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Effectiveness of Electric Bus Stops on Corridor 5 (Merdeka Square – Tembung) in Medan City

Noviyantini Pakpahan[1*], Anthoni Veery Mardianta[2*], Gina Cynthia Raphita Hasibuan[3]

[1,2,3] Program Studi Magister Teknik Sipil, Fakultas Teknik, Universitas Sumatera Utara, Medan, Indonesia

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ABSTRACT

Good public transport services are determined not only by the operational performance of vehicles, but also by the quality of bus stop facilities that are safe, comfortable and easily accessible to the public. The method used in this study is an analysis of operational performance based on the Decision of the Director General of Land Transportation No. 271/HK.105/DRJD/96 through a survey conducted on board buses, using parameters including load factor, headway, journey time, and vehicle stopping time. In addition, the Importance Performance Analysis (IPA) and SWOT methods were used to evaluate the level of bus stop service based on user perceptions. Data processing was carried out using IBM SPSS software. The results of the study indicate that the operational performance of public transport is relatively good but not yet optimal. Vehicle stopping time and travel time between bus stops are relatively efficient; however, load factors and the distance between buses still show variation, indicating that service regularity is not yet fully consistent. The IPA analysis reveals that the importance score (MIS) is higher than the performance/satisfaction score (MSS), suggesting that bus stop services have not yet fully met user expectations.

Corresponding Author:

Noviyantini Pakpahan,
Program Studi Magister Teknik Sipil, Fakultas Teknik, Universitas Sumatera Utara, Medan, Indonesia.
Email: noviyantinipakpahan@gmail.com

1. INTRODUCTION

The development of urban transportation systems in various countries demonstrates a paradigm shift toward more efficient, scheduled, and environmentally friendly public transportation services. In Indonesia, the policy to accelerate the adoption of battery-based electric motor vehicles through Presidential Regulation No. 55 [1] has triggered the operation of electric buses in several major cities. This program demonstrates the government's commitment to providing environmentally friendly transportation while reducing dependence on fossil fuels. However, a major challenge arises when the electric buses provided by the government are not accompanied by a service strategy that attracts passengers. Muhammad Nanang Prayudyanto [2] emphasized the importance of integration between bus facilities, bus stops, and operational management in urban mass transportation systems. Without such integration, service performance will decline and people will tend to be reluctant to switch to public transportation.

Medan City as one of the metropolitan cities in Indonesia that faces high levels of congestion. Tom-Tom Traffic [3] places Medan as the second most congested city in Indonesia with a congestion level reaching 40% and an average travel time of 32 minutes for a distance of 10 kilometers. As an effort to overcome this problem, the Medan City Government has operated an Electric bus which is a transition between the existing Trans Metro Deli service and the Mebidang Integrated Bus Raya plan. The trial began on the J. City - Plaza Medan Fair corridor since January 4, 2024. The Medan City Government then took over all Teman Bus corridors, Trans Metro Deli on August 20, 2024. All Trans Metro

Deli fleets were replaced by electric buses since November 2024. It is known that 60 electric buses are operated in 5 corridors, namely corridor 1: Amplas terminal - Merdeka Square - Pinang Baris, corridor 2: J City - Plaza Medan Fair, corridor 3: Belawan - Merdeka Square, corridor 4: Tuntungan - Merdeka Square and corridor 5: Tembung - Merdeka Square [4].

Corridor 5 itself is a vital route serving travel from the city center to densely populated residential areas in eastern Medan. However, on the ground, government-operated electric buses often operate with low load factors, particularly during off-peak hours, resulting in underutilization of available seating capacity. Pratama [5] found that many bus stops on this corridor do not meet technical standards, and bus occupancy rates vary, with a tendency to be low during off-peak hours. This indicates a gap between bus fleet availability and actual public utilization.

According to a media report by Detik Sumut [6] the Medan City Government (Pemkot) has budgeted Rp. 143.6 billion for management related to electric buses in Medan. This condition poses a risk that the government's large investment in providing electric buses will be wasted or less effective if it is not accompanied by serious efforts to increase passenger occupancy on electric buses. In other words, the presence of electric buses in Medan is not just a symbol of transportation modernization, but must be ensured to provide real benefits by increasing the load factor through the integration of adequate bus stops and efficient operational arrangements [7].

Therefore, a study on the integration of bus stops and electric bus operations to support the optimization of occupancy rates on the Merdeka Square–Tembung Corridor 5 is highly relevant [8]. This research is expected to provide empirical understanding of how bus stop quality, passenger satisfaction with the stops, and other operational strategies influence electric bus occupancy rates. Thus, the research results can provide input for the government in ensuring that the provision of electric buses is not a wasted investment, but is truly utilized by the public as an effective, efficient, and sustainable mode of transportation.

2. RESEARCH METHOD

The data collection location was carried out by following the route taken by the Electric Bus on the Tembung – Merdeka Square route. For the Tembung – Merdeka Square route, the roads traveled were Jl. Letda Sujono – Jl. Prof. HM. Yamin – Jl. St. Ka. Meanwhile, the Merdeka Square – Tembung route. The route taken is Jl. St. KA – Jl. Train – Jl. Pulau Pinang – Jl. City Hall – Jl. Prof. HM. Yamin – Jl. Merak Orange Princess – Jl. Pioneers of Independence – Jl. Prof. HM. Yamin – Jl. Lieutenant Sujono.

The distribution of questionnaires and surveys conducted on the bus regarding load factors, vehicle capacity, stopping time, and the time between stops will be conducted for 3 days, namely Sunday to represent holidays, Monday and Wednesday to represent working days. The survey will be conducted on the bus during peak hours, namely in the morning at 07.00-09.30 and in the afternoon at 15.00-17.00. The research methodology is structured as a series of flowcharts that show the stages of research implementation. The scope and stages of the research can be seen in the flowchart as in Figure 3.2 below [9].

Secondary data were obtained from official agencies and supporting literature, especially the Medan City Transportation Agency, electric bus operators, and academic library sources. The data collected included the number and capacity of the electric bus fleet operating on Corridor 5 Merdeka Square – Tembung; the number of electric bus passengers since the start of operations until the research period; [10].

Primary data is data obtained directly from the field through observation and questionnaires. Primary data collection in this study was conducted to obtain a picture of the actual operational conditions of the Trans Medan Electric Bus and the quality of bus stops (halts), as well as to determine user perceptions of the services provided [11].

Electric bus operational observation data obtained through direct field observations. This data includes headway (the time between buses), travel time, dwell time at each stop, vehicle capacity, and passenger occupancy rate (load factor). This data is used to determine the operational performance of electric buses in serving passengers on the studied corridors.

Observation data for bus stops were obtained through a direct survey of the physical condition of the bus stops. This data includes the physical condition of the stops, the availability of main facilities, the level of accessibility, comfort, security, and the distance between stops [12]. This observation aims to assess the suitability of the bus stop conditions with the applicable minimum service standards (SPM). Respondent perception data were obtained through distributing questionnaires to Trans Medan Electric Bus users. The questionnaire was compiled using a Likert scale with a value range of 1 to 5, which describes the level of respondents' assessment of the quality of the bus stops. The assessment was carried out based on two aspects, namely the level of performance and the level of importance, so that it can be analyzed using the Importance Performance Analysis (IPA) method.

The sampling technique in this study used probability sampling with simple random sampling. Based on the data obtained, the total number of passengers during the three months was 73,386 people. Furthermore, to obtain an average number of passengers, a monthly average was calculated by dividing the total number of passengers by the number of months of observation, resulting in an average of 24,462 people per month [13].

According to Sugiyono [14] a research variable is anything determined by the researcher to be studied to obtain information about it and then draw conclusions. In this research, there are two types of variables: independent variables and dependent variables.

The independent variables in this study were structured based on bus stop quality indicators, which refer to the Minimum Service Standards (SPM) for public transportation. The independent variables comprise six main dimensions: affordability, security, safety, comfort, equality (accessibility), and regularity of service and facilities.

The data processing process in this study was carried out to transform raw data obtained from the field into information ready for statistical analysis. The stages of data processing are explained as follows: Primary data were obtained through on-board surveys, observations of bus stop and bus stop conditions (TPB), and distribution of questionnaires to users of the Medan City Electric Bus Corridor 5 route Lapangan Merdeka–Tembung. Operational observation data were grouped based on public transportation performance parameters according to the Decree of the Director General of Land Transportation No. 271/HK.105/DRJD/96, including load factor, headway, travel time, and vehicle stopping time. Meanwhile, questionnaire data were grouped based on variables of affordability, security, safety, comfort, accessibility, and regularity of bus stop facilities. All data were then entered into Microsoft Excel to check for completeness, consistency, and coding process before further processing [15].

The coded questionnaire data was then processed using IBM SPSS Statistics software version 25. Validity testing was conducted using the Pearson Product Moment method to determine the relationship between item scores and total variable scores. The instrument was declared valid if the calculated r value was greater than the table r at a significance level of $\alpha = 0.05$. Furthermore, reliability testing was conducted using the Cronbach's Alpha method to determine the level of consistency of respondents' answers. The instrument was declared reliable if the Cronbach's Alpha value ≥ 0.60 [16].

Public transportation service parameters include load factor, headway, travel time, and vehicle stopping time. This analysis aims to determine the level of operational effectiveness of the Medan City Electric Bus Corridor 5 based on applicable public transportation service standards [17]. The results of the analysis are presented in the form of tables, graphs, and descriptions of operational conditions in the field. Customer Satisfaction Index (CSI) is a measurement method used to determine the level of passenger satisfaction with the services of the Trans Medan bus stops that have been experienced (Umam et al., 2018). Finding the CSI calculation can be obtained from the customer satisfaction index value [18].

The Importance Performance Analysis (IPA) method is used to analyze the level of importance and user performance/satisfaction with bus stop and shelter services [18]. The analysis is conducted based on the average value of the level of importance (MIS) and the level of satisfaction/performance (MSS) for each service indicator, which includes affordability, security, safety, comfort, accessibility, and the regularity of bus stop facilities [19]. The IPA results are then visualized in a Cartesian diagram and a spider chart to identify service attributes that are the main priority for improvement.

The results of the IPA analysis were then used as the basis for compiling a SWOT analysis to formulate a strategy for improving bus stop and shelter services on Corridor 5 of Medan City. The SWOT analysis was conducted by identifying strengths, weaknesses, opportunities, and threats based on the existing conditions of bus stop services. The results of this analysis were used to formulate strategic recommendations in the form of providing decent, safe, comfortable, and easily accessible bus stops to improve service quality and public interest in using Medan City's electric buses [20].

3. RESULTS AND DISCUSSION

Condition Existing Bus Stops and Places Bus Stop (TPB)

Route stops and places electric bus stop (TPB) corridor 5

For give description about track electric bus service being studied, then route data and a list of stops on Corridor 5 that serve journey from Merdeka Square to Bandar Khalipah and vice versa. Presentation of this data aim for identify eligibility facility bus stop. Electric bus route Corridor 5 is presented in table 1 below.

Table 1. Corridor 5 Electric Bus Routes

Merdeka Square - Bandar Khalipah route	Route Bandar Khalipah - Merdeka Square
Stop Independence Square	Stop Bandar Khalipah Station
Stop Agarwood	TPB Simpang Match 2
Cultural Park Bus Stop	TPB Simpang Bandar Setia 2
Stop Methodist 3	TPB Kua Percut Sei Tuan 2
TPB Struggle 45	TPB Gas Station 2
TPB Ibrahim Umar	TPB Fighters Second Lieutenant Sujono 2
TPB Sentosa	Sei Padang 2 Bus Stop
TPB Literacy	Budi Satrya High School TPB
TPB Mandala Bypass	Joint TPB 2
Joint TPB	TPB Mandala Bypass 2

Bandar Selamat Toll Road	TPB Literacy 2
TPB Sei Padang	TPB Sentosa 2
TPB Fighters Second Lieutenant Sujono	TPB Ibrahim Umar 2
TPB Prayatna Medan	Pringadi TPB
TPB Gas Station	TPB Simpang Thamrin
TPB Kua Percut Sei Tuan	TPB Simpang Sutomo
TPB Simpang Bandar Setia	Stop Medan Station
TPB Simpang Partner	Stop Independence Square
Stop Bandar Khalipah Station	

(Source: Developed by the Author)

Based on results identification to electric bus routes on Corridor 5 serving track Merdeka Square – Bandar Khalifah and directions on the contrary, as presented in Table 1 Electric Bus Route Corridor 5, it is known that system services implemented is pattern operational two direction (*bidirectional service*) with amount relative stop balanced, namely as many as 5 stops and 14 TPB in the direction departure serts 4 bus stops and 14 TPB in the direction back. Difference amount stop This show existence adjustment common operations in system transportation urban areas, especially as response to condition geometric road, pattern Then cross, and need service passengers. According to Vukan R. Vuchic in study system transportation urban, differences point stops on the same route is common things happen as form optimization efficiency operations bnnal and safety Then cross [21].

In a way spatial distribution stops on the route This reflect spatial structure divided urban areas to in several service zones, namely the central zone city (*central business district),* transition zone, and suburban zone. *The* bus stops are located in the area center cities, such as Merdeka Square, Gaharu, Taman Budaya, and Juang 45, show characteristics area with intensity activity functional height as center activity economic, social, and governmental. Furthermore, the transition zone is represented by the bus stop such as Aksara, Mandala Bypass, Bersama, and Sentosa play a role as a transition area with pattern use land mixture. Meanwhile that, the peripheral zone which includes stop such as the KUA Percut Sei Tuan, Simpang Bandar Setia, and Bandar Khalipah Station reflect area with density more low functioning as area settlement and expansion areas city. Zoning pattern This in line with draft structure cities and systems transportation as stated by Ofyar Z [22]. Tamin who stated that network transportation public ideally connect center activity main with area buffer in a way efficient

In addition, the existence of integrated bus stops with knot transportation others, such as Bandar Khalipah Station and Medan Station, showing that electric bus routes on Corridor 5 has adopt principle integration intermodal *integration.* This integration is one of the indicator important in increase performance system transportation public, because allows occurrence displacement more modes easy, fast, and efficient [13]. In perspective planning transportation sustainable, integration intermodal contribute to improvement Power competition transportation public compared to vehicle personal [14].

In a way general, the most frequently used facilities available is signs instructions and in a number of case seating, though its existence Not yet evenly throughout point. Meanwhile that, the facilities important like board information route, bus stop markings, identity Name termination, as well as lighting Still dominant No available in some big bus stops and TPB. This is show that aspect provision information and convenience users Still Not yet fulfilled optimally.

In addition, there are a number of point same stop very No own facility supporters, which indicates that point the Not yet fulfil standard as place a proper dismissal. On the other hand, only a number of stop certain things that can categorized relatively complete compared to others [23].

Based on results recapitulation, can concluded that level completeness facility stops and TPB on the route under review Still classified as low and not yet evenly. Most of point termination Not yet fulfil criteria minimum facilities, especially in matter provision information route, identity bus stops, and lighting. Therefore that, is necessary improvement and arrangement facility in a way comprehensively so that it can support comfort, security, and convenience access information for users electric bus service [15].

Findings This in line with a number of study previously by Yermadona, as in the evaluation facility Trans Padang bus stops and TPB which show that Lots bus stop / TPB no fulfil condition completeness facilities, although distance between bus stops /TPB in general Already Enough good ; research it also concludes existence the need improvement facility general For increase comfort and accessibility users. On the other hand, research by Farhan and Hidayat facility Trans Jogja bus stop shows that although part big stop Already own more of 50% minimum facilities, TPB tends to there are still very minimal facilities, so need arrangement and improvement facility in a way comprehensive at all points- unfinished termination fulfil standard. Compared with research research- that, your research confirms similar patterns However more emphasize on aspects information route and identity the bus stop that became weakness main on the facility electric bus stops and TPB, so that recommendation improvement facilities in your research can viewed as development logical from findings- previously, especially in context demanding electric bus mode availability more information and explanation Good [24].

Interview results with officer Electric bus operations also show that condition facility supporters in several bus stops and points bus stops (TPB) are still not optimal. Officers convey that there is a number of signs stop and signs supporters others who have No available again in the field. This is caused by action taking or theft by unauthorized parties responsible answer. As a result, some location termination become not enough clear for passengers, especially for users new ones who are not familiar with electric bus route. Conditions This Of course impact on the decline level comfort and convenience accessibility service transportation public. In addition, the loss of signs also have the potential cause irregularity in the process of going up and down passenger Because No existence clear marker as point termination official [25].

Distance between stops based on usage land

Analysis to location bus stops and points stops on the Merdeka Square – Tembung Electric Bus corridor done For know level suitability facility transportation general to standard technical placement applicable bus stops. Evaluation This important done Because existence stop No only functioning as high and low points passengers, but also influence to aspect safety, comfort users, accessibility, and smoothness current Then cross in the area urban areas. In research this, assessment condition existing done with compare results survey field to provisions stated in the Director General's Decree Land Transportation Law Number 271 of 1996 concerning Engineering Technical Guidelines Place Stop Vehicle General Passenger. Parameters analyzed covering distance stop to intersection road, proximity stop with area education, region office / trade, as well as area settlements [26]. Each parameter has standard distance different services in accordance characteristics of use land and intensity activity area.

Public Transport Performance Parameters

Performance parameters analyzed in study This covering factor load factor, time dwell time, time between arrival (*headway*), time Wait passengers, speed travel, as well as time journey [17]. All of these parameters each other related and used For evaluate level efficiency, effectiveness, and quality service transport general on the corridor being reviewed. Data collection was carried out with method observation direct use four surveyors who were inside vehicle (*on-board survey*). Each surveyor is tasked with record data on each stops /TPB passed, including time arrival and departure vehicles, number passengers boarding and alighting, as well condition operational others. With method this, the data obtained more accurate Because follow movement vehicle in a way continuous throughout route journey.Division of surveyors in One vehicle aim For minimize error recording as well as ensure all over observed variables can documented with good. In addition, the method this also allows detailed observation of pattern service transport general, including time stop at every bus stops and dynamics amount passenger throughout journey [27].

If reviewed in a way spatial, occurs decline level occupancy in a way gradually from stop beginning going to stop end. This is seen clear on the point end route such as TPB Simpang Match and TPB Bandar Khalipah Station which has level lowest occupancy, with minimum value reaches 3% in some period time. Condition This indicates that distribution passenger No evenly and tend to concentrated in the central region city.

In a way overall, average occupancy value passenger Still was below 50 % across the board period time, which shows that bus capacity of 35 passengers Not yet utilized in a way maximum.

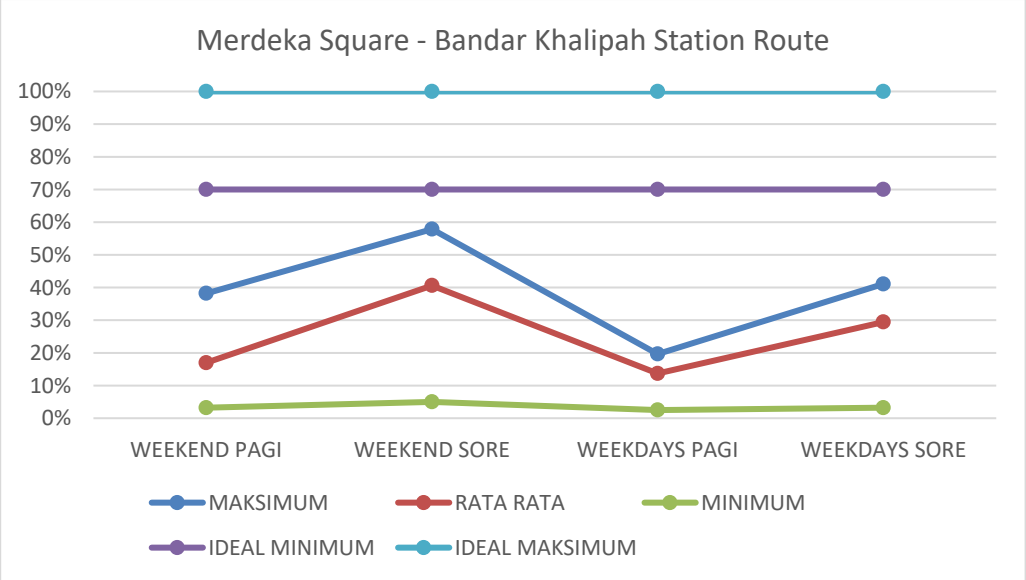

Figure 1. Graph mark route *load factor* field Merdeka - Bandar Khalipah Station
Source: Director General's Decree Land Transportation No. SK.687/AJ.206/DRJD/2002

Based on chart *load factor* on the route Merdeka Square – Bandar Khalipah Station, obtained that mark maximum *load factor* is in the range of 20% to 58%, while average value only range between 14% to 40%. This value Still be under

ideal standards based on the Director General's Decree Land Transportation No. SK.687/AJ.206/DRJD/2002, namely by 70–100% of capacity vehicle seats and a maximum of 100% of total vehicle capacity [28].

In a way overall, average occupancy value passengers throughout period Still is below 50 %, which shows that bus capacity of 35 passengers Not yet utilized optimally. However Thus, there are indication that direction journey going to center city own potential more requests high, especially during the period *weekend* afternoon [29].

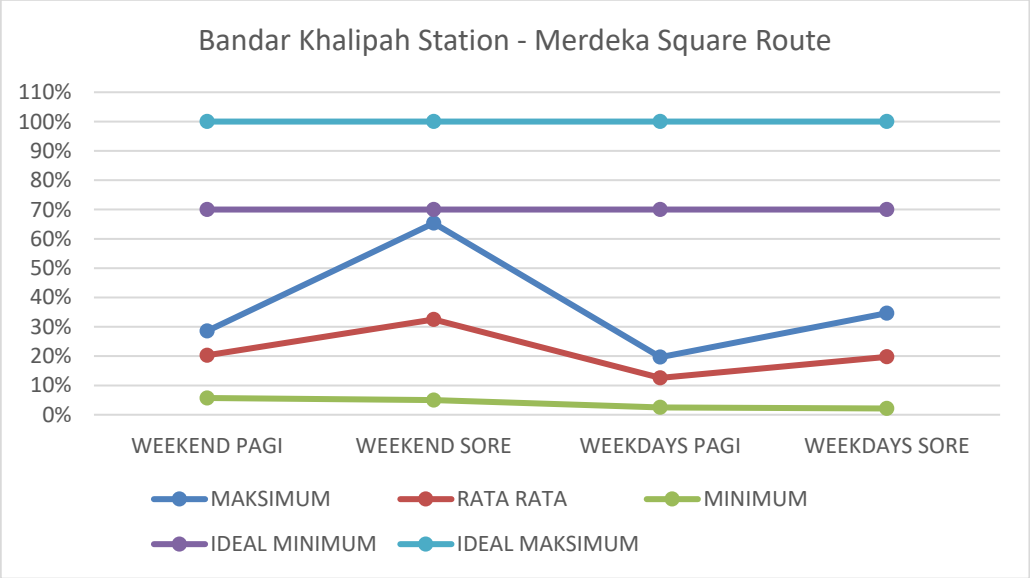

Figure 2. Graph mark route *load factor* Bandar Khalipah Station - Lapangan independent
Source: Director General's Decree Land Transportation No. SK.687/AJ.206/DRJD/2002

Based on chart *load factor* on the route Bandar Khalipah Station – Merdeka Square, obtained that mark maximum *load factor* is in the range of 20% to 65%, while average value ranges between 13% to 33%. The minimum *load factor value* is in the range around 2% to 5%. When compared with ideal standards based on the Director General's Decree Land Transportation No. SK.687/AJ.206/DRJD/2002, namely by 70–100% of capacity vehicle seats and a maximum of 100% of total vehicle capacity, all mark load *factor* obtained Still be under ideal standards. Highest *load factor* value occurred in the period *weekend* afternoon with mark maximum reach around 65%, which shows existence improvement amount passengers during the period said. Meanwhile that, value lowest occurs on *weekdays* Morning with maximum *load factor* only around 20%, which indicates low level occupancy vehicle at the time This pattern show that activity passenger tend increases in the afternoon compared to Morning day [30].

In a way overall, results analysis show that level occupancy passengers on the route This Still classified as low, so that capacity vehicle Not yet utilized optimally. Although there is improvement *load factor* in the period certain, the value obtained Still Not yet reach ideal service standards transport general [31]. This is show that operational transport common on the route Bandar Khalipah Station – Merdeka Square still not enough efficient from side utilization capacity vehicle.

Time analysis distance traveled per stop or TPB

In research this, analysis time travel done based on the results data survey collected fields through method *on-board survey.* In overall, schedule data collection shows that survey has done in a way systematic with involving a number of vehicles and time different observations. This is allows obtaining more data comprehensive in analyze performance transport general, especially in see difference condition operational between rush hours morning and evening. Collected data furthermore used as base in calculation of performance parameters, starting from analysis factor load (*load factor*) in subchapter next [32]. Based on results survey Electric Bus operations on the corridor Merdeka Square – Tembung, carried out evaluation to time parameters travel travel time with referring to the provisions in the Director General's Decree Land Transportation Decree Number SK.687/AJ.206/DRJD/2002 concerning Technical Guidelines for Implementation Transport General Passengers in Urban Areas in Route Steady and Regular [33]

Table 2. Travel time journey field independence - bandar khalipah

Time	Travel Time (minutes)	Ideal Minimum (minutes)	Maximum Ideal (minutes)
Weekend Morning	107	60	180
Weekend Afternoon	110	60	180
Weekday Morning	140	60	180
Weekday Afternoon	144	60	180

(Source: Developed by the Author)

Time analysis stop vehicle

Downtime vehicle (dwell *time*) is an important parameter in analysis performance transport general description duration vehicle stop at the bus stop or Place Bus Stop (TPB) for serving the up and down process passengers [34]. This parameter own role significant Because in a way direct influence smoothness operational, time travel, as well as accuracy timetable service transport general.

In research this, analysis time stop done based on the results data survey field collected by surveyors inside vehicle. Every time a vehicle stop at the bus stop / TPB, note it down time arrival and time departure, so that obtained duration time stop at each point termination. This data Then processed For knowing the average time stop, pattern variation time stop, and factors that influence it [35].

In the period *weekday* afternoon, time stop vehicle relatively more low with range 6–18 seconds. All bus stop during the period This Still be under limit maximum 30 seconds so that show the service process passenger ongoing Enough fast and efficient. Low time stop in the afternoon indicates that displacement passenger ongoing more fluent without significant queues at bus stops [36].

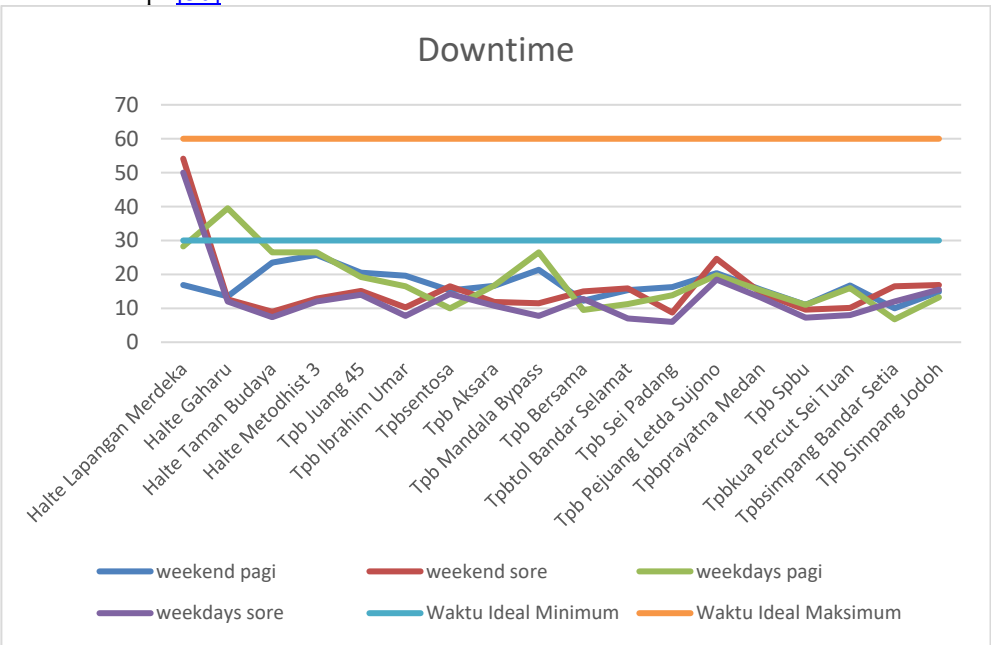

Figure 3. Graph time stop vehicle (*dwell time*) route Merdeka Square – Bandar Khalipah Station Director General's Decree Land Transportation No. SK.687/AJ.206/DRJD/2002

Based on results survey Electric Bus operations on the corridor research, conducted evaluation to time stop vehicle (*dwell time*) in each stop with referring to the provisions in the Director General's Decree Land Transportation Decree Number SK.687/AJ.206/DRJD/2002 concerning Technical Guidelines for Implementation Transport General Passengers in Urban Areas in Route Fixed and Regular [37]. Standard service set that time stop maximum at the bus stop normal is 30 seconds, while at the connecting terminal allowed up to 60 seconds, or No exceeding 10% of the total time journey. way general, results evaluation show that performance Electric Bus operations from aspect time stop vehicle has Enough good and some big has fulfil standard service based on the Director General's Decree Land Transportation No. SK.687/AJ.206/DRJD/2002. Although there is a number of stop with time stop exceed limit stop normal, condition the Still can influenced by the height activity passengers at the point certain [3]. Therefore that, is necessary optimization management operational at the bus stop with activity high so that the service process passenger can ongoing more fast, safe and efficient without bother smoothness journey vehicle general [38].

Test *the Customer Satisfaction Index* (CSI)

Measurement *Customer Satisfaction Index* done for know index satisfaction users services and made reference formation of specific strategies use maintain and improve satisfaction society. The results of the CSI calculation are as following[39].

a. *Mean Importance Score* (MIS)

$$MIS_j = \frac{\sum_{i=1}^{n} Y_{ij}}{n}; \text{ j = 1,2,…, ; i = 1,2,…,260} \quad (1)$$

$$MIS_1 = \frac{\sum_{i=1}^{260} Y_{11}}{260}; \text{ j = 1,2,…, ; i = 1,2,…,260}$$

$$= \frac{4+3+\cdots+4}{260} = 3{,}47$$

b. *Weighted Factors* (WF) (2)

$$WF_j = \frac{MIS_1}{\sum_{r=1} MIS_1} x\ 100\%$$

$$WF_1 = \frac{4.18}{3.47+\cdots+3.53}\ x\ 100\%$$

$$= 8{,}12\%$$

c. *Mean Satisfaction Score* (MSS)

$$MSS_j = \frac{\sum_{i=1}^{n} X_{ij}}{n};\ j= 1,2,\ldots,$$

$$MSS_1 = \frac{\sum_{i=1}^{260} X_{11}}{260}$$

$$= \frac{2+\cdots+4}{260} = 3.00$$

d. *Weight Score* (WS)

$$WS_j = WF_j\ x\ MSS_j$$

$$= 8.12\%x3.00$$

$$= 24.36\%$$

Table 3. *Customer Satisfaction Index Results Table* Electric Bus Users Route Corridor In Corridor 5 (Five) Fields Independence-Tembung

No	MISS	WF	MSS	WS
X1.1	3.47	8.12%	3.00	24.36%
X1.2	3.60	8.42%	2.50	21.06%
X1.3	3.62	8.46%	3.00	25.38%
X1.4	3.60	8.43%	2.33	19.65%
X2.1	3.31	7.75%	2.07	16.06%
X2.2	3.13	7.32%	2.09	15.32%
X3.1	3.61	8.45%	1.80	15.21%
X3.2	3.70	8.66%	1.75	15.15%
X3.3	3.28	7.68%	1.68	12.87%
X4.1	3.52	8.24%	2.16	17.77%
X4.2	3.31	7.74%	2.18	16.88%
X4.3	3.51	8.21%	2.09	17.17%
X4.4	3.35	7.83%	2.00	15.66%
X4.5	3.45	8.08%	2.12	17.13%
X5.1	3.12	7.30%	1.90	13.90%
X5.2	3.33	7.79%	1.93	15.05%
X6.1	3.43	8.04%	2.52	20.25%
X6.2	3.42	7.99%	1.92	15.31%
X6.3	3.49	8.17%	1.75	14.33%
X6.4	3.53	8.27%	1.94	16.03%

(Source: Developed by the Author)

$$Value\ CSI = \frac{WS_j}{HS} = \frac{161}{5} = 32\% \quad (3)$$

Based on the table and results calculation CSI value obtained mark by 32%. This value is in the value interval "0%-34.9%" which means electric bus users **" No satisfied "** to condition bus stops and TPB in corridor 5 (five) fields independence-tembung in a way overall [40].

In addition, the results study this is also consistent with study on Trans Padang by Irawan et al., which shows that although in a way general users feel satisfied to service, still there is required attributes improved, especially in the aspect of facilities, comfort, and accessibility. In the study mentioned, priority repair focused on facilities for group vulnerable, cleanliness, and comfort room passengers, who are in line with findings on variables equality (X5) and comfort (X4) in study This [12].

These results are also reinforced by research on services BisKita Trans Depok which shows that condition stop Still need improvement from side infrastructure and facilities, although aspect comfort users in a way general Already classified as Good [41]. Findings This indicates that quality stop as point service own role important in determine satisfaction users transportation public [42].

Next, research about stop Transjakarta show that facility bus stops and aspects security own influence significant to satisfaction passengers, while a number of other aspects such as comfort and accessibility No always influential in a way significant. This give perspective addition that although comfort become priority in study this, other factors such as facility

support and systems security also has contribution important in increase satisfaction users. Differences main between study This with study previously located in distribution attribute in science quadrant. In the study Suroboyo Trans by Pradana et al., , partly big attribute is in Quadrant IV which shows performance tall However his interests low, whereas in the research This Still found attribute important in Quadrant I which shows existence lack fundamental in service bus stops, especially in the aspect of comfort. While that, Trans Padang research shows more distribution balanced between required attributes improved and maintained.

In a way overall, various study the show that effective science methods in identify gap between performance and expectations users. However, research This give emphasis special that in context electric bus stops in Medan City, aspects safety, facilities physique bus stops, and incoming cleanliness in Quadrant I. Meanwhile that aspect accessibility location and capacity the bus stops in Quadrant II have show satisfactory and necessary performance guarded consistency in order to support comfort users electric bus service in a way sustainable [43].

SWOT analysis

SWOT is method analysis strategic use For identify and evaluate Strengths, Weaknesses, Opportunities, and Threats. A analysis This aim For formulate strategies that can maximize strengths and opportunities as well as minimize weaknesses and threats

SWOT analysis in research This arranged based on results performance parameter evaluation operational transport general which includes factor load factor, time dwell time, time between arrival (*headway*), time Wait passengers, speed travel and time travel, as well as supported by the results analysis *Customer Satisfaction Index* (CSI) and *Importance Performance Analysis* (IPA).

STRENGTHS	***WEAKNESSES* (Weaknesses)**
Distance between stop assessed affordable pedestrians (Quadrant II Science)	CSI is only 32% — very low, passengers No satisfied to stop
The bus capacity is sufficient accommodate passenger	Facility safety very few bus stops: without fence, stopping area No safe
Time analysis relatively stable travel However period busy afternoon happens improvement variation due to factor external	Not available seat, place trash, and boards information route
Time analysis dwell time has been fulfil standard SK.687/2002	Low load factor — capacity vehicle Not yet optimally filled
Headway performance is sufficient Good although there is variation consequence condition Then cross	Lighting Evening day and sidewalk going to stop Not yet adequate
OPPORTUNITIES	***THREATS* (Threats)**
Digitalization information bus stops (running text schedule, QR code route) increase CSI	Users switch to vehicle personal consequence lack of access comfortable
Revitalization program stop answer Quadrant I IPA (safety & cleanliness)	Congestion center city (Medan Station –Merdeka Square) becomes a time bottleneck travel
Intermodal integration by KRL/ public transport increase Power pull corridor	Competition online transportation increases demands passenger to quality service
Regulation of street vendors and illegal parking in bus stop areas can increase comfort and safety bus stop space	Budget limited hinder repair physique stop
	Decline amount passenger if the gap between CSI and performance Keep going widen

(Source: Developed by the Author)

Based on combination internal and external factors that have identified, SWOT matrix is used For formulate development strategies Electric Bus services as served as following

1. SO Strategy (*Strengths – Opportunities*)

1. Utilise accessibility good bus stop for support integration intermodal and improve Power pull electric bus service.
2. Optimizing performance operations that have been fulfil standard through implementation system management and information service digital- based.

1. WO Strategy (*Weaknesses – Opportunities*)

1. Increase satisfaction users through revitalization facility bus stops and TPB which become priority repair based on science results.

2. Increase regularity service with utilise technology real -time fleet monitoring for control headway.
2. ST Strategy (*Strengths – Threats*)
1. Maintain quality services and facilities supporters as superiority competitive compared to fashion online transportation.
2. Maintain affordable rates and reliable service for guard loyalty user in the middle competition transportation.
3. WT Strategy (*Weaknesses – Threats*)
1. Prioritize repair facility safety, comfort and information at the bus stop use prevent decline interest user.
2. Optimizing management operations in segments experiencing density Then cross For guard accuracy time and regularity service.

Based on SWOT results, the most recommended strategy is improvement quality facility bus stops and TPB as well implementation system real - time fleet monitoring [44]. This due to performance Electric Bus operations on corridor five (5) Merdeka Square - Tembung classified as good, but level satisfaction users Still low consequence limitations facility bus stops and TPB [45]. Therefore that, improvement strategy facility stop as well as implementation system real -time fleet monitoring becomes relevant steps for increase satisfaction users and quality service in a way overall. because in a way direct can overcome low level satisfaction users (CSI) at once increase regularity electric bus service

4. CONCLUSION

Based on results evaluation Based on the Decree of the Director General of Land Transportation No. 271/HK.105/DRJD/96, the quality of the Corridor 5 Merdeka Square–Tembung Electric Bus stops can be concluded that the existing condition of the stops and supporting infrastructure still does not meet optimal service standards. Several stops still have shortcomings in the aspects of safety, comfort, accessibility, cleanliness, and the arrangement of stop facilities. In addition, there are still stops that are too close to intersections, lack of crossing facilities, information facilities, trash cans, and the bus stop area is not organized from illegal parking and street vendors. However, the aspects of accessibility between stops and bus stop capacity are considered quite good. Overall, the quality of the Corridor 5 Electric Bus stops still needs improvement to comply with service standards. applicable bus stops. Based on results The CSI method obtained a level of satisfaction with the condition of the bus stops and TPB in corridor 5 (five) Merdeka-Tembung field as a whole of 32%, which means that electric bus users are "not satisfied". Based on the Importance Performance Analysis (IPA) method, it is known that the bus stop and bus stop services in Corridor 5 have not fully met user expectations because the importance value (MIS) is higher than the performance/satisfaction value (MSS) [46]. The affordability aspect is relatively good and needs to be maintained, while the safety, comfort, accessibility, and orderliness of facilities are still the main priorities for improvement, especially in crossing facilities, bus stop areas, waiting rooms, and bus stop area arrangements [47]. Based on Based on the SWOT results, the most recommended strategy is improving the quality of bus stop and TPB facilities and implementing a real-time fleet monitoring system. This is because the operational performance of the Electric Bus on corridor five (5) Merdeka Square - Tembung is relatively good, but the level of user satisfaction is still low due to limited facilities. bus stops and TPB [48]. SuggestionThe suggestions that can be given based on the results of this research are as follows: It is hoped that the Medan City Transportation Agency will improve the quality of bus stop facilities and infrastructure and the Electric Bus TPB by providing seating, information boards and bus stop identities, safety facilities and public accessibility to be safer, more comfortable, orderly and appropriate. standard service.

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