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Feasibility Analysis of Implementing Micromobility E-Bike Sharing in Depok City

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ABSTRACT

Dependence on private vehicles and limited integration of public transportation contribute to congestion and environmental problems. Micro-mobility solutions, such as e-bike sharing, have emerged as a potential alternative to improve the accessibility of public transportation and encourage a shift from the use of private vehicles. This research aims to analyze the key factors that influence the adoption of e-bike-sharing services as a mode of transportation for short and long distances in Depok City. This research also assesses the feasibility of implementing this system by evaluating the characteristics of the road network, public transportation integration, and land use conditions. The research methodology used was a structured research methodology, starting with a literature review and factor identification, followed by factor weighting using the Likert scale and the Analytical Network Process (ANP) method. A preference survey was conducted among potential users, and the collected data was analyzed using a binomial logit model in RStudio. The findings show that savings in travel costs, distance to daycare, and travel time significantly influence the adoption of electric bicycles. The probability of switching to e-bike sharing services is higher among users of private motorbikes at distances of 100-200 meters, mainly due to cost savings and accessibility. Meanwhile, online ojek users show a higher tendency to switch at distances of 350-500 meters, driven by convenience, flexibility, and privacy. Although the cost of e-bike sharing is relatively higher, users consider accessibility, modern technology, and environmental benefits as strong incentives.

Keywords: Binary Logit, Cost Savings, E-Bike Sharing, Shelter Distance, Sustainable Mobility, User Preference.

INTRODUCTION

Transportation is an essential element in society's functioning (Karim et al., 2023). It is closely related to living patterns, the scope and location of productive activities, entertainment, and access to goods and services that can be utilized (Romadhani et al., 2024). The movement of people and goods has been part of mankind's history.

The main potential of micro-mobility in the urban context lies in solving first-mile and last-mile problems by increasing access to public transport, thereby improving access to services and also contributing to changes in mobility patterns and behaviors aimed at a less car-centric urban mobility system (Haustein & Møller, 2016). However, it should be underlined that the concept of micromobility in accessibility is as a first and last mile to public transport substitutes on foot or feeder, not as an origin and destination mode to a location (Liu & Miller, 2022). This is often a bias for some people who do not understand the meaning of micromobility.

Micromobility can offer flexibility and door-to-door accessibility to efficient Public Transport, while higher speeds and greater spatial coverage characterize Public Transport (Oeschger et al., 2020). The resulting synergy between high-speed Public Transport (and spatial coverage) and the door-to-door accessibility provided by micromobility creates access, speed, and convenience that can compete with private motor vehicles (Hofbauer, 2022). This combination, therefore, makes modal shift more likely and has great potential to contribute to more livable cities, less congestion, and reduced levels of air and noise pollution.

Several studies have explored micromobility implementation in urban environments. (Julio & Monzon, 2022) found that e-bike-sharing adoption is highly influenced by infrastructure availability and users' perceptions of safety. Meanwhile, (McQueen et al., 2021) emphasized that pricing schemes and accessibility significantly impact the shift from private vehicles to shared micromobility services. Additionally, research by (Haryanti et al., 2024) highlighted the importance of land use and urban planning in ensuring the effectiveness of micromobility as a feeder mode to public transportation. However, these studies primarily focused on general urban conditions without specifically addressing micromobility's feasibility in cities with inefficient public transportation networks, such as Depok.

Depok City is an administrative city with a population of 2,113,612 people with an average population density of 10,552 people/km2 where public transportation is available, such as commuter lines, inter-city buses, and urban transportation. From the results of previous research, the time efficiency factor and the inefficient number of public transport units are factors in the lack of public interest in mobilizing in the Depok city area by public transport. The high value of travel time (40.25 minutes to 55.33 minutes) and the low value of load factors on several public transportation, such as D11 and D112, are factors in the lack of public interest (Fredy, 2019).

With the inefficiency of the public transport network in the city of Depok, with the characteristics of micro-mobility as a public transport feeder, it is expected that the application of one type of micro-mobility vehicle, namely electric-bike sharing, can function as a connecting mode to the nearest public transport to increase public interest in mobilization by using public transportation. This raises the question of whether the implementation of micro-mobility is efficient in increasing the number of people in Depok City who use public transit, so it is necessary to test the feasibility of electric bike sharing in Depok City based on the characteristics of the road network, public transport network and land-use conditions in Depok city area.

The problem of inadequate public transportation networks in Depok City must be resolved immediately to create intermodal integration in Depok City. However, not yet finished with this, it is planned to implement Micromobility in electric bicycles (Electric Bike Sharing) as the first and last mile mode to the nearest Public Transport to attract public interest in using Public Transport in mobilizing the Depok City area. In applying an E-Bike in an urban area, it is necessary first to analyze what factors affect the application of Micromobility (Electric Bike) as a mode to the nearest Public Transport Station. This raises the question of whether Micromobility (Electric Bike) is feasible in the Depok City area. At the same time, the demand for Public Transportation in Depok City is still low. For this reason, an analysis of the feasibility of micromobility (electric bike) in the Depok city area was conducted to answer this problem.

Based on the above background, the purpose of this research is to analyze the factors that influence the implementation of micro-mobility in the form of electric bike sharing as a first mile and last mile mode of public transportation in Depok City. The results of this research are expected to provide strategic recommendations in integrating micro-mobility with public transportation, so as to increase public interest in using public transportation as their primary mode of mobility. The benefit of this research is to provide empirical insights to local governments and stakeholders in developing an efficient and environmentally friendly transportation system. The implementation of electric bike sharing is expected to reduce dependence on private vehicles, reduce congestion, and reduce air and noise pollution in Depok City.

RESEARCH METHOD

This research employed a structured methodology encompassing several key stages. The research began with an introductory phase, followed by a literature review to establish theoretical foundations. The research identified factors influencing the adoption of micromobility electric bike-sharing services, which were then weighted using the Likert scale and the Analytical Network Process (ANP) method. The primary influential factors in Depok City were subsequently mapped. A stated preference survey was conducted to assess public perceptions, and the collected data underwent cleaning and descriptive analysis to ensure validity and reliability.

The research proceeded with the development of a utility model using RStudio, applying a binary logit model to determine the impact of significant independent variables on respondents' decision-making. Sensitivity analysis was performed to evaluate the likelihood of users switching to e-bike sharing under varying conditions. The research concluded with an assessment of the feasibility and potential implementation of e-bike-sharing services. Based on the findings, recommendations were provided to stakeholders to enhance micromobility adoption as a first- and last-mile solution, aiming to reduce traffic congestion and dependence on private vehicles by promoting an efficient and environmentally friendly urban transportation alternative..

RESULT AND DISCUSSION

Weighting Influence Factors with the Likert Scale

Respondent Characteristics Data Survey Results with Likert Scale

Based on the survey implementation results, 102 questionnaire data were obtained, which were then sorted into questionnaires to get 99 questionnaires (according to the calculation of the Slovin formula). The data obtained were respondent characteristics, respondent travel characteristics, and data on the intensity of the influence of e-bike sharing micromobility implementation in Depok City.

Table 1. Recapitulation of Respondent Characteristics

Respondent Characteristics	Classification	Percentage	Total
Gender	Male	38,18%	100%
	Female	61,82%	
Age Range	16-22 Years	3,64%	100%
	23-27 Years	63,64%	
	28-38 Years	21,82%	
	39-60 Years	10,91%	
	>60 Years	0%	
Type of Work	ASN/TNI/POLRI	16,36%	100%
	SOE/Private	60%	
	Entrepreneurship	9,09%	
	Student	1,82%	
	IRT	9,09%	
	Not working yet	3,64%	
Revenue	IDR 0-1 Million	3,70%	100%
	IDR 1-3 Million	7,41%	
	IDR 3-5 Million	14,81%	
	IDR 5-10 Million	53,70%	
	IDR 10-15 Million	14,81%	
	>Rp 15 Million	5,56%	
Transportation Funding Source	Dana Mandiri	96,43%	100%
	Agency/Company Funds	3,57%	

Table 2. Frequency of Respondents Using Public Transportation

No.	Frequency of Use Public Transportation	Number of Respondents	Percentage
1	one day per week	14	14,14%
2	2-3 days per week	21	21,21%
3	4-6 days per week	30	30,30%
4	Every day	34	34,34%
	Total	99	100%

Source: Analysis Results, 2024.

Based on Table 2, it is known that the proportion of respondents who travel by public transportation once a week is 14.14%, the frequency of 2-3 days during the week is 21.21%, the frequency of 4-6 days during the week is 30.30% and the frequency of every day during the week is 34.34%. The percentage shows that most respondents travel by public transport daily at a weekly time interval.

Table 3. Type of Mode of Introduction to the Nearest Public Transportation

No.	Vehicle Type	Number of Respondents	Percentage
1	Online Motorcycle Taxi	56	56,57%
2	Private Motorcycle	41	41,41%
3	Angkot	2	2,02%
	Total	99	100%

Source: Analysis Results, 2024.

Based on Table 3, the proportion of respondents who travel to the nearest public transportation station/stop using online motorcycle taxis is 56.57%, those using private vehicles in the form of motorbikes are 41.41%, and those using city transportation (angkot) are 2.02%.

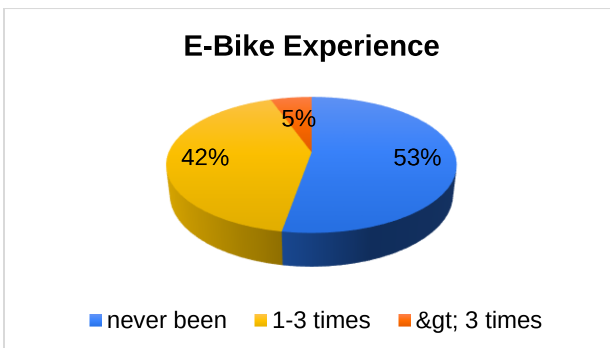

Figure 1. Experience group using E-Bike Sharing

Figure 1 shows the proportion of respondents who have used electric bikes before is known. The proportion of respondents who have never used an electric bike was 52.73%, for respondents who have used electric bikes 1-3 times, 79.31%, and for respondents who often use electric bikes, 13.04%. These results indicate that the majority of respondents have never used an electric bike before.

Likert Scale Weighting Survey Results

After surveying 99 respondents, the research results of each influence factor were obtained, which will be used to carry out weighting. Table 4 shows the results of recapitulation of questionnaire data with a Likert scale.

Table 4. Recapitulation of Respondent Data

Influence Factor	Weighted Value (Likert Scale)				Total Respondents
	1	2	3	4	
E-Bike Sharing Station Distance	0	3	37	59	99
Travel Destination	9	17	33	40	99
Travel Time	4	8	36	51	99
Travel Costs	2	3	42	52	99
Income and Population Density	15	25	31	28	99
Age and Profession Type	25	28	31	15	99
Convenience of E-Bike Sharing Facilities	7	20	39	33	99
E-Bike Sharing Infrastructure Completeness	8	15	35	41	99
Safety and Security	0	24	28	47	99
E-Bike Sharing Experience	27	35	27	10	99
Environment	15	20	31	33	99

Source: Analysis Results, 2024.

Based on Table 4 above, each factor has a different influence, according to the survey results. Therefore, the next variable feasibility test is carried out by conducting validity and reliability tests on the initial variables. The validity test is carried out to determine the degree of density between the data that occurs on the object and the data reported by the researcher. The reliability test is carried out to measure the level of consistency of an instrument/questionnaire used by the researcher so that the instrument can be relied upon even though the research is carried out repeatedly with the same instrument.

Validity Test

Table 5. Validity Test Results

No.	Variables	*Significance Value*	*r* Calculated *(Pearson Co...)*	*r* Table *(n= 99)*	Ket.
1	X1	0,0022	0,3040	0,1956	Valid
2	X2	0,0000	0,6711	0,1956	Valid
3	X3	0,0000	0,4205	0,1956	Valid
4	X4	0,0006	0,3360	0,1956	Valid
5	X5	0,0000	0,3998	0,1956	Valid
6	X6	0,0008	0,5182	0,1956	Valid
7	X7	0,0000	0,4255	0,1956	Valid
8	X8	0,0000	0,6088	0,1956	Valid
9	X9	0,0000	0,6248	0,1956	Valid
10	X10	0,0005	0,3438	0,1956	Valid
11	X11	0,0000	0,5200	0,1956	Valid

Source: Analysis Results, 2024

Reliability Test

Table 6. Reliability Test Results

Cronbach's Alpha	**N of Items**
.612	18

Source: Analysis Results, 2024

Based on Table 6 above, the variables that have been tested get a Cronbach's Alpha value greater than the r-table or 0.60. Therefore, all variables that have been tested are declared reliable.

Weight Calculation of Influencing Factors with Likert Scale

Table 7. Weighting Results of Implementation Influence Factors E-Bike Sharing in Depok City Area with Likert Scale

Influence Factor	Description	Weighted Value (Likert Scale)				Total	Weight
		1	2	3	4		
E-Bike Sharing Station Location	Total	0	3	37	59	99	3,566
	Weight	0	6	111	236	353	
Travel Destination	Total	9	17	33	40	99	3,051
	Weight	9	34	99	160	302	
Travel Time	Total	4	8	36	51	99	3,354
	Weight	4	16	108	204	332	
Travel Costs	Total	2	3	42	52	99	3,455
	Weight	2	6	126	208	342	
Income and Population Density	Total	15	25	31	28	99	2,765
	Weight	15	50	93	112	270	
Age and Profession Type	Total	25	28	31	15	99	2,364
	Weight	25	56	93	60	234	
Convenience of E-Bike Sharing Facilities	Total	7	20	39	33	99	2,990
	Weight	7	40	117	132	296	
E-Bike Sharing Infrastructure Completeness	Total	8	15	35	41	99	3,101
	Weight	8	30	105	164	307	
Safety and Security	Total	0	24	28	47	99	3,232
	Weight	0	48	84	188	320	
E-Bike Sharing Experience	Total	27	35	27	10	99	2,202
	Weight	27	70	81	40	218	
Environment	Total	15	20	31	33	99	2,828
	Weight	15	40	93	132	280	

Source: Analysis Results, 2024

Table 8 shows the weight of each factor influencing mode selection on E-Bike Sharing services with a four-level Likert Scale. The assessment weight is then used to rank the level of importance of the factors tested. The ranking of factors influencing the selection of the Electric bike-sharing mode in question can be seen in Table 9 below.

Table 9. Ranking of Influencing Factors for E-Bike Sharing Mode Selection In the Depok City Area with Likert Scale

Influence Factor	Weight	Rating
E-Bike Sharing Shelter Location	**3,566**	**1**
Travel Costs	**3,455**	**2**
Travel Time	**3,354**	**3**
Safety and Security	**3,232**	**4**
E-Bike Sharing Infrastructure Completeness	**3,101**	**5**
Travel Destination	3,051	6
Convenience of E-Bike Sharing Facilities	2,990	7
Environment	2,828	8
Income and Population Density	2,765	9
Age and Profession Type	2,364	10
E-Bike Sharing Experience	2,202	11

Source: Analysis Results, 2024.

In Table 9 above, it can be concluded that the 5 (five) E-Bike Sharing mode selection factors in the Depok City Region have the highest weights in order of the location of e-bike sharing shelters, travel costs, safety and security, travel time and completeness of e-bike sharing infrastructure. Thus, the five factors are the most influential in shifting modes using e-bike sharing in the Depok City Area. However, the weight results have a difference in value that is not much different. This is because the Likert scale is a fairly simple way of ranking. With this, further analysis is needed with the Analytical Network Process (ANP) method on the 5 (five) highest factors from the Likert scale results to determine a more representative weight of importance by respondents.

Determination of Attribute Levels and Scenarios

Based on the results of weighting with the ANP method, 3 (three) attributes are obtained that are the most influential factors in the selection of e-bike sharing modes between private motorbikes and online motorcycle taxis (online) in Depok City, namely cost savings, shelter radius, and travel time.

Cost-Effective Attributes of Travel

Travel cost savings are the main factor that influences the people of Depok City to use E-Bike Sharing as a feeder to the nearest KRL station. One of the main reasons people choose transportation such as online motorcycle taxis and private motorbikes is that the costs incurred are affordable for short distances. If the travel cost of e-bike sharing is cheaper than these modes, people tend to switch to e-bike sharing because getting to the KRL station is more cost-effective.

Information on the travel costs of private motorcycle vehicles and online motorcycle taxis are needed to determine the cost-effectiveness. The cost in question is the fuel cost for private vehicles, while online motorcycle taxis are charged in the form of rates per kilometer according to the trip's destination. According to Chairul (2015), the cost of travel by private motorcycle vehicles includes the price of fuel per kilometer with an optimum average vehicle speed of 54 km / h, amounting to Rp 1,294.74 / km for an annual vehicle mileage of 12000 km/year. In addition, the average parking tariff through Regional Regulation (Perda) No. 43/2013 for motorcycles is IDR 2,000 for the first hour and IDR 1,000 for each subsequent hour, with a maximum tariff of IDR 8,000. If the scenario of respondents traveling 4 kilometers to the station is applied, the cost incurred per private motorcycle is Rp. 13,178.95.

In addition, online motorcycle taxi tariffs in the Jabodetabek area can provide an indication of the cost of travel per kilometer. Based on the Decree of the Minister of Transportation of the Republic of Indonesia Number KP 348 Year 2022, online ojek tariffs in zone ii with a lower limit tariff of Rp 2,600 per kilometer and an upper limit tariff of Rp 2,700 per kilometer, with a minimum service fee of Rp 13,000 to Rp 13,500 for trips up to the first 4 kilometers. With the previously available data, the next interval can be determined for cost savings using e-bike sharing for private motorcycles and online motorcycle taxis by determining the difference in tariffs of three thousand rupiahs up to the highest tariff of Rp.9,000.

Attribute Distance to E-Bike Sharing Shelter

Ease of access and affordability of e-bike sharing shelters are also determining factors in mode shift. A distance too far between the user's residence or location and the e-bike shelter can make this system less attractive, especially if it is associated with the tariff incurred to use e-bike sharing. Shelters located in strategic locations such as dense residential and commercial areas can encourage higher adoption of e-bike sharing due to the influence of user decisions in choosing transportation modes.

The attribute of distance to the shelter is one of the key factors in evaluating public preferences for e-bike sharing services, especially in the context of switching from existing modes such as online motorcycle taxis and private motorbikes. This research considers scenarios of varying shelter distances, namely 100 meters, 200 meters, 350 meters, and 500 meters from respondents' homes, to understand the tolerance of access distance to e-bike sharing modes. In addition, each KRL station in the Depok City area is assumed to have an e-bike shelter, with an average distance from home to the station of about 4 km. With this approach, the research seeks to illustrate the extent to which the presence of closer shelters can increase user convenience and interest in choosing e-bike sharing as a mode of transportation. Determining the optimal access distance contributes to the service's sustainability and the efficiency of transportation mode integration in supporting environmentally friendly mobility in urban areas. The following is the scenario created by the author in this research.

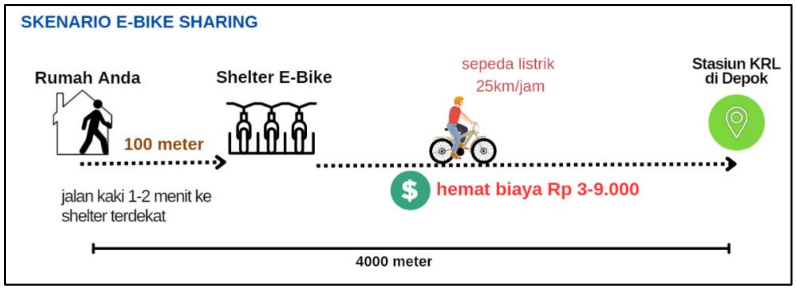

Figure 2. Scenario Distance to E-Bike Sharing Shelter 100 meters

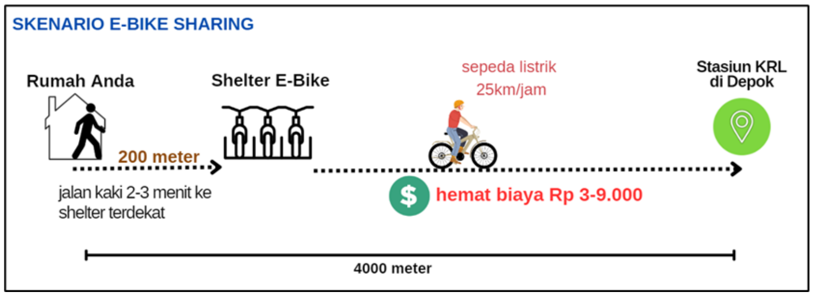

Figure 3. Scenario Distance to E-Bike Sharing Shelter 200 meters

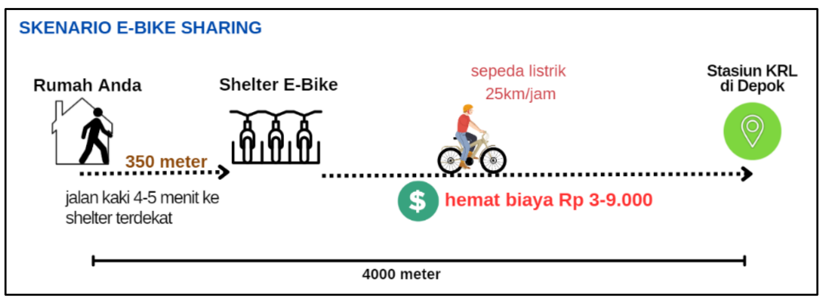

Figure 4. Scenario Distance to E-Bike Sharing Shelter 350 meters

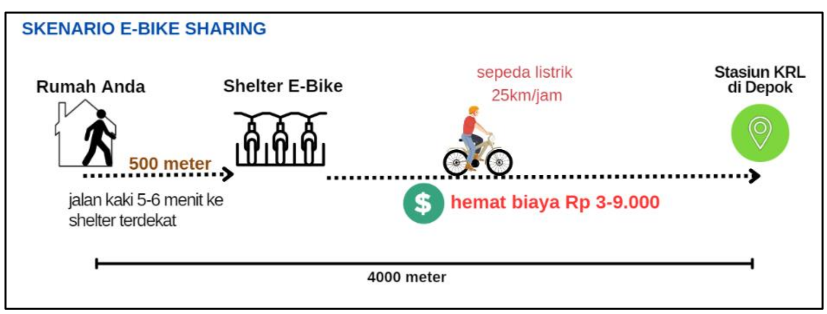

Figure 5. Scenario Distance to E-Bike Sharing Shelter 500 meters

Travel Time Attribute

In this research, the travel time attribute plays an important role in understanding people's preferences in Depok City to switch from existing modes of transportation, such as online motorcycle taxis and private motorbikes, to e-bike sharing services. Travel time is classified into four main categories: morning, afternoon, evening, and night. Each time category reflects different traffic conditions, mobility needs, and individual preferences. In the morning, users often focus on time efficiency due to the need to reach work or educational institutions on time. Meanwhile, during the day, trips are flexible with more diverse destinations, such as lunch or social activities.

In the afternoon, travel typically involves higher traffic density, mainly due to work or school commutes, influencing preferences for more convenient and time-saving modes of transportation. People's mobility needs may be more focused on convenience and safety at night, given that lighting conditions and activity tend to be less than at other times. Through preference analysis based on travel time attributes, this research aims to identify how e-bike-sharing services can meet users' needs in each time category.

Stated Preference Questionnaire Design

The Stated Preference questionnaire contains questions in conditions or scenarios offered to respondents (hypothetical scenarios). The scenario uses the attributes of cost and travel time with the intervals described in the previous sub-chapter.

Table 10. Hypothesis Combination of Online Ojek Users

Scenario	Distance to Shelter	Service Cost Savings	Decision to Use ***E-Bike Sharing*** **Service**
1	500 meters	IDR 3,000	"Yes" and "No"
2	500 meters	IDR 6,000	"Yes" and "No"
3	500 meters	Rp 9,000	"Yes" and "No"
4	350 meters	IDR 3,000	"Yes" and "No"
5	350 meters	IDR 6,000	"Yes" and "No"
6	350 meters	Rp 9,000	"Yes" and "No"
7	200 meters	IDR 3,000	"Yes" and "No"
8	200 meters	IDR 6,000	"Yes" and "No"
9	200 meters	Rp 9,000	"Yes" and "No"
10	100 meters	IDR 3,000	"Yes" and "No"
11	100 meters	IDR 6,000	"Yes" and "No"
12	100 meters	Rp 9,000	"Yes" and "No"

Table 11. Hypothesized Combination of Motorcycle Users

Scenario	Distance to Shelter	Service Cost Savings	Decision to Use ***E-Bike Sharing*** **Service**
1	500 meters	IDR 3,000	"Yes" and "No"
2	500 meters	IDR 6,000	"Yes" and "No"
3	500 meters	Rp 9,000	"Yes" and "No"
4	350 meters	IDR 3,000	"Yes" and "No"
5	350 meters	IDR 6,000	"Yes" and "No"
6	350 meters	Rp 9,000	"Yes" and "No"
7	200 meters	IDR 3,000	"Yes" and "No"
8	200 meters	IDR 6,000	"Yes" and "No"

Scenario	Distance to Shelter	Service Cost Savings	Decision to Use *E-Bike Sharing* Service
9	200 meters	Rp 9,000	"Yes" and "No"
10	100 meters	IDR 3,000	"Yes" and "No"
11	100 meters	IDR 6,000	"Yes" and "No"
12	100 meters	Rp 9,000	"Yes" and "No"

Twelve scenario combinations were offered to respondents. By offering changes in cost savings and distance to the shelter, respondents' preferences for the selected scenario will be obtained.

Stated Preference Survey Results

The stated preference survey activities were conducted in May - June 2024 and November 2024. The survey or data collection was carried out in 2 (two) ways: online and by direct observation. The first method is to spread the survey link to WhatsApp groups and social media. The form was made in the form of a website form with the URL https://docs.google.com/forms/d/e/1FAIpQLSfc8C6bjh8Vq1_g9fDJSXZPb8W9pCR07HsMdsJiJX mWTcSr5w/viewform which has been compiled and adjusted to the original form. The limited reach of social media resulted in limited data obtained, so direct observation was needed by interviewing the people of Depok City at Pondok Cina KRL Station and UI KRL Station. Based on the survey results, 63 questionnaire data were obtained. From the total data, sorting was carried out on data that was considered incomplete and incorrect answers, so the total data used in the analysis was 60, consisting of 30 respondents of online motorcycle taxi users and 30 respondents of private motorcycle users.

Table 12. Recapitulation of Respondent Characteristics

Respondent Characteristics	Classification	Percentage	Total
Gender	Male	38,18%	100%
	Female	61,82%	
Age Range	16-22 Years	3,64%	100%
	23-27 Years	63,64%	
	28-38 Years	21,82%	
	39-60 Years	10,91%	
	>60 Years	0%	
Type of Work	ASN/TNI/POLRI	16,36%	100%
	SOE/Private	60%	
	Entrepreneurship	9,09%	
	Student	1,82%	
	IRT	9,09%	
	Not working yet	3,64%	
Revenue	IDR 0-1 Million	3,70%	100%
	IDR 1-3 Million	7,41%	
	IDR 3-5 Million	14,81%	

Respondent Characteristics	Classification	Percentage	Total
	IDR 5-10 Million	53,70%	
	IDR 10-15 Million	14,81%	
	>Rp 15 Million	5,56%	
Transportation Funding Source	Dana Mandiri	96,43%	100%
	Agency/Company Funds	3,57%	

Table 13. Personal Vehicle Ownership of Respondents in Depok City

No.	Number of Vehicles	Percentage
1	0 units	0%
2	1 unit	47,73%
3	2 units	34,09%
4	3 units	13,64%
5	4 units	4,55%
	Total	100%

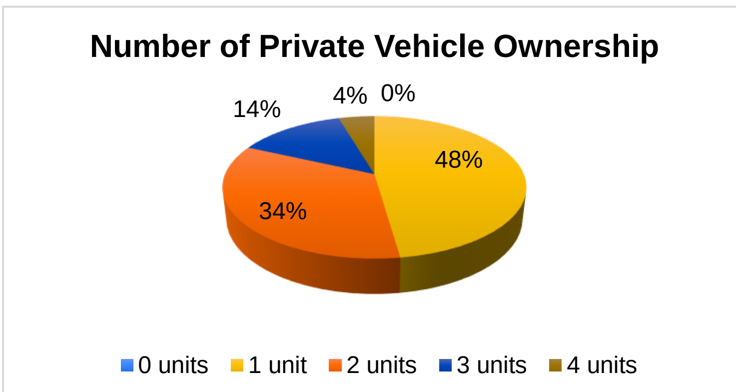

Figure 6. Number of Vehicle Ownership of Respondents in Depok City

Based on Figure 6, all respondents have private vehicles, either motorbikes or private cars, with the highest number being 1 unit at 47.74%. This data can later be used as a reference to determine the mode selection model.

Utility Model

Table 14. Utility Model Parameters of Online Ojek Users

Parameters		Estimate	Std. Error	t-value	Pr(>t)	Significant
ASC.EBike	β_0	3.0464+00	5.355e-01	5.689	1.28e-08	***
Cons.Save_Cost	β_1	1.782e-04	6.082e-05	2.920	3.40e-03	***
Cons.Distance_Shelter	β_2	-9.150e-03	1.139e-04	-8.028	9.89e-16	***
Cons. Time_Travel	β_3	-3.637e-01	1.205e-01	3.015	2.57e-03	***
Log Likelihood			-147,8225			

Source: Analysis Results, 2024

To find out how much influence the attribute has on the model, it is necessary to compare the t-value with the t-table. If the t-value is greater than the t-table value, then the attribute in the model has a big influence. But if the t-value is smaller than the t-table value, the attribute has less or no effect. If it is known that the value of α = 0.05 and the number of respondents is 30, then the t-table value on the statistical modeling of online motorcycle taxi users is 1.699167 or -1.699167 (2 tailed). Table 5.6 shows that the t-value is greater than the t-table value, so the cost-effective attributes and distance to the shelter are very influential on the model formed.

In the RStudio application, the significance value is denoted by a dot (.) and an asterisk (*). Attributes are declared significant if the running results contain stars (either * or ** or ***). The more asterisks, the more important. But the attribute is declared insignificant if it does not have an asterisk ( ) or a dot (.). In Table 5.6, it can be seen that three stars symbolize all attributes, so in the statistical modeling of online motorcycle taxi users, cost-effective attributes and distance to the shelter have a significant influence on the model formed.

The log-likelihood value shows whether a model is good or not. The smaller the log-likelihood value, the better the model. In Table 5.6, the log-likelihood value of online motorcycle taxi user modeling statistics is -153.9983, which shows that the model made is good.

Table 15. Utility Model Parameters for Private Motorcycle Users

Parameters		Estimate	Std. Error	t-value	Pr(>t)	Significant
ASC.EBike	$\boldsymbol{\beta_0}$	4.099+00	5.9489e-01	7.141	5.56e-12	***
Cons.Save_Cost	$\boldsymbol{\beta_1}$	1.932e-04	6.5644e-05	2.944	3.24e-03	***
Cons.Distance_Shelter	$\boldsymbol{\beta_2}$	-1.327e-02	1.405e-04	-9.445	< 2e-16	***
Cons.Time_Travel	$\boldsymbol{\beta_3}$	-4.6875e-01	2.143e-01	2.187	2.872e-02	**
Log Likelihood			-130.56560			

Source: Analysis Results, 2024

If it is known that the value of α = 0.05 and the number of respondents is 30, then the t-table value on the statistical modeling of online ojek users is 1.699167 or -1.699167 (2 tailed). Table 15 shows that the t-value is greater than the t-table value, so the cost-effective attributes and distance to the shelter are very influential on the model formed. For the significance value in the modeling statistics of private motorcycle users, the cost-effective attribute and distance to the shelter significantly influence the model formed. Modeling in Table 15 has also been said to be good because the log-likelihood value in statistics is -130.5650.

After the utility function parameters are obtained, the utility equation model in this research can be formed. The utility equation of travelers who are willing to switch to using e-bike sharing is symbolized by the form U_EBS, and it is influenced by cost savings and the distance to the nearest shelter.

Table 16. Utility Function

Utility Function	Description
$\boldsymbol{U_{EBS-MOD} = 3,0464 + 0,000178\,X1 - 0,00915\,X2 + 0,36327\,X3}$	Online Motorcycle Taxi
$\boldsymbol{U_{EBS-SMP} = 4.0991 + 0,000193\,X1 - 0,01327\,X2 + 0,46875\,X3}$	Private Motorcycle

Where:

$U_{(EBS-MOD)}$: Utility function between E-Bike Sharing and Online Motorcycle Taxi
$U_{(EBS-SMP)}$: Utility function between E-Bike Sharing and Private Motorcycle
X_1 : Cost Savings
X_2 : Distance to Shelter
X_3 : Travel Time

Based on Table 16, the ulitiltas function model between online motorcycle taxi users and private motorcycles is the same. It can be seen that both constants have positive values. So if the cost savings parameter (X_1) and the distance to shelter parameter (X_2) are 0 (zero), then the utility value of e-bike sharing is greater than the utility value of online motorcycle taxis and motorcycle users.

The travel time savings parameter (X_1) value in both utility functions has a positive value. So, the greater the value of (X_1) (the greater the cost savings), the value of the utility difference will increase (the probability of users switching to e-bike sharing increases, and the likelihood of online motorcycle taxi and private motorcycle users will decrease). On the other hand, the service tariff parameter (X_2) value in both utility functions has a negative value. So, the greater the value of (X_2) (the further the distance to the e-bike sharing shelter), the value of the utility difference will decrease (the probability of e-bike sharing users decreases, and the likelihood of online motorcycle taxi users and private motorcycles will increase).

Logit Model Development

The results of the binomial logit model in this research can be seen in Table 5.9.

Table 17. Binomial Logit Model

Mode Selection Model	Description
$P_{EBS} = \frac{e^{U_{EBS}-U_{MOD}}}{1+e^{U_{EBS}-U_{MOD}}}$ $P_{EBS} = \frac{e^{3,0464+0,000178\,X1-0,00915\,X2+0,36327\,X3}}{1+e^{3,0464+0,000178\,X1-0,00915\,X2+0,36327\,X3}}$	*Online* Motorcycle Taxi
$P_{MOD} = \frac{1}{1+e^{Ui}}$ $P_{MOD} = \frac{1}{1+e^{3,0464+0,000178\,X1-0,00915\,X2+0,36327\,X3}}$	
$P_{EBS} = \frac{e^{U_{EBS}-U_{SMP}}}{1+e^{U_{EBS}-U_{SMP}}}$ $P_{EBS} = \frac{e^{4.0991+0,000193\,X1-0,01327\,X2+0,46875\,X3}}{1+e^{4.0991+0,000193\,X1-0,01327\,X2+0,46875\,X3}}$	Private Motorcycle
$P_{SMP} = \frac{1}{1+e^{Ui}}$ $P_{SMP} = \frac{1}{1+e^{4.0991+0,000193\,X1-0,01327\,X2+\,0,46875\,X3}}$	

Model Sensitivity

To determine the probability of switching the e-bike sharing mode offered in the Depok City Area, it is necessary to make a sensitivity diagram with the previously obtained model to see changes in the probability value. Sensitivity graphs for online motorcycle taxi (OD) and private motorcycle (MP) users are presented in the following figure.

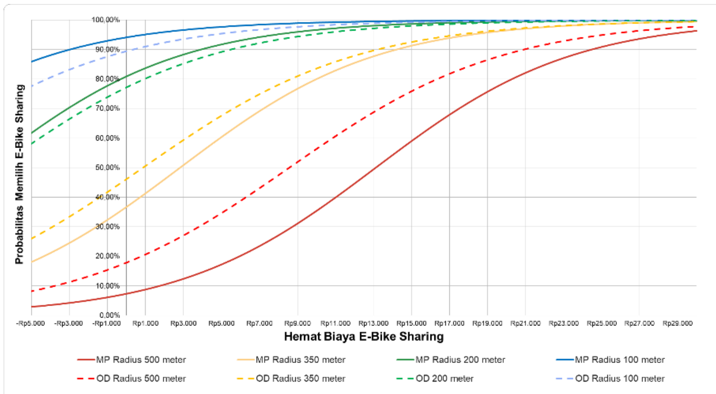

Figure 7. E-Bike Sharing Sensitivity Diagram to Cost Savings

The probability diagram above is depicted in 2 (two) dimensions: the x-axis and y-axis. The x-axis represents cost savings, and the y-axis represents the probability of choosing e-bike sharing in Depok City to the nearest station. From the sensitivity diagram obtained above, if taken, for example at the level of cost savings of Rp 6,000 and Rp 9,000, the graph shows the difference in the probability value of users choosing e-bike sharing services based on the mode of transportation used and the distance to the shelter as follows:

Table 18. Willingness to Choose E-Bike Sharing Service in Depok City

User	Shelter Radius	Probability when saving Rp 3,000	Probability when saving Rp 6,000	Probability when saving Rp 9,000
Online Motorcycle Taxi	500 meters	27,05%	38,01%	54,75%
	350 meters	59,38%	69,69%	81,93%
	200 meters	85,22%	89,60%	94,45%
	100 meters	93,50%	95,41%	97,62%
Private Motorcycle	500 meters	12,40%	20,21%	35,11%
	350 meters	50,87%	64,14%	79,26%
	200 meters	88,34%	92,67%	97,62%
	100 meters	96,62%	97,90%	99,32%

The results show that the probability value generated at a distance of 100 (one hundred) meters and 200 (two hundred) meters shelter, the probability value of private motorcycles is greater than online motorcycle taxi users. Whereas for shelter distances of 350 (three hundred and fifty) meters and 500 (five hundred) meters, the probability value generated by private motorcycle users is smaller than that of online motorcycle taxi users. This is due to differences in the characteristics of users of the 2 (two) modes.

Physical access barriers are almost non-existent at shorter distances of 100-200 meters. In this situation, private motorcycle users will more easily consider switching to e-bike sharing as they tend to be more sensitive to parking fees, congestion, and convenience for short trips to the nearest station. In addition, the cost savings become an additional intensive that is very competitive for private motorcycle users to switch. As for online motorcycle taxi users, the accessibility benefits of this close shelter distance may not be too significant because the door-to-door facilities provided by online motorcycle taxis are already sufficient.

For longer distances of 350-500 meters, the probability of online motorcycle taxi users switching to e-bike sharing is higher than that of private motorcycle users because e-bikes offer the same comfort as a private vehicle, thus reducing external driver dependence and providing users with flexibility in traveling.

In addition, in terms of cost savings in the previous probability graph, it was found that although the cost of using e-bike sharing is more expensive than transportation modes such as online motorcycle taxis or private motorbikes (indicated by negative cost savings), there is still a significant probability that users still choose e-bike sharing. This can be explained through several factors, such as accessibility, convenience, flexibility, privacy, and time efficiency. Perceived value-added factors such as the use of modern technology and being environmentally friendly are also attractions for switching to e-bike sharing despite the additional costs.

Discussion

The findings of this research align with previous research on micromobility adoption and user preferences. Research conducted by (Jaber et al., 2023) emphasized that pricing, accessibility, and travel time efficiency significantly influence users' willingness to shift from private vehicles to micromobility services. In this research, cost savings and shelter distance emerged as key determinants in the adoption of e-bike sharing, reinforcing the argument that financial incentives and convenient access can drive mode shifts toward more sustainable transportation alternatives.

Moreover, the probability analysis indicating a higher likelihood of private motorcycle users switching to e-bike sharing at shorter distances (100-200 meters) corroborates the findings of (Safar et al., 2024), which suggest that travelers are more likely to adopt micromobility options when accessibility barriers are minimal. This is particularly true for private vehicle users who are more sensitive to operational costs, parking fees, and congestion-related inconveniences, making e-bike sharing a competitive alternative. Conversely, at distances of 350-500 meters, online motorcycle taxi users exhibit a higher probability of switching, which supports the argument by (Faris F, 2023) that convenience and flexibility play a crucial role in transportation mode decisions. The ability to travel independently without relying on a driver contributes to the appeal of e-bike-sharing services, particularly for longer distances.

Additionally, the influence of modern and environmentally friendly perceptions in e-bike-sharing adoption echoes the findings of (Monde, 2024), which highlight that sustainability concerns and the appeal of innovative mobility solutions significantly impact urban transportation choices. The increasing global emphasis on reducing carbon emissions and promoting green mobility solutions aligns with the growing interest in micromobility services, particularly in cities with congestion and environmental concerns such as Depok.

Despite these promising findings, challenges remain in ensuring the seamless integration of e-bike sharing with existing public transportation networks. (Wartono et al., 2024)) argue that for micromobility to be an effective first- and last-mile solution, adequate infrastructure, including dedicated lanes and well-planned docking stations, must be in place. This research supports that assertion by highlighting the need for strategic shelter placement to optimize adoption rates. Furthermore, (Gumasing, 2025) stress the importance of user education and awareness in enhancing micromobility adoption, as misconceptions about e-bike-sharing services may hinder broader acceptance.

CONCLUSION

The conclusion of this research shows that there are three main factors that influence the choice of e-bike-sharing services in Depok City: travel cost savings, distance to shelters, and travel time. The binomial logit model shows that the probability of choosing e-bike sharing services over online ojeks and private motorbikes varies by distance. At a distance of 100-200 meters, private motorcycle users are more likely to switch to e-bike sharing because of cost savings and ease of access. On the other hand, at a distance of 350-500 meters, online ojek users are more likely to switch, driven by convenience, flexibility, and privacy considerations. Although the cost of e-bike sharing is relatively higher, factors such as accessibility, modernity, and environmental benefits contribute to its appeal.

This research provides valuable insights for policymakers and service providers in optimizing e-bike sharing systems to increase adoption. Future research should focus on conducting comprehensive feasibility analyses, including financial feasibility and long-term user retention, to assess the sustainability of e-bike-sharing services. In addition, exploring behavioral shifts influenced by technological advances and policy interventions can provide deeper insights into the transformation of urban mobility.

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