car ownership particularly appealing to individual users. There is no sales tax on electric vehicles as a direct incentive (very high for conventional cars). Furthermore, electric automobiles now get a 25% VAT exemption on purchase. Electric vehicle parks also benefit from free municipal parking and toll road fee exemptions. Electricity is quite cheap ($0.11) in Norway, and gasoline is highly expensive ($ 2.05/Liter), hence the operating costs of electric vehicles are very low compared to traditional automobiles. State budget subsidies for petroleum products mostly used in transportation were $4.37 billion in 2015. The appropriate solution to decarbonize road transportation and establish sustainable transportation networks is to phase out this subsidy arrangement in favor of the automobile zero-emission program on Omani roads, [12].

2.2.3 Carbon Footprint and Environmental Impact in Oman

When buying a new car, Omanis car buyers have two main concerns: fuel efficiency and environmental friendliness. Only HEVs have the best chance of achieving the two conditions outlined above. However, while comparing conventional and HEV vehicles, it's necessary to consider the advantages and disadvantages of each. Greater mileage, increased resale value, and cleaner energy are all advantages of HEVs, but they come at a price, with higher maintenance costs and no sport-tuned suspensions. Conventional fuel automobiles, on the other hand, have a cheaper price tag, superior engine power, and minimal maintenance costs, but they have dangerous emissions and poor mileage. According to a paper issued by Argonne in 2009, HEVs can save 90 percent on petroleum energy and 40-80 percent on greenhouse gas emissions, [15].

In the case of Oman, current environmental data indicates that carbon statistics have been steadily increasing since the country's early oil and gas discoveries and production. Oman's total CO2 emissions increased dramatically from 2,000 Gg to 40,000 Gg between 1972 and 2011, [16]. Similarly, Yousif et al. (2017) found that CO2 and greenhouse gas emissions in the nation are expected to rise by about 60 million tonnes over the next decade. Continuous fuel burning (57.9%), manufacturing (24.2%), and transportation (12.3%) are the principal sources of these emissions, [17]. When the CO2 released by conventional automobiles in the nation is coupled with the transportation and fuel combustion components, the result is a substantially greater statistic. In this sense, the Sultanate of Oman sees HEVs as having the ability to reduce the country's steadily rising CO2 and GHG emissions, [15].

In 2015, several car brands released HEVs in Oman, including the Toyota Prius, which is leading the Middle East's transition to HEVs (Times of Oman, 2016). According to the car model's expectations, it will likely cut CO2 emissions by 67 million tonnes over the next 20 years, [15]. Because it is unknown how many HEVs were deployed in Oman, the precise assessment of their influence on the country's CO2 emissions decrease remains unknown, [7]. In terms of future HEV deployment in Oman, various problems have been identified, one of which is the formation of regulators to monitor the activities entailed by the introduction of HEVs in the nation. One of the most important questions is who will be in charge of implementing and regulating regulations like charging stations, tariff setting, and government registration and requirements, [7].

2.3 Overview of the Conceptual Framework

Social Cognitive Theory emphasizes that relationships between personal behavior, environmental factors, and human behavior may result in a human behavior outcome, [18]. People can learn in a variety of forms, according to Bandura (1986), namely not just through direct experience, but also through interactions and observations. People's behavior is determined by a combination of environmental and personal influences, such as their thought patterns, emotional reactions, and beliefs. As a consequence of these actions, the person's future convictions are likely to be formed, [19]. Overall, this study applies the Social Cognitive Theory, this research examines Omani Social Norms, Perceived Usefulness (as Personal Factors), the Government's Personnel Information Technology IT Competencies, Electric Vehicles System Quality, and the Lack of charging infrastructure (as Technological Factors) as independent variables; with Electric Vehicles in Oman (as dependent variable). Fig. 8 displays the proposed framework.

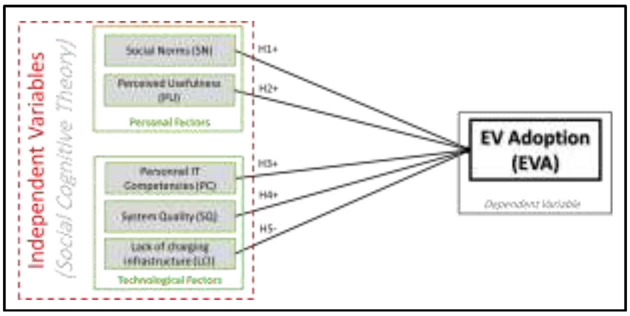

Fig. 8: Proposed Conceptual Framework

Perceived usefulness refers to the degree to which a person believes that using a particular system would enhance his or her job performance, [20].

Social Norms refer to established rules -mostly unspoken- of conduct in a society that the individual members are expected to abide by. Individuals learn them by observing fellow members and following them to obtain the approval of the larger society, [21].

Information Technology Competency: it is the ability to utilize information technology tools to find, use and evaluate the information for a specific purpose, [22].

System Quality is a desirable characteristic of an information system that focuses on the usability and performance of a particular system, [23].

The charging station is an important component for the healthy growth of the electric vehicle industry. A charging station refers to an infrastructure similar to a petrol station (for conventional vehicles) that provides electric energy for the charging of plug-in hybrid electric vehicles (PHEVs). Many charging stations are on-street facilities provided by electric utility companies; mobile charging stations have been recently introduced. From the grid standpoint, a charging station is one way that the operator of an electrical power grid can adapt energy production to energy consumption, both of which can vary randomly over time. EVs in a charging station are charged during times when production exceeds consumption and are discharged at times when consumption exceeds production. In this way, electricity production need is not drastically scaled up and down to meet momentary consumption, which would increase efficiency and lower the cost of energy production and facilitate the use of intermittent energy sources, such as photovoltaic and wind, [24].

Adoption intention: it is the individual's readiness to perform a given behavior. Here readiness to buy mobile services, [25].

3 Research Methods

In this research, the researcher will utilize quantitative research methods. Primary data was collected from employees working for the Oman Royal Police, which is the official body in Oman that is in charge of imposing and facilitating the necessary systems for Electric Vehicles. Therefore, the researcher distributed a total of 30 questionnaires.

4 Instrument Development

The development of instruments was carefully executed to reflect the nature of this research. As such, the questionnaire was designed to include 26 items, and the variables were measured using the five-point Likert scale, with five standing for 'Strongly Agree' and one standing for 'Strongly Disagree'. Since the participants spoke Arabic, the survey needed to be accurately translated from English to Arabic. As a result, a reverse translation was conducted, which is a common method for determining the accuracy of a translation in a cross-cultural survey, [26]. Furthermore, the validated instruments listed in Table 3 were adopted from relevant prior research to measure the variables in this research.

Table 3. Research Instrument

Construct	No of Items	Adapted	Citation
Social Norms	4	SN1: My relatives believe that they should use electric vehicles. SN2: The people who are important to me hotly wish to drive electric vehicles in Oman. SN3: Often my relatives recommend electric vehicles because they respect the environment in Oman. SN4: I have learned from the society in Oman about environmental foreseeable problems which makes electric vehicles the best option to avoid them.	[27], [28]
Perceived Usefulness	4	PU1: I think the smart system of Electric vehicles can improve the traffic services in Oman. PU2: I believe that electric vehicle systems will enrich the research on traffic data in Oman. PU3: I think electric vehicles can the environment in Oman. PU4: I think adopting an electric vehicle system can improve my work efficiency.	[29]
Personnel IT competencies	4	PC1: I know how to use basic digital equipment. PC2: I collaborate in schemes of work or planning, using the use of a technical tool. PC3: I think I am willing to handle different programs to do specific tasks. PC4: I have knowledge of legal and ethical issues regarding systems used in Electric Vehicles.	[28]

System quality	4	SQ1: I believe the Electric Vehicles system will be easy to use in case if adopted in Oman. SQ2: Electric Vehicles' system should be easy to comprehend by all users. SQ3: Electric Vehicles' system should contain necessary features and functions that help us while monitoring. SQ4: The data of the Electric Vehicles' system should be fully integrated and consistent with the traffic system in Oman.	[30]
Lack of charging infrastructure	4	LCI1: When the drivers of Electric Vehicles have access to the charging facilities either at home or university, it would make it easier for Electric Vehicles to be widely adopted by the Omanis. LCI2: The availability of charging units for Electric Vehicles makes it easier for drivers to be satisfied with their decision of driving these vehicles. LCI3: When the drivers have sufficient knowledge about the availability of charging units for Electric Vehicles, it will make the Police's work much easier. LCI4: When drivers experience any difficulties in accessing the charging units, they may refrain from using Electric Vehicles.	[31], [32]
EVs Adoption	6	EVA1: I think the Omani people would consider vehicle emissions when they plan to purchase a car. EVA2: It can be anticipated that the staff of Oman Royal Police have a positive attitude towards electric vehicle adoption in their guidelines and policies. EVA3: Compared to traditional cars, an electric vehicle is similar in performance. EVA4: Compared to traditional cars, an electric vehicle is cheaper over the long term. EVA5: I (might) have more mechanical problems with an electric vehicle than with traditional cars. EVA6: I would prefer to drive a traditional car to an electric vehicle.	[33]

5 Results and Analysis

The pilot study is always conducted before the data collection. Saunders, Lewis, and Thornhill (2016) assure the usefulness of carrying out a pilot study before collecting the data. It will provide great help by giving the researcher an index to correct any inadequacies in the research instrument before the data collection, [34], [35]. In this study, first, the researcher will demonstrate the descriptive statistics of the respondents (respondent profile), followed by the reliability and validity tests for the pilot study.

5.1 Respondent Profile

The first segment of the instrument compiled information on the background profile of the respondents which comprises their Gender, Age, Level of employment, and Level of Education. The characteristics of each demographic profile are described below in Table 4.

Table 4. Respondent Profile (Frequencies)

Item	Choice	Frequencies (Percentage)
Gender	Male	17 (56.6)
	Female	13 (43.3)
Age (in years)	20-25 years	11 (36.6)
	26-35 years	8 (26.6
	36-45 years	5 (16.6)
	46-55 years	4 (13.3)
	56 years and above	2 (6.6)
Level of employment	Executive Employee	14 (46.6)
	Head of the department	9 (30.0)
	Middle management	4 (13.3)
	Head of division	2 (6.6)
	Top management	1 (3.3)
Level of education	University degree	21 (70)
	Master	7 (23.3)
	PhD	2 (6.6)

5.2 Reliability of the Scale

The reliability of the instrument will be tested in this study; as a prior literature review was the source of the questions. At the same time, Cronbach alpha will be conducted on a sample of 30 participants to make sure that the instrument is valid and reliable. Hair et al. (2019) highlighted that a cut-off point of 0.6 is required during the pilot test level to consider the research instrument is reliable with a valid internal consistency, on which any value below 0.7 is considered poor and unacceptable, while the value of Cronbach Alpha above 0.7 is considered as good and acceptable, above 0.8 is excellent, and above 0.9 will be considered perfect, [36].

In this study, all of the constructs achieved a satisfactory level of reliability. Table 5 is illustrating the results of the reliability of the scale of the current study. The scores of the Cronbach Alpha were acceptable and above 0.7 for the constructs of Social Norms and Lack of charging infrastructure (0.705 and 0.779 respectively) and excellent for the constructs of Perceived Usefulness, Personnel IT Competencies, System Quality, and Electric Vehicle Adoption (0.898, 0.800, 0.876, and 0.885 respectively).

Table 5. Results of Scale Reliability

Reliability Statistics		
Constructs	Cronbach's Alpha	N of Items
SN	0.705	4
PU	0.898	4
PC	0.800	4
SQ	0.876	4
LCI	0.779	4
EVA	0.885	6

5.3 Validity of the Research Model

Criterion-related validity reflects the success of measures used for prediction or estimation. To achieve the validity of the research model, the researcher will utilize Pearson Bivariate Correlation using SPSS 28.0, [37]. The Pearson correlation coefficient is a standardized measure of covariance. Covariance coefficients retain information about the absolute scale ranges so that the strength of association for scales of different possible values cannot be compared directly. Researchers find the correlation coefficient useful because they can compare two correlations without regard for the amount of variance exhibited by each variable separately, [38]. According to Pallant (2016), the Sig. value, which is less than 0.05 in the correlation test means there is a relationship between the two variables, and statistically shows a significant unique contribution to the equation, [39]. Table 6 shows the value of Pearson Bivariate Correlation alongside the significance of the association between the variables, which highlights the validity of the research model of the current study.

Table 6. Pearson Bivariate Correlation Results

Correlations		
Constructs	Pearson Correlation	P-value
SN	.552	0.000
PU	.626	0.000
PC	.680	0.000
SQ	.700	0.000
LCI	.508	0.000
Dependent Variable: EVA		

6 Discussions

This study aims to propose a conceptual framework that links the Personal and Technological Factors with Electric Vehicle (EV) adoption in Oman and to test the validity and reliability of the research model. Based on the Social Cognitive Theory, the framework contained Omani Social Norms, Perceived Usefulness (as Personal Factors), the Government’s Personnel Information Technology IT Competencies, Electric Vehicles System Quality, and the Lack of charging infrastructure (as Technological Factors) as independent variables; with Electric Vehicles in Oman (as dependent variable). The statistical data analysis was carried out using SPSS and revealed that all of the constructs in this research have achieved a satisfactory level of scale reliability using the Cronbach Alpha scores. In addition, the results of the Pearson Correlation showed a significant level of validity.

The findings of this study were inconsistent with the published literature. Charters and Heffernan (2021) proposed a conceptual model that identifies and incorporates the factors affecting owners' attitudes toward PV adoption to solve the existing paucity of solar photovoltaic (PV) adoption by Australian apartment residents. The model depicts the steps that an apartment owner may take to get from investigating solar PV adoption to advocating it to their strata property's Owners' Committee. In decision-making and social connections and status, it contains three motivating drivers (pragmatic concerns, perceived values, and perceived social norms), [40]. In addition, Jaiswal et al. (2022) published research that looked at the importance of electric vehicle knowledge in predicting customer adoption intentions both directly and indirectly in the context of a developing market. The findings support the current study model, which reveals that electric vehicle knowledge, perceived utility, perceived ease of use, and perceived risk all play a role in customer adoption, [41]. Furthermore, Ngo et al. (2014) published research that looked at the relationship between HRM competencies and the adoption of high-performance work systems (HPWS). HRM competency has a significant and positive impact on business success, according to the findings. The accomplishment of external fit, but not the adoption of HPWS, is shown to mediate this impact, [42]. the goal of this research is to propose interaction quality as an extra, but a more relevant quality metric that leads to trust in and adoption of an AI-based VAS. The findings imply that the quality of interactions and trust are important factors in the adoption of AI-based VASs. In the context of AI-based VASs, the results also show that traditional quality factors (i.e. system quality) influence interaction quality, [43]. Kumar et al. (2021) also investigated a vehicle supply chain and proposed several charging infrastructure development modes that impact EV adoption. The data revealed that investing in charging infrastructure as well as providing a subsidy for EV purchases are both successful in increasing EV demand, market share, and adoption, [44].

7 Limitations and Future Recommendations

This research was surrounded by many limitations. The current study collected data from only 30 respondents, which is enough for the pilot study. However, this sample size can be increased in future research to achieve empirical results. In addition, the sample of the current study was limited only to the personnel working for the Oman Royal Police, which is the official body in Oman that is in charge of imposing and facilitating the necessary systems for Electric Vehicles. Therefore, surveying other affiliated institutions in Oman like the Ministry of Economy and Ministry of interior affairs. This study was conducted only to show the reliability and validity of the conceptual framework using Cronbach Alpha scores and Pearson Correlation. This study has a lot of potentials, and many of them could be addressed here to make sure that future researchers are aware of them. For instance; focusing on models of other Social Cognitive Theories, like technology adoption or Diffusion of innovation among the personnel working for the Oman Royal Police with systematic selection would generate different types of results on the factors that affect EV adoption. Moreover, an empirical study that considers both the measurement and structural model may be the perfect completion of the current study results. In this study, System Quality was considered as the independent variable while a good sum of studies focused on the dimensions of system quality as independent variables, it is recommended that future studies may consider Service or System Quality and associate them with EV adoption in a holistic study.

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