TEM Journal. Volume 13, Issue 2, pages 1633-1644, ISSN 2217-8309, DOI: 10.18421/TEM132-76, May 2024.

Accelerating Electric Motorcycle Adoption: Comparison Between Users and Non-Users Perspectives In Jakarta, Indonesia

Syafira Nurin Aqmarina [1], Rahmat Nurcahyo [1], Sik Sumaedi [2]

[1] *Universitas Indonesia, Kampus UI, Depok, Indonesia*
[2] *Research Center of Testing Technology and Standards, National Research and Innovation Agency, Indonesia*

Abstract **– The adoption rate of electric motorcycles in Indonesia, including large cities like Jakarta, remains relatively low. This study aims to evaluate both barriers and drivers of electric motorcycle (EM) adoption from the perspectives of users and non-users. The research utilized Importance-Performance Analysis (IPA) to identify areas for improvement, and determine the most important factors to prioritize strategy development. This research has found that the 'driver attributes' for EM adoption have a positive perceived performance according to the IPA mapping. However, the attributes that act as barriers to EM adoption have low performance and need to be prioritized for improvement. A comparison study was conducted between EM users and non-users, revealing several differences in importance and performance assessments. Furthermore, a technical preference analysis was conducted among the community to provide deeper insights from the public's perspective regarding EM. The research implies that a comprehensive strategy is needed to foster the adoption of electric vehicles in urban areas like Jakarta. This strategy aims to overcome high prices, range anxiety, and lack of infrastructure to increase adoption rates and support a sustainable urban transport system.**

Keywords **– Electric motorcycle, consumer adoption, importance-performance analysis, comparison, technical preferences.**

DOI: 10.18421/TEM132-76
https://doi.org/10.18421/TEM132-76

Corresponding author: Rahmat Nurcahyo,
Universitas Indonesia, Kampus UI, Depok, Indonesia
Email: rahmat@eng.ui.ac.id

Received: 12 January 2024.
Revised: 15 April 2024.
Accepted: 25 April 2024.
Published: 28 May 2024.

1. Introduction

Air pollution has emerged as a crucial environmental concern globally due to its increasingly severe impacts and potential threat to human health [1]. The decrease in air quality is partly due to the significant emissions from the transportation sector [2]. As a result, many countries worldwide are transitioning from traditional transportation to electric vehicles (EV) [3].

Indonesia is actively encouraging its citizens to adopt different types of EV to reduce carbon dioxide emissions by 29% by 2030 [4]. Electric motorcycles (EM) have become a primary focus of transportation electrification in Indonesia due to the widespread use of motorcycles, especially in urban areas such as Jakarta. The use of EM is expected to be an alternative solution as the emissions generated by these vehicles are significantly lower than conventional internal combustion engine (ICE) motorcycles [6].

However, the adoption rate of EM in Indonesia is still slow. As of 2021, the market share of EM is only 0.2% compared to conventional ICE motorcycles [7]. According to previous studies, the slow adoption rate of electric vehicles (EV) can be attributed to the lack of public acceptance [5], [8]. Consumer concerns related to financial, technological, and infrastructural factors have been identified as barriers to the adoption of EV in Indonesia [4], [7]. On the other hand, certain factors can act as drivers for the adoption of EV [5], [8].

This study aims to prioritize the drivers and barriers of EM adoption in Jakarta by exploring how the city's residents perceive them. The study will prioritize the most important aspects using the Importance-Performance Analysis (IPA) method, which will help stakeholders and the government to focus on the critical areas. The research will also compare the perceptions of EM users and non-users to identify the differences between these groups and devise suitable approaches based on societal segmentation.

Additionally, the study will explore the technological preferences for EM among the Jakarta populace.

2. Literature Review

In this section, an exploration will be conducted on the aspects categorized as drivers and barriers to the adoption of EM based on prior literature.

2.1. Driving Factors for Electric Motorcycle Adoption in Indonesia

In the context of decision-making or taking initiatives, factors that prompt an individual or organization to take action are referred to as drivers [9]. Driver aspects can play a crucial role in promoting the use of EV [10]. Therefore, it is important to consider the driver aspects that can positively contribute to the adoption of EV.

One of the primary drivers for EV adoption is government incentives [11]. Studies have shown that incentives, especially financial incentives, significantly impact the intention to adopt EV [12]. Another financial consideration that can impact the decision to adopt EV is their lower operational costs. EV offer significant savings in terms of battery charging and maintenance costs as compared to ICE vehicles [5], [13].

In addition to financial benefits, factors related to product design and brand reputation can also influence the adoption of electric vehicles [14]. Based on previous studies, consumers tend to prefer vehicles with better features than their previous vehicles [15]. The image of electric vehicle manufacturers and their country of origin can also influence consumers' buying decisions [5], [15].

The public perception regarding the environmental benefits of EV usage is also one of the main drivers of EV adoption [13]. EVs are considered to be a more eco-friendly mode of transportation compared to traditional ICE vehicles, which particularly appeals to environmentally conscious consumers [12]. EV are also viewed as an innovative step forward in transportation technology, as they offer higher fuel efficiency, produce minimal engine noise, and reduce or even eliminate local carbon emissions. [15].

2.2. The Barriers to Electric Motorcycle Adoption in Indonesia

Barriers refer to any factors that may prevent an individual from taking a specific action or step [9]. In the case of EV adoption, attribute barriers must be resolved so that individuals do not encounter any difficulties or obstacles during the EV adoption process.

One of the main barriers to the adoption of EV is the high purchase price, as consumers will only adopt EV if the prices offered fit their financial capabilities [4], [12], [16]. Concerns regarding EV depreciation are also crucial for consumers, which may affect the resale value of electric vehicles [17], [18].

The lack of technological performance in EV is often seen as a barrier, as it is perceived to be inferior to ICE vehicle technology [19]. Insufficient range, speed, battery life, charging time, safety, and driving comfort are some of the technological limitations that contribute to this perception [15]. Studies conducted in Indonesia have highlighted range capability, maximum speed, and charging duration as significant obstacles to EM adoption [4]. The lack of performance and endurance of EM batteries are also significant considerations, as they can impact the driving experience [15]. Furthermore, driving comfort and safety are parameters that need attention because there is still public skepticism about driving EM and other EV, particularly in uncertain climates and weather conditions [13], [15].

Previous studies have identified the lack of readiness of critical infrastructure facilities such as charging stations, battery exchange stations, maintenance workshops, and dealerships as major barriers [13], [20], [21]. This issue has been noted in Indonesia, where consumers perceive the availability of infrastructure as a barrier to the adoption of EV [14].

3. Research Methodology

The research methodology encompasses the development of research instruments (questionnaires) and the data processing methods employed, such as the Mann-Whitney-U (MWU) test and Importance Performance Analysis (IPA).

3.1. Questionnaire Design and Data Collection

The survey aimed to gather information from licensed motorcycle riders who are 17 years old and above, residing in Jakarta and nearby areas, and use either EM or conventional ICE motorcycles. An online survey was conducted to increase the number of participants. The survey was distributed through different social media platforms, including WhatsApp, Line, Telegram, Facebook, and Instagram. The questionnaire was also distributed to communities of EM users and electric motorcycle-based ride-hailing in Jakarta, and the snowball sampling method was used with the help of community members to distribute the questionnaire among other members of the community.

Additionally, on certain occasions, direct (offline) approaches were made to obtain broader and deeper insights from EM users and non-users.

The questionnaire contains a range of questions that cover demographics, technical preferences about electric vehicles, and assessments for importance and performance. Firstly, the demographic questions are designed to establish the composition of the survey respondents. These questions aim to elicit information such as age, gender, income, and education level. Secondly, the preference questions delve into the technical features of electric cars that people find important. These features may include, but are not limited to, the purchase price, driving range, top speed, and charging time. The goal is to obtain detailed insights into the factors that influence people's decision-making regarding EM.

The questionnaire's core section consists of importance and performance assessments with 18 attributes, 9 of which represent drivers and the other 9 represent barriers to adoption. The questionnaire uses neutral intention statements to assess the importance of barriers and drivers. However, when assessing importance, statements are made in the context of the attribute. For performance assessment, the driver attribute is presented as a positive statement, while the barrier attribute is expressed as a negative statement. A 5-point Likert scale is utilized to evaluate both the importance and performance assessment. The scale values for importance section are as follows: 5 = "very important," 4 = "important," 3 = "neutral," 2 = "unimportant," 1 = "very unimportant." Similarly, the performance section is evaluated using a 5-point Likert scale. The scale values are: 5 = "very agree," 4 = "agree," 3 = "neutral," 2 = "disagree," 1 = "very disagree". Importance and performance assessment data in this research will later be used for comparative analysis and prioritization segmentation using Importance-Performance Analysis (IPA).

3.2. Comparison Analysis using Mann-Whitney-U Test

The Mann-Whitney U (MWU) test is a non-parametric test used to compare two groups that are not related to each other [22], [23]. The MWU test requires the combination and ranking of both groups. If the combined sample shows a random mixing in rank order, it indicates that there is no difference between the two groups [24]. In this study, the MWU test will be used to compare the perceptions of importance and satisfaction regarding EM adoption among users and non-users in Jakarta area. A confidence level of 95% ($\alpha = 0.05$) will be considered to determine the significance of the results. If the significance value is below 0.05, the difference between the two groups will be considered significant.

The objective is to identify differences in perception between two sample groups. This will enable us to determine the varying influence of each attribute on the desire to adopt for each group. The resulting insights can be utilized to create customized strategies based on the specific development needs of each group.

3.3. Importance-Performance Analysis (IPA)

The use of the IPA method identifies which attributes have poor performance and which require maintenance for customer satisfaction [15]. The method involves plotting importance-performance data on a two-dimensional graph, with performance on the x-axis and importance on the y-axis. The graph is divided into four quadrants: "Concentrate Here," "Keep up the Good Work," "Potential Overkill," and "Low Priority" [26]. In the IPA method, the quadrants are divided by placing crosshairs on each axis. Previous studies have used either a scale-centered or data-centered approach for this purpose [27]. In this study, the IPA graph will integrate a scale-centered and data-centered approach, using the mean-centered method and adding an iso-rating line. The mean-centered approach is chosen over the other methods to ensure a more even attribute plotting. The iso-rating line will also be employed in the IPA diagram, which is a diagonal line used to differentiate prioritization. The iso-rating representation is used by dividing the graph into two discussion areas, namely the area below or above the diagonal line, to determine priorities [28]. The line will pass through (0,0) using mean-centered, thus distributing the discussion areas more evenly. The representation of attribute placement analysis using iso-lines (in quadrants with mean-centered approach), shows that if an attribute falls below the line, then its performance is higher than its importance value. On the other hand, if the attribute falls above the line, it requires priority improvement as it indicates that its performance is lower than its importance value [26].

In this research, assessments of importance and performance are conducted on attributes previously identified as drivers and barriers to EM adoption based on prior studies. These assessments aim to determine whether the attributes identified as drivers of EM adoption in the literature review exhibit good performance, experience regression, or even have the potential to become barriers. On the other hand, EM adoption barriers obtained from the literature review are analyzed to see whether they are still obstacles. The IPA quadrant that will be produced can help in prioritizing the barriers that need to be focused on first.

4. Result and Discussion

The gathered data undergoes processing employing the previously mentioned methodologies. Subsequently, the results of each method are analyzed to ascertain findings aligned with the research objectives.

4.1. Descriptive Statistic of Demographic

In Table 1, descriptive statistics were conducted to observe the distribution of 407 respondents who completed the questionnaire. Among them, 105 were EM users, while 302 were non-users. The table reveals that the majority of respondents were male (65.1%), aged between 26-45 years (58.2%), had obtained a diploma/bachelor's degree as their highest education level (66.1%), and were employed as private sector employees (57%).

4.2. Comparative Analysis between User and Non-user of EM

Before conducting the study, a normality test was performed using the Kolmogorov-Smirnov method, which revealed that the collected data did not meet the normality assumption. Hence, the comparative analysis between the perceptions of importance and performance among users and non-users of EM in Jakarta will utilize the Mann-Whitney-U Test due to the lack of normal distribution in the data from the two independent groups.

Table 1. Descriptive statistics of demographics

Subject	Characteristic	Amount of People	Percentage
Gender	Male	265	65.1%
	Female	142	34.9%
Age	17-25	70	17.2%
	26-45	237	58.2%
	46-65	95	23.3%
	>65	5	1.2%
Educational Level	Elementary / Middle School	1	0.2%
	High School	69	17%
	Diploma / Undergraduate	269	66.1%
	Graduate (Magister or Doctoral)	68	16.7%
Job/Profession	Student	40	9.8%
	Civil Servant	33	8.1%
	Private Employee	232	57%
	Entrepreneur	29	7.1%
	Housewife	21	5.2%
	Others	52	12.8%
Electric Motorcycle User	Non-User	302	74.2%
	User	105	25.8%

The study results in Table 2 show a comparison between the perceived importance and performance of EM among users and non-users in Jakarta. The perceived importance of EM adoption between EM users and non-users significantly differs only in DD2, which refers to the reputation of the manufacturer. For users, manufacturer reputation is crucial (M = 4.13), while non-users perceive it neutrally (M = 3). This difference in perception might be due to the fact that users have undergone decision-making processes when considering the EM to purchase. It is common for consumers to choose a brand that is widely used by people around them or society because reputation is created by the flow of positive information from one user to another [14], [30].

In terms of performance assessment, there are DD2, DE3, BF1, and BT1 that have different impacts on users and non-users. The reputation of the manufacturer (DD2) is viewed as a more significant driver for EM adoption by users (M = 4.05) than by non-users who are more neutral (M = 3). Users also considered the environmentally friendly aspect (DE3) of EM as an excellent driver (M=4.71) compared to non-users (M=3.8). On the other hand, the cost of purchasing an EM (BF1) is viewed as less of a barrier to adoption by users (M=2.85) than by non-users (M=2.1). Non-users still perceive the purchase price of electric motorcycles as being unattractive compared to conventional ICE motorcycles, which deters them from adopting this technology.

Table 2. A comparative test of Electric Motorcycle attributes based on importance and performance according to EM users and non-users.

Variable	Code	Asymp. Sig. (2-tailed)		Description	
		IMP	**PERF**	**IMP**	**PERF**
Driver Attributes					
Government subsidies assistance for electric motorcycle prices	DC1	0.519	0.854	No Differences	No Differences
Lower charging costs	DC2	0.281	0.353	No Differences	No Differences
Lower vehicle maintenance costs	DC3	0.158	0.073	No Differences	No Differences
Availability of design or models offered for electric motorcycles	DD1	0.426	0.358	No Differences	No Differences
Trusted manufacturer brand reputation	DD2	0.038	0.017	**Sig. Different**	**Sig. Different**
Trusted brand based on country of manufacturing origin	DD3	0.075	0.797	No Differences	No Differences
Less emissions produced	DE1	0.432	0.744	No Differences	No Differences
Less vehicle noise levels	DE2	0.572	0.126	No Differences	No Differences
Environmentally friendly vehicle	DE3	0.633	0.019	No Differences	**Sig. Different**
Barrier Attributes					
High price compared to conventional motorcycles	BF1	0.732	0.046	No Differences	**Sig. Different**
Anxiety of resale price of electric motorcycles	BF2	0.827	0.069	No Differences	No Differences
Driving range limitation	BT1	0.163	0.005	No Differences	**Sig. Different**
Speed limitation	BT2	0.54	0.133	No Differences	No Differences
Limitation battery lifespan	BT3	0.4	0.147	No Differences	No Differences
Long battery charging duration	BT4	0.118	0.143	No Differences	No Differences
Safety concerns in specific weather conditions	BT5	0.074	0.645	No Differences	No Differences
Lack of availability of Public Electric Charging Stations (PECS) / swap stations	BI1	0.551	0.465	No Differences	No Differences
Lack of availability of dealerships and maintenance workshop	BI2	0.071	0.465	No Differences	No Differences

Lastly, the lack of driving range of EM (BT1) is seen as a greater barrier to adoption by non-users (M=1.94) compared to users (M=2.75). This suggests that non-users are more concerned about the technical aspects of EM, while users are generally more accepting of this technology.

The study's findings indicate that users, who have a direct driving experience, generally have a more positive perception of EM performance (M=4.2) than non-users (M=4.12), who base their assessment on assumptions [31]. The researchers conducted offline interviews with a few non-userrespondents to gain a deeper understanding of the barriers that they perceive regarding EM adoption. A total of 15 non-users were interviewed and admitted that they had answered questions based on assumptions or information from the Internet or TV, as most of them were unfamiliar with EM. This highlights the fact that non-users could be more receptive to EM if they had better knowledge and experience with it. This is consistent with several studies that have shown that consumer knowledge and experience play a crucial role in the adoption rate of EV and other EM technologies [5], [14]. Therefore, it is important to educate and create awareness among consumers, especially non-users, to increase the adoption rate of EV technologies like EM.

4.3. Importance-Performance Analysis

In this study, the importance-performance analysis (IPA) method was used to evaluate the importance and performance of various barriers and drivers. The analysis produced four quadrants that classify the barriers and drivers based on their level of importance and performance. The IPA approach used in this study is the mean-centered approach, as described in Deng's research [26]. This approach combines two IPA methods, namely the data-centered and scale-centered approaches, each with advantages and limitations in constructing IPA quadrants. The IPA quadrants obtained from the evaluations of EM users and non-users are presented in Figures 1 and 2 respectively.

In Quadrant I, the areas of high importance and performance values are indicated by the label 'Keep Up the Good Work'. According to EM users, DE1, DE2, and DE3 fall into this category, while for non-users, it includes DC2, DC3, and DE3.

Both groups agree that EM usage contributes significantly to environmental effectiveness, making it a crucial driver for EM adoption. This aligns with the findings of Hanssen and Hasan [15], which suggest that environmental factors are often primary motivators for adopting EM and other EV types. Moreover, the lower cost-related factors, DC2 and DC3, are recognized as drivers for non-users, consistent with Bhat and Verma's research [13], indicating that increased awareness of lower-cost benefits positively influences the inclination toward EM adoption among non-users. The driver attributes falling into this quadrant represent aspects that currently form the strengths and added value within the existing EM ecosystem in Jakarta. Therefore, these aspects require consistent maintenance of their performance levels.

The Quadrant II, termed 'Potential Overkill,' indicates a low importance value and high performance. EEM user assessments show that some driver attributes, such as DC1, DC2, DC3, DD1, DD2, and DD3, fall into Quadrant II. Non-users of the EM ecosystem also have driver attributes in Quadrant II, such as DC1, DD1, DD2, DD3, and DE1. While these attributes are important, they are less crucial than those in Quadrant I. These attributes do not require immediate attention and resources should be focused on areas that require significant improvement, like Quadrant IV [15]. Nonetheless, the system's performance depends on all attributes, and it is still essential to maintain them effectively.

The attributes falling into quadrant III, 'Low Priority,' exhibit low importance and performance levels. For EM users, these attributes are BF2 and BT2, while for non-users, they include BF2, BT2, and BT5. The issue of resale value (BF2) is considered low priority by both groups, which aligns with prior research that shows the minimal impact of resale value on the decision-making process of EV adoption for both groups [32].

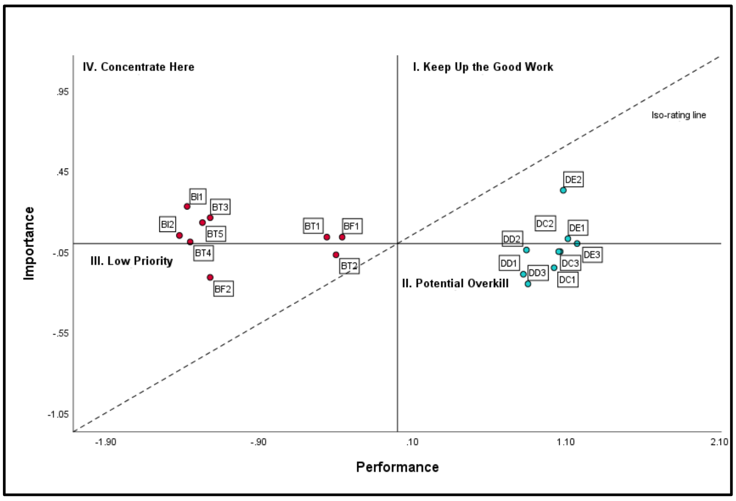

Figure 1. The IPA Matrix for prioritizing the driver and barriers attributes to EM adoption according to EM users

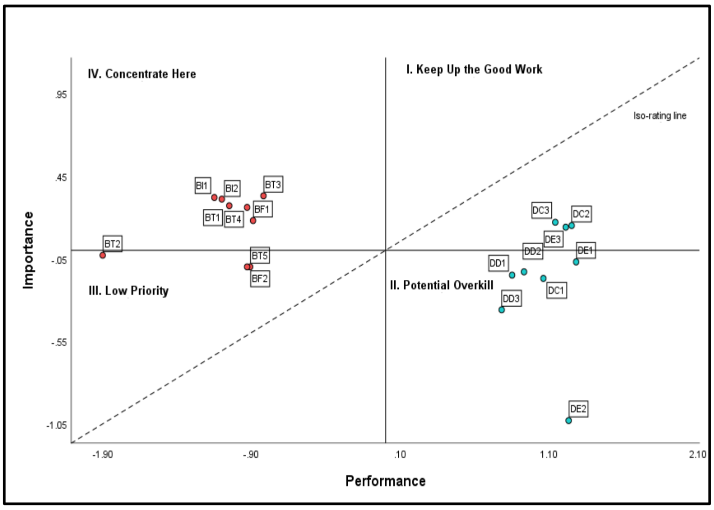

Figure 2. The IPA Matrix for prioritizing the driver and barriers attributes to EM according to EM non-user

On the other hand, non-users assign low priority to the limitation maximum speed of EM (BT2) and safety concerns during extreme weather conditions (BT5), which contradicts the findings of Bhat and Verma [13]. Their research shows that factors like maximum speed and driving safety under extreme weather conditions could influence EM adoption. The attributes in Quadrant III are inhibiting issues that do not cause much concern for both groups, thus having lower priority levels than other attributes. Based on previous research, resources allocated for improving these attributes might require less attention than attributes in higher-priority quadrants such as Quadrant IV [15].

The focus of using the IPA method is to observe the attributes falling into Quadrant IV, 'Concentrate Here,' where these attributes have high importance but low performance. In this study, according to EM users, BF1, BI1, BI2, BT1, BT3, BT4, and BT5 exhibit low performance, with the lack of maintenance workshops (BI2), lack of public charging/swap stations (BI1), and battery charging long duration (BT4) being the three barriers with the lowest performance, respectively. It indicates that the challenges experienced by EM users mainly emphasize operational barriers. Meanwhile, according to EM non-users, BF1, BI1, BI2, BT1, BT3, and BT4 display low performance, with the three lowest barriers being the high price of EM (BF1), lack of public charging/swap stations (BI1) and the lack of maintenance workshops (BI2). Apart from infrastructure scarcity (charging stations and maintenance workshops), previous research has suggested that the perceived high cost of buying EM is a major barrier to their widespread use, as well as to the adoption of EV in general [12], [14]. This is because EM, despite being more efficient and environmentally friendly in their operation, are still relatively new in the market and require a higher initial investment compared to their fossil fuel counterparts [7], [13].

In addition to using the 4 quadrant approach to prioritize tasks, analyzing priorities based on the placement of attributes on iso-rating lines can also provide deeper insights. Based on Figures 1 and 2, all attributes that act as barriers are positioned at the top of the diagonal line, whereas all attributes classified as drivers are located below the diagonal line.

This indicates that barrier attributes should be given more priority than driver attributes since they have lower performance values. The results of this prioritization analysis will greatly assist authorities and manufacturers in identifying the factors that are significantly hindering the adoption of EM. This will enable them to focus their efforts on improving those specific areas and removing the major barriers to EM adoption.

4.4. Technical Preferences

This study also analyzes the technical preferences for currently available EM to deepen the recommendations and insights for stakeholders and manufacturers. The results of preferences from both groups are presented in Table 3.

Table 3. Descriptive statistics for EM technical preferences in user and non-user groups

Subject	Characteristic	EM User	EM Non-User		
		Amount	Percentage	Amount	Percentage
Preference for electric motorcycle purchase price	5 - 10 million	22	21%	52	43%
	11 - 15 million	36	34.3%	51	42.1%
	16 - 20 million	25	23.8%	16	13.2%
	> 20 million	22	20%	2	1.7%
Preference for electric motorcycle range	40 - 60 km	22	21%	30	24.8%
	61 - 80 km	36	34.3%	39	32.2%
	81 - 100 km	25	23.8%	25	20.7%
	101 - 120 km	21	20%	26	21.5%
	> 120 km	1	1%	1	0.8%
Preference for maximum speed of electric motorcycles	40 - 60 km/h	33	31.4%	39	32.2%
	61 - 80 km/h	37	35.2%	59	48.8%
	81 - 100 km/h	24	22.9%	16	13.2%
	101 - 120 km/h	11	10.5%	6	5%
	> 120 km/h	0	0%	1	0.8%
Preference for the duration of electric motorcycle charging	1 - 2 hours	25	23.8%	62	51.2%
	3 - 4 hours	23	21.9%	37	30.6%
	5 - 6 hours	7	6.7%	10	8.3%
	7 - 8 hours	2	1.9%	7	5.8%
	< 1 hours	48	45.7%	5	4.1%

Only respondents who were familiar with or knowledgeable about the technical aspects of EM were considered to ensure relevant results. This filtering was explicitly applied to EM non-users, while EM users automatically received these questions as they were assumed to have experience and knowledge about EM through ownership. EM non-users were asked whether they have good knowledge or familiarity with various technical specifications offered by EM in the Indonesian market, or if they have worked in fields closely related to EM, either directly (such as manufacturers, component industries, EM maintenance workshops, etc.) or indirectly (such as government ministries, academia, etc.). If EM non-users identified with any of these categories, they were invited to fill out the preference section.

The study consists of four questions related to the preferences of buyers of EM. These questions are related to the purchase price, travel range capability, maximum speed capability, and charging duration of EM. These technical aspects are often considered by prospective buyers while making a purchase decision [33]. The answer choices provided for each question are based on the available options in the Indonesian market, particularly in the Jakarta area, which represent the current technical capabilities of EM in the Indonesian market. Range choices were included to account for respondents who have preferences outside the given answer options. These range choices are meant to represent the category of "other". This approach helps to determine if majority preferences exist within the industry.

Preferences regarding the purchase price offer four options: 5-10 million, 11-15 million, 16-20 million or above 20 million Indonesian Rupiah. The majority preference for price range differs between EM users and non-users. Among EM users, the most favored price range is 11-15 million Rupiah (34.3%), whereas EM non-users predominantly prefer the 5-10 million Rupiah range (43%). EM brands in the Indonesian market currently offer these price ranges as purchase prices (post-subsidy) [29]. Based on interviews with some users, it was found that the price range of 11-15 million Rupiah (after subsidies) is still acceptable to them, considering the lower operational costs of electric motorcycles (such as charging and maintenance) compared to conventional ICE motorcycles. Moreover, many users believe that this price range is justified due to the expected improved technical features of EM. This finding indicates that government subsidies have been effective in setting the purchase price range for electric motorcycles at 11-15 million Rupiah. On the other hand, non-users of EM prefer a price range of 5-10 million Rupiah as the effective price for the EM market in Indonesia.

This finding can be used as feedback for EM manufacturers and policymakers, suggesting that they should expand their product range to cater to a wider price range, enabling individuals from diverse economic backgrounds to consider EM usage.

The study conducted on EM driving preferences has revealed some interesting results. The research analyzed several range options and found that the 61-80 km range was the most popular among both EM users and non-users, with 34.3% and 32.2% of votes, respectively. When it comes to the preference for maximum speed of electric vehicles (EV), the user and non-user groups demonstrated the highest choice for the same range, namely 61-80 km/h, with percentages of 35.2% and 48.8%, respectively. The range of 61-80 km for distance coverage and a maximum speed of 61-80 km/h represents the standard capabilities of most EV brands available in the market [29]. These results indicate that both groups share a preference that aligns with the technical specifications of EV in the Indonesian market. Therefore, to optimize these preferences, EV manufacturers and stakeholders could pursue marketing strategies and approaches that are more engaging. Recognizing that technical information about an EV, such as distance range and maximum speed, could influence the public's intention to adopt EV, these strategies aim to attract the interest of potential users.

It is also important to consider the charging duration preferences when using an EM product. The charging time of each EM product may differ based on its electrical power and the charging duration at public charging stations may vary depending on the technology used, especially in the case of fast charging. It is important to note that there may be differences in charging preferences between electric motorcycle users and non-users. According to the survey, the respondents were given five options for charging duration: less than 1 hour, 1-2 hours, 3-4 hours, 5-6 hours, and 7-8 hours. The results showed that 45.7% of EM users preferred charging for less than 1 hour, while for EM non-users, the most popular choice was 1-2 hours (51.2%). However, the average charging time for batteries in Indonesia is around 3-4 hours or more, which means that the existing charging facilities in the country have not met the community's preferences [25]. Specifically, EM users prefer a charging duration below 1 hour, which may relate to their experience using and operating EM. Many respondents compared this duration with the refueling time for conventional ICE motorcycles, which usually takes only 10-15 minutes. Rapid charging times for EM are only achievable when users perform battery swapping, and not all EM products in Indonesia are battery electric vehicles (BEV).

This finding has emphasized the importance of ongoing innovation and technological advancements in charging system, especially for charging station proprietors and EM manufacturers. The finding suggests that such advancements can simplify the decision-making process for individuals who are transitioning to using EM. These advancements can help relieve concerns regarding charging time and range anxiety by providing faster and more efficient charging solutions. Furthermore, they can help reduce the overall cost of ownership of EM, making them more accessible and appealing to a wider audience.

5. Conclusion

The challenge of convincing the public to switch from using conventional ICE vehicles to EV is a major issue globally. In Indonesia, one type of EV available is the EM, but its adoption rate remains slow compared to conventional ICE motorcycles. This study aimed to explore the barriers and drivers of electric motorcycle (EM) adoption by users and non-users in Jakarta. The study evaluated the importance and performance of various attributes that influence EM adoption. The Mann-Whitney-U Test was used to analyze the perceived differences between the two groups. Results showed that there were differences in the importance ratings for barrier attribute DD2, whereas there were significant differences in the performance ratings for barrier attributes DD2 and DE3, and driver attributes BF1 and BT1. Users who have experienced riding EM have rated their performance more positively than non-users. This suggests that direct experience with EM may contribute to a more favorable opinion. Therefore, stakeholders should take a more active role in increasing public awareness and knowledge of driving EM. By doing so, people can become more familiar with electric motorcycles and potentially attract more non-users to convert to EM users.

The study used the importance-performance analysis (IPA) method to identify areas for improvement in each community. The nine driver attributes fell into Quadrants I and II, while the barrier attributes were located in Quadrants III and IV for both groups. This indicates that the 'driver' attributes maintain good performance, making them preferable for retention (Quadrant I) or focus allocation to areas with lower performance (Quadrant II). However, the 'barrier' attributes still require attention due to their lower performance, particularly those falling into Quadrant IV (Concentrate Here). Considering that most barrier attributes are in Quadrant IV, it suggests a need for more significant improvements from stakeholders and the government in addressing EM adoption issues in Jakarta. Through prioritization mapping from the IPA method, can help authorities and manufacturers to identify and prioritize the factors that significantly influence the deceleration of EM adoption intentions. By analyzing these factors, authorities and manufacturers can make the necessary improvements to overcome the barriers that inhibit the widespread adoption of EM, such as high costs, lack of charging infrastructure, and many more. By focusing their efforts on improving these specific areas, authorities and manufacturers can facilitate the transition to a more sustainable and environmentally friendly transportation system. Moreover, mitigation strategies can be tailored based on the targeted community, whether the development strategy aims to attract new customers to adopt EM and retain existing EM users to continue using EM or other EV types.

In the study, a simple preference study was conducted regarding the technical aspects of EM, which provided additional insights. The majority of chosen respondents for the technical preference section chose the best EM purchase price within the range of 11 - 15 million IDR, a travel range between 61 - 80 km, a maximum speed range of 61 - 80 km/h, and a charging duration of below 1 hour. Both respondent groups had similar technical expectations, except that EM non-users had expectations of lower prices (5-10 million IDR) and charging duration expectations (1-2 hours). Apart from the previous analyses, comparative analysis and prioritization using IPA, the information gathered from this preferences section can offer a deeper insight into the specific features that are aligned with the preferences and desires of the community. These insights can be instrumental in designing and developing products or services that cater to the needs and preferences of the community members.

The academic contribution of this research lies in the novelty and discoveries obtained from the study of EM objects in Indonesia. As the study of EM in Indonesia is still in the developmental stage, the findings of this research can serve as a reference for future research in this area. This research can help policymakers improve the Jakarta community's satisfaction with the system. The preferences of both existing and potential customers should be considered when developing and evaluating the system to meet their expectations. Making improvements that meet customer expectations can encourage non-users to adopt EM, while addressing existing users' concerns can ensure their continued commitment to using EM. Policymakers must prioritize the needs of their customers to create a more effective and efficient system. Future research could focus on investigating the barriers and drivers that influence the uptake of other forms of EV transportation, such as electric cars (EC).

The findings may vary across different modes of transportation, as the target audiences for each mode are distinct. Therefore, EV initiatives can be tailored more precisely to each transportation model, especially in Indonesia. Other than that, the prioritization techniques for EV adoption context are not limited to IPA; other methods, such as multicriteria decision-making (MCDM) or multicriteria decision-analysis (MCDA), could be explored in future research.

Acknowledgements

The Faculty of Engineering Professorial Seed Funding 2023 at the Universitas Indonesia provided financial support for this research, under Grant No. NKB-2597/UN2.F4.D/PPM.00.00/2023.

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