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Investigating the Impact of Key Factors on Electric/Electric-Vehicle Charging Station Adoption in Indonesia

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ABSTRACT

The transportation sector is a major contributor to carbon dioxide emissions, and the adoption of electric vehicles (EVs) is seen as a solution to reduce this impact. However, the utilization of electric charging stations (ECS) and EV charging stations (EVCS) in Indonesia is not optimal, as evidenced by low usage levels. This study aimed to understand the characteristics of ECS and EVCS users in Indonesia in order to identify determinant factors for ECS and EVCS utilization. Using descriptive quantitative analysis, exploratory factor analysis, and binary logistic regression, the study found that potential EVCS users are adults from upper-middle-class backgrounds, with four family members, who own a motorcycle and live in suburban areas. Furthermore, a wide social network, knowledge of technology, and ease of access, convenience, and price were identified as key factors for choosing ECS/EVCS. However, an attitude of caring for the environment had a negative effect on ECS/EVCS usage, and respondents who charge their electronic devices at home overnight were less likely to use ECS/EVCS. The study also found that the number of sockets in a respondent's home, previous family members' experience, and duration of work experience and self-identity were also reasons for choosing to use ECS/EVCS. Overall, this study provides a deeper understanding of the factors that influence the utilization of ECS and EVCS in Indonesia.

Keywords: Electric Charging Stations, Electric Vehicle Charging Stations, Consumer Behavior, Exploratory Factor Analysis, Binary Logit Regression

JEL Classifications: C01, C83, Q4

1. INTRODUCTION

Carbon dioxide (CO_2) emissions are a significant contributor to global warming, with the transportation sector being one of the major sources. According to the International Energy Agency (IEA), global CO_2 emissions reached 35,153.3 $MtCO_2$ in 2018 and have increased by nearly 31% over the past 9 years (IEA 2020). Fossil fuels such as coal and petroleum are major contributors to these emissions, accounting for 42% and 32% of global CO_2 emissions in 2018, respectively. Indonesia, as a country that contributes to these emissions, has committed to participate in global warming mitigation efforts and has pledged to reduce 29% of its greenhouse gas emissions by 2030, including emissions from the transportation sector (DEN 2019).

On the other hand, the number of vehicles in Indonesia continues to rise, with two-wheeled vehicles accounting for 81.7% of the total vehicle population in 2018 (BPS 2019). This increase in vehicles on the road has led to a need for mitigation strategies in the transportation sector, as it is a major contributor to greenhouse gas emissions due to high energy consumption and fuel consumption, which is primarily gasoline or diesel (DEN 2019; Javid et al., 2019; Sidabutar 2020).To address this issue, several countries have turned to electric vehicles as a means of reducing emissions intensively (Knobloch et al., 2020; Kumara and Sukerayasa 2009). Similarly, Indonesia has also begun to develop its electric vehicle ecosystem by implementing regulations related to the Acceleration of the Battery Electric Vehicle Program for Road Transportation (CNN 2020; Perpres 2019). This move has been well-received by the public, as evidenced by the 2,278 units of electric vehicles, both motorcycles and cars, that have obtained the Type Test Registration Certification (SRUT). The number of electric vehicle users is expected to continue to increase in the future, with the Indonesian government aiming to have 2.13 million electric motorcycles and 2,200 electric cars by 2025 (ESDM 2020; ESDM 2021).

In line with the Electric Vehicle acceleration program, several major cities in Indonesia have already installed Electric Charging Stations (ECS) and Electric Vehicle Charging Stations (EVCS) such as Jakarta, Surabaya, Semarang, Bali, and Bandung. These stations are known as Stasiun Penyedia Listrik Umum (SPLU) and Stasiun Pengisian Kendaraan Listrik Umum (SPKLU) respectively. ECS are electric charging stations that can be utilized by micro-entrepreneurs, bicycle users, and electric motorbike owners, while EVCS are specifically designed for charging electric vehicles. The development of ECS and EVCS aims to make it easier for people to access electricity for their vehicles and other electronic devices. In recent years, investment in the construction of ECS and EVCS in Indonesia has been increasing. However, a problem that needs to be addressed is whether this investment is beneficial for both investors and users.

Field observations indicate that the development of ECS and EVCS infrastructure has not been effective. The low number of visitors utilizing ECS and EVCS and a small number of electric vehicle users suggest that the deployment of these facilities has not been successful. Additionally, it has been observed that the majority of ECS visitors are street vendors who use the ECS as a source of electricity for lighting and production tools. According to evaluations, the percentage of ECS usage in Jakarta, where the highest number of ECS are located, was only 39.23% in September 2020, and the usage rate is even lower in areas with fewer ECS. Furthermore, the adoption of electric vehicles is crucial for optimizing the utilization of ECS and EVCS, as the availability of charging infrastructure is a key factor in encouraging EV adoption (Javid et al., 2019). To increase utilization and optimize the establishment of ECS and EVCS, it is essential to ensure that these facilities also provide substantial benefits to the public (Greene et al., 2020).

In order to improve the effectiveness of ECS and EVCS deployment, it is necessary to understand the preferences and behaviors of customers who use or have the potential to use these facilities. Studies on the factors and reasons that influence consumer adoption of electric vehicles and use of ECS/EVCS have been conducted in various countries, including China (Habich-sobiegalla et al., 2018; Ji et al., 2020; Chu et al., 2019; Wang et al., 2018), Nordic countries (Chen et al., 2020; Sovacool et al., 2018), Brazil (Habich-sobiegalla et al., 2018), Russia (Habich-sobiegalla et al., 2018), England (Skippon and Garwood, 2011), Europe (Neves et al., 2019; Plötz and Funke, 2017; Mukherjee and Ryan, 2020), USA (Javid et al., 2019; Greene et al., 2020; Vergis and Chen, 2015), and South Korea (Chu et al., 2019; Kim and Heo, 2019; Kim et al., 2019). In Indonesia, several studies on electric vehicles have also been conducted. Guerra (2017) conducted research on the public's desire to adopt electric motorcycles in Solo, Indonesia. However, this study only examined one city and analyzed electric vehicles before the Electric Vehicle Charging Infrastructure (EVCI) was built. To date, there has been no study that analyzes the utilization of ECS and EVCS in multiple major cities in Indonesia such as Jakarta, Tangerang, Bandung, Semarang, Surabaya, and Bali. Thus, this study aims to fill this gap by examining the characteristics and profile of ECS and EVCS users in Indonesia's electricity market.

The research structure of this study is divided into five main chapters. Chapter 1 is the introduction, which explains the background, problem statement, research objectives, and research questions. Chapter 2 provides a literature review of previous studies and theories related to the use of ECS/EVCS and consumer behavior. In addition, it also explains the data collection method and the research design used in the study. Chapter 3 presents the results of the research, including the characteristics of ECS/EVCS users, reasons for using ECS/EVCS, and factors that influence the use of ECS/EVCS. Chapter 4 discusses the results of the research, including the comparison of the results with previous studies and the implications of the results for the development of electric vehicles and charging infrastructure in Indonesia. Finally, Chapter 5 provides the conclusion of the study, highlighting the main findings and contributions of the research as well as suggestions for further research.

2. LITERATURE REVIEW AND METHOD

2.1. Literature Review

The theory of consumer behavior is closely related to understanding the characteristics of ECS/EVCS users. It posits that consumers make decisions based on their preferences and the perceived utility of different options. According to the theory, consumer preferences have three basic properties: completeness, transitivity, and continuity (Nicholson and Synder 2017). Consumers strive to meet their needs by considering their preferences and budget constraints. The theory suggests that increasing consumer preferences will lead to an increase in perceived utility, while budget constraints are a major factor that influences consumer decision-making. Consumers are unable to consume goods or services that exceed their budget limit (Nicholson and Synder, 2017).

In addition, the theory of consumer behavior can also be explained through the theory of lifestyle, as studied by Axsen et al. (2018). Lifestyle theory suggests that consumers' identities are reflected in their consumption choices. The lifestyle theory can explain how consumers view Plug-in Electric Vehicle (PEV) technology and public charging infrastructure from different perspectives. For instance, a consumer who prioritizes environmental sustainability may view the use of PEVs and charging infrastructure as a means to reduce the number of vehicles on the road, thus benefiting the environment. On the other hand, a consumer with a technology-oriented lifestyle may view the use of PEVs and charging infrastructure as a way to access the latest technology, and may be more interested in controlled charging programs that can improve the efficiency of the grid (Axsen et al., 2018).

The lifestyle segmentation expressed in the study (Axsen et al., 2018) has a close relationship with the consumers motivation in charging electric vehicles on power charging infrastructure. Individuals who support eco-friendly technology encourage power charging in public infrastructure, which can serve as an example to encourage others to adopt electric vehicles. Simultaneously, individuals who prefer technology advancement have the consumer motivation that consists of the ease, comfort, and practicality of the charging process.

In recent years, electric vehicles have become an increasingly important topic of research. Many studies have focused on understanding the demand for electric vehicle charging and the implementation of charging infrastructure for electric vehicles. The availability of a suitable charging infrastructure network is considered a crucial factor in encouraging greater adoption of electric vehicles for daily use. (Javid et al., 2019; Greene et al., 2020; Habich-sobiegalla et al., 2018; Chen et al., 2020; Neves et al., 2019; Vergis and Chen, 2015; Guerra 2017; Sierzchula et al., 2014).

Charging opportunities for electric vehicles are closely tied to the travel patterns of their owners. Strategic locations for electric vehicle charging include: (1) within or near the home, (2) workplaces or other common travel destinations, (3) publicly accessible locations such as grocery stores and shopping centers, and (4) rest stops along major travel corridors for long-distance trips (Ji et al., 2020; Idaho National Laboratory, 2015; Nicholas and Tal, 2013; Tal et al., 2020).

Access to home charging is the most significant factor in encouraging consumers to purchase a Plug-in Electric Vehicle (PEV) (Skippon and Garwood, 2011; Plötz and Funke, 2017; Bailey et al., 2015; Dunckley, 2016). Home charging includes both private and public charging points in residential areas. The next most commonly used charging points after home charging are workplaces or other common travel destinations (Skippon and Garwood, 2011; Nicholas and Tal, 2013; Björnsson and Karlsson, 2015).

The electricity consumption from *ECS/EVCS* utilization can also be improved by increasing the number of electric vehicles. Some research states that household characteristics are significant to the adoption of the electric vehicle. The number of household electric vehicles (Javid et al., 2019; Kim et al., 2019), living in the sub-urban area (Mukherjee and Ryan, 2020), the number of children (Chen et al., 2020), and households with higher income levels can significantly encourage a household to adopt electric vehicles (Habich-sobiegalla et al., 2018; Chen et al., 2020; Sovacool et al., 2018; Mukherjee and Ryan, 2020).

Individual factors such as gender (Javid et al., 2019; Chen et al., 2020; Sovacool et al., 2018), education level (Habich-sobiegalla et al., 2018; Sovacool et al., 2018; Mukherjee and Ryan, 2020; Vergis and Chen, 2015; Kim and Heo, 2019), and age have a positive effect on individual decisions (Chen et al., 2020; Mukherjee and Ryan, 2020). A detailed study from Sovacool explains that men with higher education and between 30 and 45-years-old, and women with higher income and who have retired, are more likely to use electric vehicles (Sovacool et al., 2018). Also, the wide social network is a psychological factor that influences the electric vehicle adoption decision. Individual awareness of the environment also affects the electric vehicle adoption decision (Habich-sobiegalla et al., 2018; Chu et al., 2019; Wang et al., 2018; Chen et al., 2020).

2.2. Data

This study used both primary and secondary data sources. Primary data was collected through questionnaires and interviews. Surveys were conducted in areas where ECS/EVCS facilities were already available, specifically in Jakarta, Tangerang, Bandung, Semarang, Surabaya, and Bali, with a total of 357 respondents over a 2-month period from October to November 2019. The respondents consisted of 126 existing ECS/EVCS users and 231 potential ECS/EVCS users. Secondary data was obtained from company reports and research documents related to ECS/EVCS from the state-owned power company Perusahaan Listrik Negara (PLN).

Ach respondent will be asked about their socio-demographic characteristics, such as age, gender, distance from their residence to the city center, number of family members, income, number of vehicles per household, educational background, power rating groups of household, environmental concern and social activity. Additionally, respondents will be asked about their reasons for choosing ECS/EVCS for charging their electric vehicles or obtaining electricity, using a Likert scale ranging from 1 to 4.

2.3. Research Method

This study employs a combination of descriptive quantitative analysis, exploratory factor analysis, and binary logistic regression to analyze consumer behavior and identify the characteristics of ECS/EVCS users. Descriptive quantitative analysis is used to examine the average scores of the respondents' answers to questions about their socio-demographic characteristics and reasons for using ECS/EVCS for charging or obtaining electricity (Sierzchula et al., 2014; Foley et al., 2020). The results of these analyses are further validated through interviews with the respondents, providing an in-depth understanding of the condition of ECS/EVCS in the field.

In addition to descriptive analysis, this study employs exploratory factor analysis (EFA) to reduce the data set and identify the underlying factors (Field, 2007). The factor extraction method used is Principal Component Analysis (PCA) with Varimax factor rotation, which allows for clear interpretation of the factor structure by optimizing the grouping of indicators on one factor. The number of factors is determined using the scree cut-off points (Cattell, 1966) and Kaiser rule, by extracting factors with eigenvalues >1 (Kaiser, 1960). The suitability of the data for factor analysis is determined using the Kaiser-Meyer-Olkin (KMO) criteria. Kaiser recommends a cut-off value of 0.50 and a value of 0.8 or higher to proceed with factor analysis (Kaiser, 1970).

Before conducting the binary logistic regression test, both validity and reliability tests are conducted. To test the validity of the items, the Pearson Correlation Product Moment test is used. In this test, the correlation between each item and the total score of the variable in question is examined. If the 2-Tailed significance is less than

0.05, the items are considered highly correlated and deemed valid. To test the reliability of the items, the Alpha Cronbach test is performed. If the Cronbach Alpha value is >0.6, the questionnaire items are considered reliable.

After being grouped into several factors, this study then employs binary logistic regression for quantitative analysis. In this regression analysis, the dependent variable is a binary representation of the choice between using ECS/EVCS or not

Table 1: Descriptive analysis of overall respondents

Variables	(2) Mean	(3) SD	(4) Min	(5) Max	Variables	Code Response	%
					ECS	1=existing	35.29
Age	36.39	12.34	11	80		0=potential	64.71
Range	7.920	6.596	2.50	22.50	Gender	1=male	78.71
Bike	0.532	0.869	0	5		0=female	21.29
Motbike	1.613	1.069	0	5	Last_edu	1=High School Grad	59.94
Car	0.289	0.625	0	6		0=Not High School Grad	40.06
Fammemb	4.204	1.488	1	11	Electric	1=R-1	96.36
Income	5,717	5,478	300	65,000		0=Not R-1	3.64
					Env_act	1=Active	33.61
						0=Not Active	66.39
					Social_act	1=Active	18.21
						0=Not Active	81.79

Description Age: Age of Respondents, Range: Distance of Respondent's Residence to The City Center, Bike: Number of bikes owned by respondents, Motbike: Number of motorcycles owned by respondents, Car: Number of cars owned by respondents, Fammemb: Number of respondents' family members, Income: Total respondents' income per month, ECS: User ECS/EVCS (Potential and existing), Gender: Gender of respondents (Male and female), Last_edu: Respondents' last level of education (High school graduation and non-high school graduation), Electric: Respondents' electric power class (R-1 [450-2200 VA] and not R-1 [450-2200 VA]), Env_act: Activeness in environmental action, Social_act: Activeness in social action

Table 2: Reasons to use ECS/EVCS

S. No.	Statement	Totally Disagree (%)	Disagree (%)	Agree (%)	Strongly Agree (%)	Mean
1.	It is easier to charge electric vehicles or electronic devices anytime, anywhere easily.	1.59	4.76	70.63	23.02	3.15
2.	It is easier for me to charge an electric vehicle or electronic device anytime, anywhere, comfortably.	1.59	5.56	73.02	19.84	3.11
3.	Because I know information about how to operate ECS/EVCS	3.17	8.73	80.95	7.14	2.92
4.	I am a flexible person, can charge electric vehicles or electronic devices at home or in ECS or EVCS, depending on the time and opportunity I have	1.59	19.05	65.87	13.49	2.91
5.	It fits my budget	0.79	16.67	74.60	7.94	2.90
6.	It adjusts to the economic situation	0.79	16.67	75.40	7.14	2.89
7.	There is insufficient electricity in my house, especially if it is used for other activities	00.00	21.43	69.84	8.73	2.87
8.	It is easy to find in my area	1.59	16.67	77.78	3.97	2.84
9.	It can reflect my work	0.00	26.98	62.70	10.32	2.83
10.	In the surrounding of my environment, it is common to use it	2.38	19.05	71.43	7.14	2.83
11.	It is practical and easy to find	3.97	15.08	76.19	4.76	2.82
12.	I have no time or forgot to charge the battery at home	0.79	23.02	71.43	4.76	2.80
13.	I usually charge the battery while doing other activities	0.00	30.16	61.11	8.73	2.79
14.	I usually charge the battery at night while sleeping	2.38	26.19	61.11	10.32	2.79
15.	Because of a friend's influence	0.79	23.81	71.43	3.97	2.79
16.	It reflects my identity	0.00	31.75	60.32	7.94	2.76
17.	Confidence when using ECS (EVCS)	0.00	34.13	56.35	9.52	2.75
18.	The number of power plugs in my house is limited	0.79	30.95	61.11	7.14	2.75
19.	I have often used this product as the main choice	2.38	29.37	58.73	9.52	2.75
20.	It reflects the duration of my work experience	0.79	32.54	58.73	7.94	2.74
21.	Considering the current popular technology	0.00	34.92	57.14	7.94	2.73
22.	It reflects the culture in my neighborhood	0.00	36.51	56.35	7.14	2.71
23.	the location of ECS (EVCS) is around my workplace	00.00	34.92	59.52	5.56	2.71
24.	Because my role and status influence it in society	0.79	33.33	61.11	4.76	2.70
25.	It suits my age	0.79	32.54	63.49	3.17	2.69
26.	My social environment influences it	0.79	33.33	62.70	3.17	2.68
27.	It reflects my lifestyle	1.59	39.68	50.00	8.73	2.66
28.	Because in accordance with the life of modern society	0.00	42.06	54.76	3.17	2.61
29.	Because it follows the current trend	1.59	42.86	50.79	4.76	2.59
30.	Because of the previous experience of family members	0.79	47.62	46.83	4.76	2.56
31.	Because it has become a principle of my lifestyle	3.97	38.89	54.76	2.38	2.56
32.	Because it was influenced by my family who used the product	1.59	45.24	51.59	1.59	2.53
33.	Because of the perception of advertising	4.76	45.24	48.41	1.59	2.47

using ECS/EVCS, where if the respondent is active, they are given a value of 1, and if not, they are given a value of 0. The factors affecting the dependent variable in this logistic regression are assumed based on the exploratory factor analysis of the reasons for using ECS/EVCS.

3. RESULTS

3.1. User Characteristics of ECS/EVCS

This study's sample was collected from various locations including Bali, Bandung, Jakarta, Tangerang, Semarang, and Surabaya. Respondents from Jakarta and Tangerang made up the largest percentage of the sample at 61.1%, or 218 respondents. Bali had the second-highest percentage of respondents at 15.4%, or 55 respondents. The least number of respondents came from Surabaya, accounting for only 4.48% or 16 respondents. The high utilization of ECS/EVCS in Jakarta and Tangerang is likely a result of the presence of online car share services, such as Grab, that have already implemented electric car fleets in these cities. Additionally, the investment of one of the largest taxi companies in Indonesia, Blue Bird, in electric vehicles also contributes to the high utilization. Furthermore, the ECS in these areas are not only utilized by electric vehicle users, but also by small and micro-entrepreneurs for lighting and production purposes, as well as by local communities for public events. This highlights the multifaceted nature of ECS/EVCS usage in these regions.

Table 1 presents a statistical summary of the 357 ECS/EVCS respondents who participated in the survey. The survey results indicate that the average age of respondents is 36 years, with the youngest participant being 11-years-old and the oldest participant being 80-years-old. The respondents had an average distance of 7.9 km from their residence to the city center, with the closest distance being 2.5 km and the farthest distance being 22.5 km. On average, the respondents owned one motorcycle and did not own a bicycle or car. Additionally, the respondents had an average of four family members.

The respondents in this study consist of both potential customers and existing customers, with a proportion of 64.71% and 35.29%, respectively. The majority of the respondents were male, accounting for 78.71%, while female respondents made up the remaining 21.29%. In terms of educational level, the majority of the respondents had completed high school (59.94%), followed by non-high school graduates (40.06%). The electrical power class variable was dominated by respondents who had R-1 power (450-2200 VA), accounting for 96.36%. Regarding involvement in environmental and social actions, the results indicate that a majority of the respondents were inactive in these actions, with 66.39% of respondents being inactive in environmental actions and 81.79% being inactive in social actions.

Table 3: Factors and items of reason to use ECS/EVCS

Factor	Item Based on Table 2
Factor 1 Personal and Cultural	1. Because according to the age of my work; 2. Because it can reflect my work; 3. Because it reflects my identity; 4. Because my role and status influence it in society; 5. Because it reflects the culture in my neighborhood; 6. Because it suits my age; 7. Because adjusting my budget; 8. Because considering the current popular technology; 9. Because it adjusts to the economic situation; 10. Because my social environment influences it; 11. Because of confidence when using *ECS* (*EVCS*); 12. Because it follows the current trend; 13. Because it has become a principle of my lifestyle; 14. Because of a friend's influence; 15. Because it has often used the product as the main choice; 16. Because of knowing the information about how to operate *ECS/EVCS*; 17. Because it reflects my lifestyle; and 18. Because in accordance to the life of modern society
Factor 2 Availability of Facilities and Infrastructure	1. Because the number of power plugs in my house is limited; 2. Because there is insufficient electricity in my house, especially if it is used for other activities; 3. Because the location of *ECS* (*EVCS*) is around my workplace; 4. Because I usually charge the battery while doing other activities; 5. Because I have no time or forgot to charge the battery at home
Factor 3 Ease of Access	1. Because it is practical and easy to find; 2. Because it is easy to find in my area; 3. Because, in the surrounding of my environment, it is common to use it
Factor 4 Environment	1. Because of the previous experience of family members; 2. Because it was influenced by my family who used the product; 3. Because I usually charge the battery at night while sleeping; 4. Because of the perception of advertising
Factor 5 Flexibility	1. Because I find it easier to charge my electronic devices (electric vehicle batteries) anytime, anywhere, comfortably; 2. Because I become easier to charge my electronic devices (electric vehicle batteries) anytime anywhere easily; 3. Because I am a flexible person. I can charge my electronic device (electric vehicle) at home or in the *ECS/EVCS*, depending on the time and opportunity I have

3.2. Reasons to Use ECS/EVCS

The results of the survey conducted on all respondents, both current users and potential users of ECS/EVCS, indicate the reasons for their utilization of these facilities. As presented in Table 2, the top five reasons for using or considering the use of ECS/EVCS are ease of access (mean value of 3.15), location comfort (mean value of 3.11), knowledge of how to use the facility (mean value of 2.92), budget considerations (mean value of 2.91), and flexibility of time and opportunity to charge their electric vehicles or other electronics (mean value of 2.90). Conversely, the reasons that have the least impact on the respondents' decision to use or consider the use of ECS/EVCS include perception from advertisements, family

Table 4: Validity test results

Correlations	Personal and cultural	Availability of facilities and infrastructure	Ease of access	Environment	Flexibility	Total
Personal and Cultural						
Pearson Correlation	1	0.645**	0.725**	0.724**	0.335**	0.970**
Sig. (2-tailed)		0.000	0.000	0.000	0.000	0.000
N	257	257	257	257	257	257
Availability of Facilities and Infrastructure						
Pearson Correlation	0.645**	1	0.568**	0.475**	0.406**	0.759**
Sig. (2-tailed)	0.000		0.000	0.000	0.000	0.000
N	257	257	257	257	257	257
Ease of Access						
Pearson Correlation	0.725**	0.568**	1	0.624**	0.219**	0.788**
Sig. (2-tailed)	0.000	0.000		0.000	0.000	0.000
N	257	257	257	257	257	257
Environment						
Pearson Correlation	0.724**	0.475**	0.624**	1	0.286**	0.793**
Sig. (2-tailed)	0.000	0.000	0.000		0.000	0.000
N	257	257	257	257	257	257
Flexibility						
Pearson Correlation	0.335**	0.406**	0.219**	0.286**	1	0.448**
Sig. (2-tailed)	0.000	0.000	0.000	0.000		0.000
N	257	257	257	257	257	257
Total						
Pearson Correlation	0.970**	0.759**	0.788**	0.793**	0.448**	1
Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000	
N	257	257	257	257	257	257

**Correlation is significant at the 0.01 level (2-tailed)

Table 5: Reliability test results

Reliability statistics		
Cronbach's alpha	Cronbach's alpha based on standardized items	No. of Items
0.654	0.834	5

influence, alignment with lifestyle principles, previous family experiences, and following current trends, with mean values of 2.47, 2.53, 2.56, 2.56, and 2.59 respectively.

To further analyze the results of the survey presented above, this study also employs exploratory factor analysis to compress all 33 reasons into five factors that represent the reasons for using ECS/EVCS. The factors are named based on the grouping of indicators indicated by the loading factor of each indicator. In this study, the five factors are (1) Personal and cultural influences, (2) Availability of facilities and infrastructure, (3) Convenience and accessibility, (4) Environmental considerations, and (5) Flexibility of usage. The item loading of these factors and communality values (h2) for each item, as well as the total variance, are stated in Table 3.

Based on the results of the exploratory factor analysis, several factors have been identified as reasons for using ECS/EVCS. The first factor, known as the "Environmental and Cultural Factor," encompasses the impact of the immediate environment and culture on an individual's decision to use ECS/EVCS facilities. The highest loading value within this factor is attributed to factors such as work experience and self-identity, while items with lower loading values include the sufficiency of information on how to operate ECS/EVCS.

The second factor represents the reasons why people prefer to charge electronic devices at ECS/EVCS facilities rather than at home. The two highest loading items on this factor include the limited number of sockets in the house and insufficient electrical power. The lowest loading item is forgetting or not having time to charge the battery at home. The third factor illustrates the practical perception and accessibility of ECS/EVCS facilities. This factor is reinforced by respondents who mostly come from major cities in Indonesia that have already provided such facilities. The fourth factor is the reasons that influenced by the previous family experience and the influence of family members who have used ECS/EVCS facilities and refer it to someone to participate in using the facility. The lowest loading item on this factor is perception from advertisement. The fifth factor illustrates the flexibility of using ECS/EVCS, such as charging the battery anytime and anywhere comfortably and efficiently. After being grouped into five factors, the study then used quantitative analysis with binary logistic regression.

However, prior to conducting the quantitative analysis using binary logistic regression, a validity and reliability test is conducted on the reasons for using ECS/EVCS. The results of these tests are presented in Tables 4 and 5. The validity test, using the Pearson Correlation Product Moment method, ensures that each item of the survey is highly correlated with the total score of the variable in question. The reliability test, using the Alpha Cronbach method, ensures that the questionnaire items are consistent and reliable. These tests are essential to ensure the accuracy and validity of the data used in the analysis.

Table 6 presents the results of the logistic regression analysis between personal and cultural, availability of facilities and infrastructure, ease of access, environment, and flexibility factors and the decision to use or not use ECS/EVCS. The results indicate

Table 6: Logistic regression test results

Variables in the Equation								
Step 1a	B	S.E.	Wald	df	Sig.	Exp (B)	95% C.I. for EXP (B)	
							Lower	Upper
Personal and Cultural	0.079	0.032	6.308	1	0.012	1.082	1.018	1.151
Availability of Facilities and Infrastructure	−0.026	0.078	0.111	1	0.739	0.974	0.835	1.136
Ease of Access	0.314	0.145	4.687	1	0.030	1.369	1.030	1.821
Environment	−0.317	0.109	8.466	1	0.004	0.728	0.588	0.902
Flexibility	−0.117	0.118	0.988	1	0.320	0.889	0.705	1.121
Constant	−2.312	1.186	3.804	1	0.051	0.099		

[a]Variable (s) entered on step 1: Personal and Cultural, Availability of Facilities and Infrastructure, Ease of Access, Environment, and Flexibility

that personal and cultural variables (P = 0.012; β = 0.079), ease of access (P = 0.030; β = 0.314) and environment (P = 0.04; β = −0.317) have a significant influence on the decision to use ECS/EVCS, as they have a P-value less than the significant level (α) of 0.05. However, the variables of availability of facilities and infrastructure (P = 0.739; β = −0.026) and flexibility (P = 0.320; β = −0.117) do not have a significant effect on the decision to use ECS/EVCS.

The results of the logistic regression analysis indicate that individuals who possess a favorable profile in terms of their use of technology, age, and employment, have a higher likelihood of utilizing Electric Charging Stations (ECS) and Electric Vehicle Charging Stations (EVCS). The data suggests that ECS/EVCS are currently being utilized by individuals who are tech-savvy, with an average age of 37 years, and who have a large social network that can influence their decision-making. Additionally, the ease of access to ECS/EVCS facilities in one's vicinity also plays a significant role in determining the likelihood of utilization. This can be attributed to the fact that individuals who are comfortable with technology are more likely to easily operate ECS/EVCS. However, it should be noted that the positive effect of these factors is not mirrored in the environmental factor. The analysis reveals that the more information or experience an individual has with ECS/EVCS through their family members, the less likely they are to use these facilities. This may be because individuals tend to trust the opinions of their peers who share similar age and lifestyle characteristics, over those of their family members. Furthermore, an individual who frequently charges electronic devices at home overnight may be less inclined to utilize ECS/EVCS.

4. DISCUSSION

The results of this study also support the theory that the use of ECS/EVCS is influenced by personal and cultural factors, as well as ease of access and the environment. In particular, the logistic regression analysis shows that personal and cultural factors, ease of access, and the environment have a significant influence on the decision to use ECS/EVCS, while the availability of facilities and infrastructure and flexibility do not have a significant effect. This suggests that individuals who have a positive perception of technology, are more likely to understand and easily operate ECS/EVCS, and have a more environmentally conscious mindset, are more likely to make use of these facilities. In contrast, those who have less experience or information about ECS/EVCS, or who have less environmentally-conscious mindset, are less likely to use these facilities. Overall, the results of this study provide important insights into the factors that influence the use of ECS/EVCS and can inform the development of strategies to promote the adoption of these facilities among consumers (Kim et al., 2019).

Consumers make decisions based on their preferences and budget limitations. These preferences ultimately increase the level of utility for the consumer. However, these preferences may also be influenced by budget constraints. Budget constraints serve as a fundamental consideration for consumers when making decisions. They cannot consume goods beyond their budget limit. Due to the high cost of charging at ECS/EVCS stations, many customers opt to charge overnight at home. In addition to preferences and utility, consumer behavior can also be understood through the lens of lifestyle theory. This theory helps to explain how consumers view Plug-in Electric Vehicle technology and public electric charging infrastructure from different perspectives, and how they form their identity.

In the test results, there is a consumer motivation in using ECS/EVCS that aligns with the principles of lifestyle theory (Axsen et al., 2018), as it reflects the user's lifestyle. Based on lifestyle theory, individuals have different perspectives on using charging infrastructure. Those with a technology-oriented lifestyle are motivated to use ECS/EVCS due to its convenience and comfort, whereas those with an environmentally-oriented lifestyle may prioritize using the infrastructure for its eco-friendly benefits. The results of this study indicate that the users are primarily technology-oriented rather than environmentally oriented. Lifestyle segmentation studies (Axsen et al., 2018) have found a strong correlation between lifestyle and consumer motivation for using public charging infrastructure. Those with environmentally-friendly lifestyles are more inclined to use ECS/EVCS. This behavior can also be used as an example to encourage others to adopt the use of ECS/EVCS.

Additionally, the empirical test results align with previous research (Ji et al., 2020; Idaho National Laboratory, 2015; Nicholas and Tal, 2013) which indicates that individuals tend to charge their EVs at strategic charging points, such as at their workplace or in publicly accessible locations, such as grocery stores or shopping malls. Furthermore, the motivation for using ECS/EVCS is also found to be related to the proximity of the ECS/EVCS to their workplace. Results also indicate that users prefer to charge their batteries while engaging in other activities, such as parking. This supports the literature that states that strategic location is a crucial factor in determining the use of publicly accessible charging infrastructure. However, based on the interviews conducted in this study, some ECS/EVCS facilities still leave an unpleasant impression on users due to the lack of seating and shelter while they wait.

5. CONCLUSIONS

The results of the survey indicate that individuals who are likely to use ECS/EVCS are those who are 36-years-old, have an average income of USD 400/month, have four family members, do not own a bicycle or car at home but have a motorbike, live approximately 7.9 km from the city center, have a high school education, and have household electrical power in the R-1 class (450 VA to 2200 VA). They are not actively engaged in community or environmental activities. The most common reasons for choosing ECS/EVCS are ease of access and convenience, followed by cost considerations that fit within their budget. Additionally, individuals prefer to use ECS/EVCS as they are easily located near their workplaces and provide the convenience of being able to park their vehicles and engage in other activities while charging. This study supports previous research that found that the most frequently visited places for charging are workplaces or travel locations such as transit points and parking lots.

It can be inferred that the higher an individual's awareness of their profile, such as their lifestyle in terms of technology use, age, and occupation, the greater the likelihood of them using ECS/EVCS. This study suggests that ECS/EVCS tends to be used by individuals who possess a technology-oriented lifestyle. Based on the analysis of the characteristics and reasons for using ECS/EVCS in Indonesia, policies that promote the adoption of electric vehicles by the community are needed to optimize the utilization of existing ECS/EVCS. This includes increasing the number of ECS/EVCS, particularly in areas that are farther from the city center, improving the facilities at ECS/EVCS locations, such as seating and shelter, and implementing promotional programs through various media outlets to increase awareness and influence the use of ECS/EVCS. Discounts for EVCS/ECS customers in collaboration with electricity token merchants could also be implemented as a promotional strategy.

In conclusion, this study has provided valuable insights into the factors that influence the use of ECS/EVCS in Indonesia. The results indicate that the main reasons for using ECS/EVCS are ease and convenience of the location, cost, and the ability to charge while doing other activities. These factors align with the theory of consumer behavior, which suggests that consumers base their decisions on preferences and budget constraints. Additionally, the study found that people with a technology-oriented lifestyle are more likely to use ECS/EVCS, which is in line with lifestyle theory.

This research makes a significant contribution to the current understanding of the factors that influence the adoption of ECS/EVCS in Indonesia. It provides valuable information for policymakers and practitioners to develop strategies and policies to increase the adoption of ECS/EVCS in the country. Additionally, the study highlights the need for further research to explore the potential for ECS/EVCS in other areas of Indonesia and to understand the impact of government policies and regulations on the adoption of ECS/EVCS. Overall, this research provides a valuable foundation for future studies in this field and will help to improve the understanding of how to promote the use of ECS/EVCS in Indonesia.

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