The Indonesian Journal of Computer Science
www.ijcs.net
Volume 15, Issue 2, April 2026
https://doi.org/10.33022/ijcs.v15i2.5092

Factors influencing Users' Perception on Yangon Bus Service and Origin-Destination Estimation for Bus Trips in Yangon City

May Thu Zar Khin[1], Nyan Myint Kyaw[2], Moe Thet Thet Aye[3]
maythuzarkhin1@gmail.com[1], nmkyaw.prof@ytu.edu.mm[2], moethetthetyae@gmail.com[3]
[1,2,3] Department of Civil Engineering, Yangon Technological University, Myanmar

Article Information

Received : 22 Feb 2026
Revised : 10 Mar 2026
Accepted : 25 Mar 2026

Keywords

Yangon Bus Service (YBS), Passenger satisfaction, Service quality, Origin–Destination (O–D) analysis, Urban public transportation

Abstract

Urban public transportation in Yangon faces challenges such as overcrowding, irregular service, and mismatched supply and demand, affecting passenger satisfaction. This study evaluates the Yangon Bus Service (YBS) by combining users' perception analysis with Origin–Destination (O–D) estimation. Surveys measured passenger satisfaction with service attributes, and O–D matrices assessed travel patterns across the city. Stepwise multiple linear regression showed that comfort (0.107), bus route (0.106), and bus stop cleanliness (0.432) positively influence satisfaction, while bus fare (-0.117) has a negative effect. Travel activity is concentrated in Yangon's central areas, reflecting the city's monocentric structure and generating high daily bus demand. The findings provide insights to improve YBS by identifying factors affecting satisfaction and travel demand, guiding service enhancements, optimizing operations, and increasing ridership.

A. Introduction

Public transportation plays a critical role in shaping urban mobility, accessibility, and the overall quality of life in cities. In Yangon, the Yangon Bus Service (YBS) was established in January 2017 as part of a comprehensive reform to enhance and restructure the city's public transportation system. The primary objectives of this initiative were to improve operational efficiency, passenger safety, route organization, and service quality, thereby creating a more reliable and sustainable transit network. As the city's major mode of public transport, YBS facilitates daily travel for workers, students, and residents, supporting economic activity and social interactions across Yangon.

Despite the improvements introduced by YBS, significant operational challenges remain. Irregular bus frequency, long waiting times, overcrowding during peak hours, traffic congestion affecting travel speed, inadequate passenger information systems, and uneven route coverage continue to limit the system's effectiveness. These factors influence passengers' perceptions of service quality, comfort, safety, journey time, and accessibility, which are crucial determinants of user satisfaction.

Understanding user satisfaction is essential because it not only reflects the effectiveness of the public transit system but also directly affects travel behavior, including the choice between public and private transport. Passenger dissatisfaction may lead to increased reliance on private vehicles, exacerbating traffic congestion, environmental pollution, and urban mobility challenges.

In addition to evaluating passenger perceptions, Origin-Destination (OD) estimation is vital for understanding travel demand and planning efficient transit services. OD data provides insights into where trips originate and terminate, enabling transportation planners to optimize routes, improve service frequency, reduce congestion, and allocate resources effectively. Integrating user perception analysis with OD estimation offers a comprehensive approach to transit planning, combining qualitative insights on service satisfaction with quantitative measures of travel demand [1].

This study aims to assess the key factors influencing users' perceptions of the Yangon Bus Service (YBS) and analyze the origin-destination (O-D) patterns of bus passengers in Yangon City. Specifically, it focuses on identifying important service attributes such as comfort, cleanliness, fare, route coverage, and punctuality that affect passenger satisfaction, and examining how these perceptions influence travel behavior and route choices. Additionally, the study estimates O-D patterns of bus trips, providing insights into major travel flows and popular routes, which can help in understanding commuter demand and optimizing bus operations [2].

The study contributes by offering evidence-based recommendations to improve operational efficiency, service quality, and sustainable urban mobility in Yangon. It links user perception with travel behavior, providing actionable insights for enhancing passenger satisfaction, increasing ridership, and supporting better urban transport planning. By combining service quality analysis with O-D estimation, the research adds empirical knowledge to the study of public transportation in Yangon and supports policy-making for long-term improvements in the city's bus system [3].

B. Research Method

This study adopts a quantitative research approach to evaluate service quality and analyze travel demand among bus commuters in Yangon City. First, the research problem is identified and relevant literature on service quality models and travel demand theory is reviewed to establish the conceptual framework. Based on the framework, a structured questionnaires using a Likert scale is developed to measure commuters' perceptions and travel behavior [4]. Questionnaires were gathered through a mixed survey approach, combining both online and face-to-face methods. The online questionnaires was distributed via Google Forms, while the face-to-face survey was conducted in person to capture responses from participants with limited internet access [5]. Descriptive statistics are used to summarize respondents' characteristics and satisfaction levels, while correlation and regression analyses are applied to examine the relationship between service quality factors and travel demand [6].

According to the actual needs of bus users' perceptions and considering the availability of data, travel characteristics, socioeconomic characteristics (such as gender, age, income, education level, and occupation), and satisfaction with bus service attributes (such as bus-stop cleanliness, ease to access, safety, comfort, and fare price) are collected in this study [7]. Finally, the findings are discussed to provide conclusions and practical recommendations for improving bus services in Yangon City.

Yangon, the largest city and commercial hub of Myanmar, comprises 44 townships, covering an area of 598.75 km^2 and accommodating a population of approximately 5.211 million. The city experiences significant intercity travel, with buses serving as a primary mode of transport connecting urban centers to peripheral regions. Intra-city travel is also extensive, with public bus services playing a central role in daily commuting within the townships. The Yangon Bus Service (YBS) operates 145 routes and serves approximately 1.5 million passengers daily. Consequently, YBS was selected as the focus of this study. For the purposes of this research, 33 townships were included in the study area, categorized into the Central Business District (CBD), Inner City, Outer City, Old Suburb, and New Suburb. The Dala and Seikgyikhanaungto townships were excluded due to the limited operation of YBS routes. Figure 1 presents the spatial distribution of the study area.

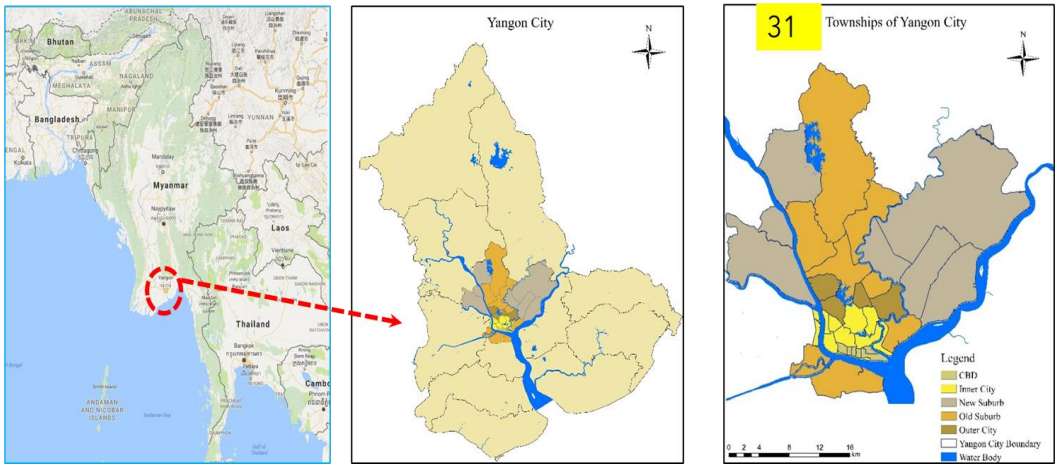

Figure 1. Study Area (Yangon City)

Before data collection, it is necessary to calculate the sample size to ensure sufficient data for analysis. According to the 33 townships, the population of the Yangon is 4,974,902 based on 2019 Inter-Census Data.

$$n_0 = Z^2\, p\cdot(1-p)/E^2 \quad (1)$$

Where,

Z = 1.96 for 95% confidence interval.

p = the estimated proportion of the population = 0.5

E = the desired margin of error = 0.05 (5% with 95% Confidence level)

$n_0 = (1.96)^2 \times 0.5 \times (1-0.5)/(0.05)^2 = 384.16$

The most common formula for estimating the sample size for a simple random sample is:

$$n = n_0 / (1 + n_0/N) \quad (2)$$

where, n= the required sample size.

n_0=384.16

N=total population

n = 384.16/ (1 + 384.16/4,974,902)

= 385

Based on the population, the required sample sizes were calculated by using equation 1 and 2 to get the require sample to collect [8]. The calculated sample sizes were 385 samples in this study.

Table 1. Questionnarie Survey Data Samples

Data Sample	Number of Sample
Required sample	385
Collected sample	2255
Invalid sample	5
Valid sample	2250

The data collection was undertaken resulting in 2255 responses in total. Following data screening and cleaning procedures, 2250 responses were retained for analysis, whereas 5 samples in all the data were excluded due to missing values in certain attributes. The following Figure 2 shows the research implementation programs of this study.

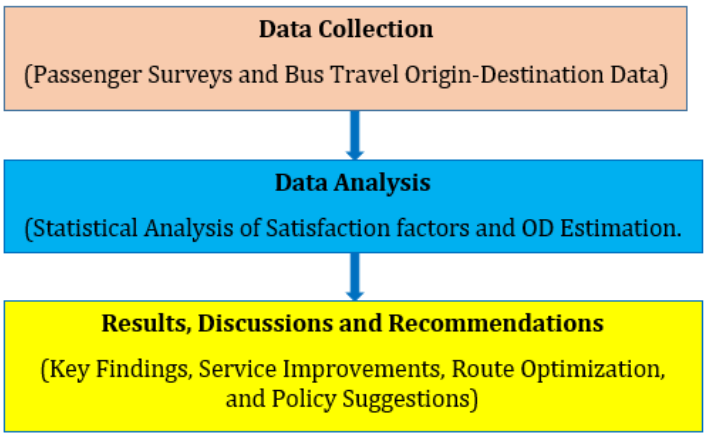

Figure 2. Implementation Program

In order to investigate the relationship between bus users' satisfaction over specific bus facilities and their overall satisfaction with the Yangon Bus System (YBS), this study utilized a multiple linear regression model with the Stepwise approach in IBM SPSS Statistics. The analysis aimed to identify the extent to which various service facilities influence overall satisfaction. Travel characteristics, socioeconomic characteristics (such as gender, age, income, education level, and occupation), and satisfaction with bus service attributes (such as bus-stop cleanliness, safety, comfort, and fare price) were all gathered through the survey. A five-point Likert scale ("Very dissatisfy", "Dissatisfy", "Normal", "Satisfy", and "Very Satisfy") was used to measure satisfaction with both individual service facilities and overall service quality (very dissatisfied, dissatisfied, neutral, satisfied, and very Satisfied). The data were analyzed by using a multiple linear regression model to determine the key factors significantly influencing overall satisfaction [9].

This study employed a multiple linear regression model using the Stepwise method in IBM SPSS Statistics to analyze the relationship between passengers' satisfaction with various bus service attributes and their overall satisfaction with the Yangon bus system. This approach allows for examining how individual bus service attributes influence overall satisfaction.

In the regression model, the dependent variable is overall satisfaction with the bus service, while the ten independent variables represent satisfaction with various bus service attributes. The multilinear regression model was specified as follows [10]:

$$Y=\beta_0+\beta_1X_1+\beta_2X_2+\cdots+\beta_nX_n+\epsilon \quad (3)$$

Where,

Y is the dependent variable (Overall Satisfaction),

$X_1, X_2,\ldots,X_n$ = independent variables (Bus service attributes),

β_0 = intercept,

$\beta_1, \beta_2,\ldots,\beta_n$ = the coefficients of the independent variables,

ϵ = error term

The following Table 1 analyzes the distribution of bus lines and fleet sizes among operators and discusses the operational implications for service performance and passenger perception. The structure of bus operations in Yangon City reflects a semi-fragmented yet coordinated public transport system managed under the supervision of the Yangon Region Transport Committee (YRTC). Based on the available data, 21 bus companies operate across 140 bus lines with a total fleet size of 5,558 buses.

Table 2. Existing Bus Company and Bus Line Da

No	Bus Company	Bus Line	Number of Buses
1	YUPT	24	699
2	YBPC	14	559
3	Bandoola	9	313
4	Omni Focus	9	400
5	Lu Tu Mate Swe	4	265
6	Khit Thit Bayint Naung	11	531
7	Shwe Taung Pine	5	303
8	Kone Baung Yangon	2	165
9	A Myint Myat Sone	3	185
10	Power Eleven	3	157

11	Yangon Myauk Pine Tike Kyi Thar	4	138
12	Shwe Lan Khinn	2	80
13	GYCT	14	413
14	RCBT	9	289
15	San Wai La	1	51
16	Trans Link	7	213
17	City Liner	1	16
18	Shwe Pyi Thar Thar	3	215
19	Thet Yin Aung	3	125
20	Transport Star	2	81
21	Pyay San Thu	10	360
	Total	140	5558

Source: Source: Yangon Region Transport Committee (YRTC)

The existing bus operational structure in Yangon City, managed under the supervision of the Yangon Region Transport Committee (YRTC), consists of 21 bus companies operating a total of 140 bus lines with a combined fleet of 5,558 buses. The distribution of bus lines and fleet size among operators is uneven, with major companies such as YUPT, YBPC, Khit Thit Bayint Naung, and GYCT managing a significant proportion of routes and buses, indicating their dominant role in serving high-demand corridors and urban areas. In contrast, several smaller companies operate only one or a few lines with limited fleet capacity, which may affect service frequency, reliability, and coverage in certain areas. This variation in operational capacity among bus companies reflects a mixed system of large and small operators and has important implications for service efficiency, network coverage, and passenger perception. Effective coordination, fleet allocation, and service standardization by the regulatory authority are essential to ensure balanced service delivery and improve the overall performance of the Yangon Bus Service network [11].

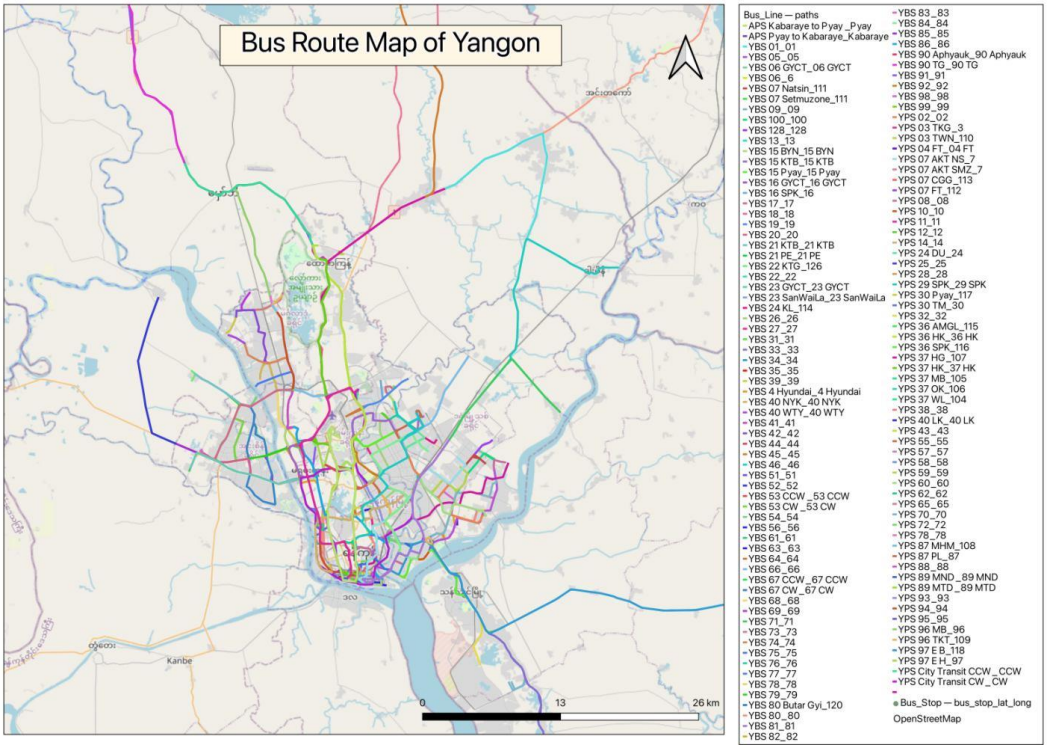

Figure 3. Current Bus Route Map of Yangon

The above Figure 3 illustrates the current bus service network in Yangon, showing the spatial distribution and coverage of bus routes across the city. The network consists of multiple routes connecting the central business district (CBD) with suburban and peripheral areas, forming a radial and partially grid-based pattern. The highest concentration of routes is observed in the central area, indicating strong service coverage and high passenger demand in major commercial and residential zones. Several routes extend outward to connect outer townships, ensuring accessibility between urban and suburban regions. The network also demonstrates important transfer corridors where multiple routes intersect, allowing passengers to transfer between services and reach various destinations efficiently. Overall, the Yangon bus service network provides extensive connectivity across the city and plays a crucial role in facilitating urban mobility and supporting daily travel demand.

Based on this spatial structure and connectivity pattern, an Origin–Destination (O–D) matrix is applied to quantitatively analyze travel interactions between different zones within the network. The O–D matrix is an essential method for estimating bus trip probability according to the trip distance between each pair of O–D zones. In this study, an appropriate bus trip distance is considered to be more than 3 km. Therefore, the shorter the distance between each pair of O–D zones, the lower the probability of choosing bus travel. Meanwhile, the O–D matrix also serves as a basis for determining the non-transfer coefficient, which reflects the proportion of direct trips without transfers within the bus network.

C. Result and Discussion

The levels of bus users' satisfaction with specific bus service facilities, based on 2,250 questionnaire responses and measured using a five-point Likert scale, are presented in Figures 4 to 6. The distribution of satisfaction reveals that the majority of respondents selected the "neutral" option, as shown in the figures below.

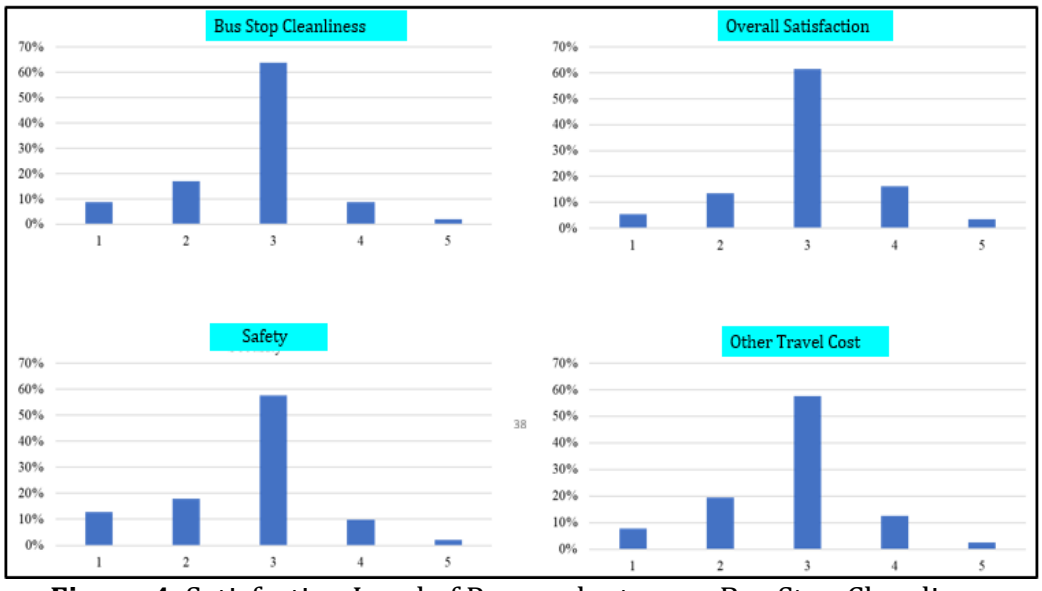

Figure 4. Satisfaction Level of Respondents over Bus Stop Cleanliness, Overall Satisfaction, Security and Other Travel Cost

The above Figure 4 presents the distribution of respondents' perceptions regarding bus stop cleanliness, overall satisfaction, safety, and other travel costs using a five-point Likert scale. The results indicate that the majority of respondents selected the neutral scale (3) across all four variables, accounting for approximately 55–65% of responses. This suggests that commuters generally perceive the current bus service conditions as moderate rather than strongly satisfactory or unsatisfactory. For bus stop cleanliness, most responses cluster at the neutral level, with smaller proportions expressing dissatisfaction (levels 1 and 2) and relatively few indicating high satisfaction (levels 4 and 5). A similar pattern is observed for safety and other travel costs, where neutral responses dominate, followed by moderate dissatisfaction.

Overall satisfaction also reflects this central tendency, indicating that while the service is acceptable to many users, there is limited strong approval. These findings imply that bus commuters in Yangon City experience an average level of service quality, highlighting the need for improvements in cleanliness, safety, and cost efficiency to enhance overall passenger satisfaction.

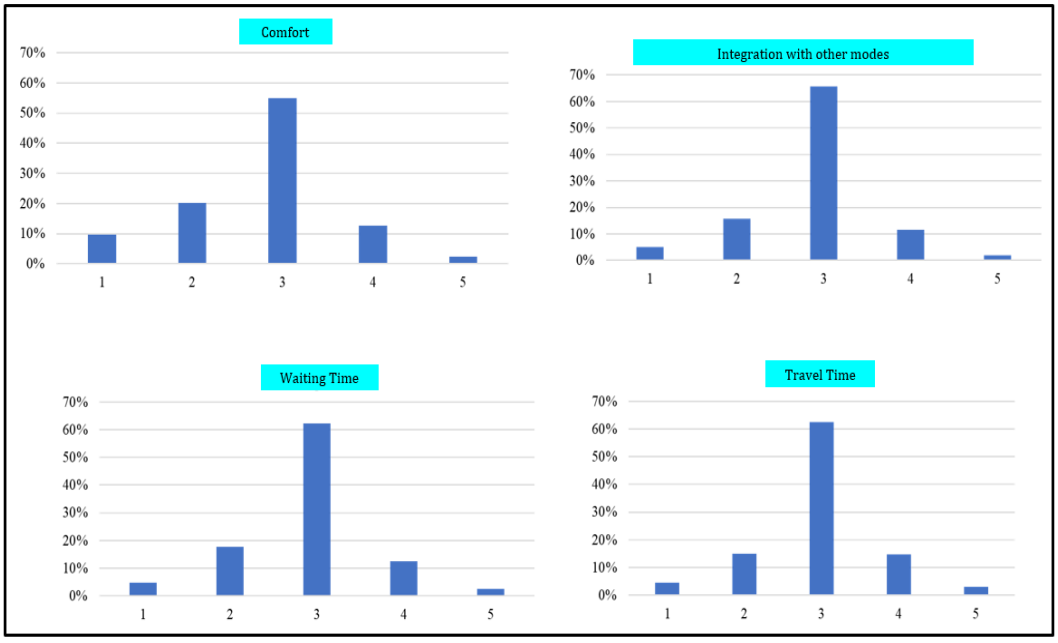

Figure 5. Satisfaction Level of Respondents over Comfort , Transit to Other Modes, Waiting Time and Travel Time

Figure 5 illustrates respondents' perceptions of comfort, integration with other transport modes, waiting time, and travel time using a five-point Likert scale. Similar to the previous findings, the majority of responses across all four variables are concentrated at the neutral level (scale 3), representing approximately 55–65% of the total responses. This indicates that most bus commuters perceive these service attributes as moderate rather than highly satisfactory or unsatisfactory.

In terms of comfort, the highest proportion of respondents selected the neutral option, while relatively smaller percentages reported high satisfaction (levels 4 and 5). A comparable distribution is observed for integration with other

modes, suggesting limited but existing connectivity between bus services and alternative transport options. For waiting time and travel time, neutral responses again dominate, followed by moderate dissatisfaction (levels 1 and 2). The proportion of respondents expressing strong satisfaction remains minimal. These patterns imply that while the bus system provides an acceptable level of performance, improvements in service reliability, scheduling efficiency, and modal connectivity are necessary to enhance overall commuter experience and increase user satisfaction.

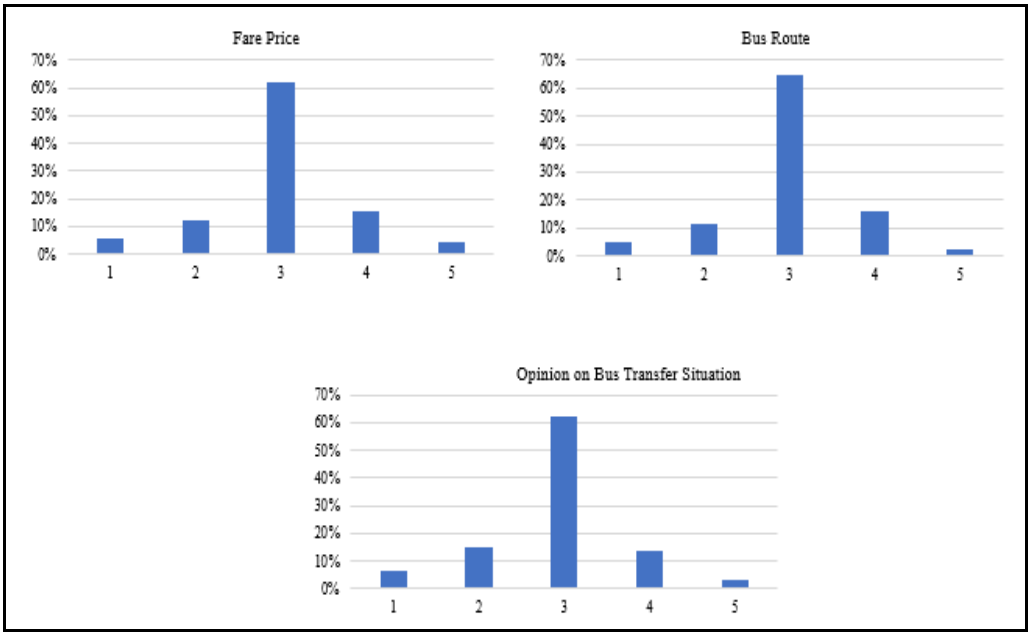

Figure 6. Satisfaction Level of Respondents over Fare Price, Bus Route and Bus Transfer

Figure 6 presents respondents' perceptions regarding fare price, bus route, and bus transfer situation using a five-point Likert scale. The distribution of responses shows a clear concentration at the neutral level (scale 3), accounting for approximately 60–65% of total responses across all three variables. This indicates that most commuters perceive these aspects of the bus service as moderate rather than strongly satisfactory or unsatisfactory. Regarding fare price, the majority of respondents selected the neutral option, suggesting that the current fare level is generally acceptable but not considered highly satisfactory. A smaller proportion expressed dissatisfaction (levels 1 and 2), while only a limited percentage indicated high satisfaction (levels 4 and 5).

Similarly, perceptions of bus routes are largely centered at the neutral scale, implying that route coverage and accessibility meet basic expectations but may require improvements in terms of efficiency and connectivity. In terms of bus transfer situations, neutral responses again dominate, followed by moderate dissatisfaction, reflecting potential inconvenience during transfers between routes. Overall, the findings suggest that while fare price, route structure, and transfer conditions are viewed as adequate by most users, there remains considerable room for improvement to enhance commuter satisfaction and overall service quality in Yangon City's bus system.

Table 3. Dependent and Independent Variables

Type	Variable	Coding
Dependent	Overall Satisfaction	1= Very Dissatisfied 2= Dissatisfied 3= Neutral 4= satisfied 5= very satisfied
Independent	Bus Price/Fare Bus Route Bus Stop Cleaniness Bus Transfer Comfort Integration with other modes Other Travel Cost Safety Travel Time Waiting Time	1= Very Dissatisfied 2= Dissatisfied 3= Neutral 4= satisfied 5= very satisfied

The above Table 3 shows the dependent and independent variables used in multiple linear regression model of users' perception on Yangon Bus Service. The dependent variable is overall satisfaction, which reflects the users' general evaluation of bus service quality. The independent variables include other travel cost, comfort, integration with other transport modes, waiting time, travel time, bus price or fare, bus route availability, bus transfer convenience, bus stop cleanliness, and safety, all of which represent key service attributes influencing passenger perception. These variables are measured using a five-point Likert scale ranging from very dissatisfied (1) to very satisfied (5), allowing quantitative assessment of user opinions. This structured variable framework enables systematic analysis of the relationship between service quality factors and overall passenger satisfaction, providing a basis for identifying critical determinants that affect bus commuters' perception and supporting improvements in bus service planning and management.

The findings from the multiple linear regression model offer significant insights into the key bus service attributes affecting bus commuters' satisfaction with the overall quality of bus services in Yangon are shown in the following Figure 7 and 8.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.582[a]	.538	.537	.65665

a. Predictors: (Constant), BusStopCleanliness, BusPrice, Comfort, BusRoute

b. Dependent Variable: OverallSatisfaction

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	494.645	4	123.661	286.788	.000[b]
	Residual	968.031	2245	.431		
	Total	1462.676	2249			

a. Dependent Variable: OverallSatisfaction

b. Predictors: (Constant), BusStopCleanliness, BusPrice, Comfort, BusRoute

Figure 7. Model Summary

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	.820	.070		11.662	.000
	Comfort	.107	.019	.111	5.558	.000
	BusPrice	-.117	.020	.121	5.878	.000
	BusRoute	.106	.022	.101	4.859	.000
	BusStopCleanliness	.432	.020	.424	22.048	.000

a. Dependent Variable: OverallSatisfaction

Figure 8. Model Results

As presented in following Equation 4, the regression model illustrates the relative influence of each independent variable on bus users' overall satisfaction with bus service quality.

$$\text{Bus Users' Overall Satisfaction} = 0.820 + 0.107(\text{Comfort}) - 0.117(\text{Bus Fare}) + 0.106(\text{Bus Route}) + 0.432\ (\text{Bus Stop Cleaniness}) \quad (4)$$

The model is statistically significant, accounting for almost 53.8% of the variation in passengers' overall satisfaction, according to the regression analysis. This indicates that factors such as access mode, bus stop cleanliness, access time, fare price, comfort, and bus route strongly positive influence passengers' satisfaction with the bus service. However, access time and number of trips per week have negative effects, meaning longer access time and more frequent travel reduce satisfaction. According to the model, passengers are satisfied when bus stops are clean, buses are comfortable, costs are affordable, and routes are feasible. Reducing access time and improving travel experience will further increase satisfaction. With an adjusted R-squared of 0.537, the model demonstrates strong and reliable. Moreover, the standard error of the estimate 0.656 indicates that the predicted values are closely aligned with resonable accuracy.

The regression model for bus users' overall satisfaction indicates that comfort, bus fare, bus route availability, and bus stop cleanliness significantly influence passengers' perception of the Yangon Bus Service under the supervision of the Yangon Region Transport Committee. The constant value of 0.820 represents the baseline level of satisfaction when all independent variables are held constant. Among the explanatory variables, bus stop cleanliness has the highest positive coefficient with 0.432, indicating that improvements in bus stop cleanliness contribute most strongly to increasing user satisfaction. Comfort with 0.107 and bus route availability with 0.106 also show positive relationships with overall satisfaction, meaning that better comfort and more accessible or convenient routes enhance passenger perception. In contrast, bus fare has a negative coefficient with -0.117, suggesting that higher fares reduce user satisfaction, and affordability remains an important concern for passengers. Overall, the model highlights that physical environment factors, particularly cleanliness, along with service comfort and route accessibility, are key

determinants of satisfaction, while fare levels have an inverse effect. These findings suggest that improving bus stop conditions, maintaining comfortable buses, optimizing route coverage, and ensuring reasonable fare levels are essential strategies to enhance user satisfaction and improve the overall performance of the bus transport system.

The following Figure 9 illustrates the distribution of trip origins and destinations of respondents across different townships in Yangon, categorized into CBD, Inner City, Outer City, Old Suburb, and New Suburb zones. The comparison between origin and destination frequencies provides insight into spatial travel patterns and the concentration of travel demand within the city.

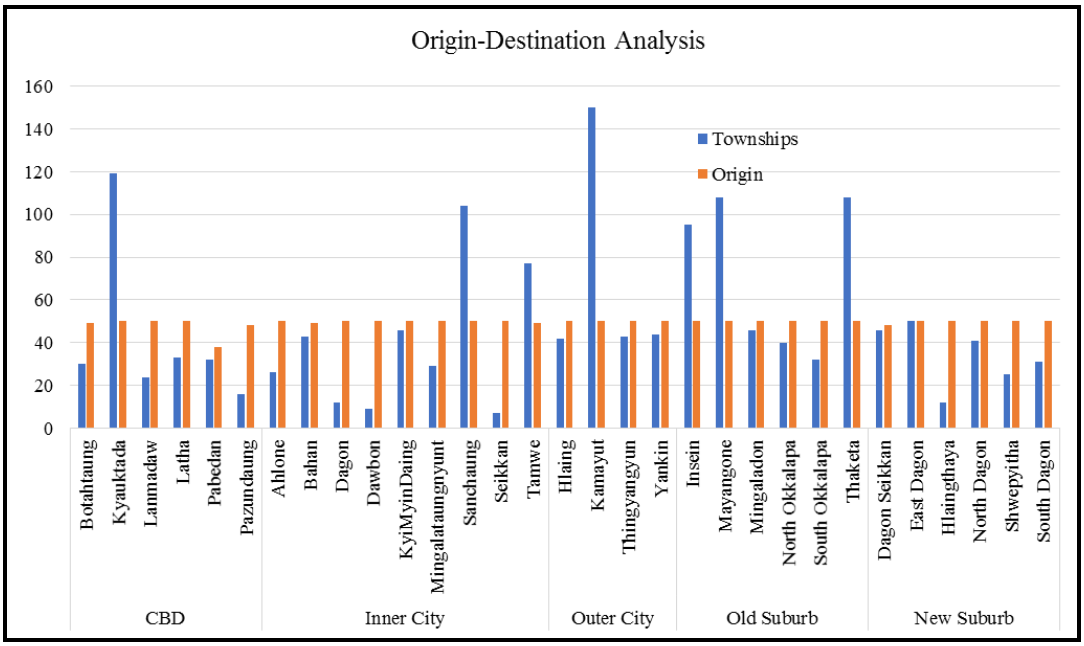

Figure 9. O-D of Respondents across Different Yangon Townships

The results indicate that several townships, particularly Kamayut and Kyauktada, record the highest trip frequencies, signifying their roles as major trip generation and attraction centers. These townships are characterized by a high concentration of commercial, educational, and administrative activities, which naturally attract daily commuting trips. In general, townships located within the CBD and Inner City zones demonstrate higher levels of trip production and attraction compared to those in outer and newly developed suburban areas.

Moreover, the relatively balanced distribution between origins and destinations in central areas suggests a strong interaction between residential and activity centers within these zones. In contrast, townships in the New Suburb category exhibit comparatively lower trip volumes, indicating reduced economic intensity and lower travel demand.

Overall, the figure reveals a clear spatial concentration of travel activity toward the central urban areas of Yangon. This pattern reflects the monocentric urban structure of the city, where employment, education, and service-related activities are predominantly located in core zones, thereby generating significant daily bus travel demand.

	Botahtaung	Kyauktada	Lamataw	Latha	Pabedan	Pazundaung	Ahlon	Bahan	Dagon	Dawpone	Kyimyintdaing	Mingalartaungnyu	Sanchaung	Seikkan	Tamwe	Hlaing	Kamaryut	Thingangyun	Yankin	Insein	Mayangone	Mingalardone	North Okkalapa	South Okkalapa	Tharkayta	Dagon Seikkan	East Dagon	Hlaing Thar Yar	North Dagon	Shwepyithar	South Dagon
Botahtaung	0	0	1	0	4	1	2	0	1	0	1	2	2	0	1	3	3	3	3	2	6	0	1	1	6	0	0	0	2	1	1
Kyauktada	1	0	3	0	1	2	1	2	0	1	1	1	5	0	2	0	8	6	4	1	3	1	1	7	3	1	3	0	2	1	2
Lamataw	7	0	2	0	0	0	0	0	0	3	4	6	0	0	6	2	3	2	4	4	2	0	0	0	3	2	0	0	2	0	3
Latha	3	5	2	7	3	0	2	1	1	3	3	1	2	1	1	0	2	5	0	2	0	0	2	2	10	5	0	0	1	0	2
Pabedan	1	0	0	1	1	0	0	0	3	0	0	0	4	0	0	0	2	1	0	0	0	0	0	0	0	24	0	0	0	0	0
Pazundaung	3	11	5	4	0	3	3	1	0	0	2	2	0	0	6	0	0	6	1	1	0	0	1	0	0	0	1	0	0	0	0
Ahlone	0	5	3	3	4	0	0	0	0	2	7	0	0	0	0	1	9	0	0	2	0	0	0	0	8	2	0	0	1	0	0
Bahan	0	4	0	1	0	0	0	1	1	0	8	0	24	0	3	0	3	2	0	0	0	0	0	0	0	0	0	0	1	0	0
Dagon	0	12	4	0	1	0	0	0	0	0	0	2	6	0	2	0	13	1	0	1	3	1	2	0	0	0	0	0	0	3	0
Dawpone	6	5	2	0	1	0	1	0	0	3	0	0	0	0	0	0	1	0	0	0	0	0	0	1	28	2	0	0	0	0	0
Kyimyintdain	0	2	0	1	0	0	0	19	0	0	7	1	15	1	4	1	3	0	0	2	0	0	0	0	5	0	1	0	1	0	0
Mingalartaun	1	12	0	0	1	0	0	0	0	0	0	4	0	0	14	0	6	1	5	0	0	0	0	0	0	0	1	0	0	1	3
Sanchaung	2	2	1	2	0	1	1	1	2	0	3	0	3	0	11	0	18	1	3	0	0	0	3	0	0	0		0	2	0	2
Seikkan	0	3	2	16	1	3	1	2	0	0	0	7	1	1	6	0	1	0	3	7	3	3	0	0	0	0	0	1	0	3	0
Tamwe	0	0	0	0	0	3	0	8	0	0	0	2	14	0	6	0	3	2	3	2	2	0	0	0	0	0	1	0	0	0	1
Hlaing	0	2	0	1	0	0	6	0	0	0	0	0	6	0	0	16	23	0	0	6	0	2	0	0	0	0	2	1	0	0	0
Kamaryut	1	5	0	0	7	1	1	1	1	0	3	0	7	0	2	7	27	0	3	8	11	0	1	1	1	0	2	1	0	0	1
Thingangyun	0	1	0	0	0	1	0	1	0	0	1	0	4	0	3	0	4	2	0	2	8	2	6	3	5	1	4	1	5	1	3
Yankin	0	19	0	0	0	0	7	3	0	0	2	0	1	0	7	0	29	2	1	1	7	1	2	2	3	0	3	6	1	1	3
Insein	0	4	0	3	0	0	1	0	1	0	1	0	7	0	0	14	45	0	0	20	7	1	3	0	2	0	6	7	0	3	0
Mayangone	0	4	0	0	0	1	3	0	1	0	0	0	2	0	1	5	11	0	4	9	20	2	1	1	2	0	2	0	3	0	0
Mingalardon	1	5	0	0	0	0	0	0	0	0	0	1	3	0	2	3	8	2	1	3	7	15	6	1	0	0	5	3	0	1	0
North Okkala	0	1	0	0	1	0	0	2	1	0	0	0	2	0	0	2	4	1	5	2	7	6	15	3	3	0	4	4	4	2	1
South Okkala	0	6	0	0	3	0	1	0	1	0	1	1	9	0	0	3	6	3	4	5	5	0	3	3	0	0	8	0	6	0	0
Tharkayta	1	8	4	6	7	2	2	1	0	1	11	0	1	0	2	0	4	3	1	1	4	0	1	2	31	5	2	0	0	1	2
Dagon Seikka	3	3	0	1	2	3	0	2	0	0	0	3	0	0	3	0	0	0	0	3	2	3	1	0	8	8	0	0	0	0	4
East Dagon	1	39	2	0	1	2	2	5	1	0	1	1	5	0	9	6	4	7	8	10	11	3	7	18	11	0	53	3	35	4	3
Hlaing Thar Y	0	0	0	0	1	0	0	1	0	0	1	0	2	0	0	0	12	0	0	38	9	5	0	0	0	0	0	4	0	0	0
North Dagon	0	11	0	0	0	0	0	1	0	0	2	0	3	0	1	0	1	3	2	2	4	1	0	5	0	0	10	0	6	0	0
Shwepyithar	0	0	0	0	0	0	1	0	1	0	1	0	1	0	2	1	6	0	2	9	8	8	0	1	1	0	2	1	0	7	0
South Dagon	0	3	0	1	2	0	0	1	0	0	0	2	2	4	1	0	3	1	0	5	2	1	2	0	9	1	7	0	0	0	8

Figure 10. O-D Matrix of Survey Data

Figure 10 presents the Origin–Destination (O–D) matrix of the survey data, showing the number of trips between different townships in Yangon. Each row represents trip origins, while each column represents trip destinations, and the values in the cells indicate the frequency of trips between corresponding townships. The highlighted diagonal cells represent intra-township trips

Then, the expansion factors in Origin–Destination (O–D) estimation are used to convert sample survey data into values that represent the total travel population. Since only a portion of travelers is surveyed, expansion factors scale up the observed trips so they reflect the actual number of trips made by all users. This helps produce a complete and accurate O–D matrix, which is essential for transport planning, demand analysis, and service improvement. The following Equation 5 is used to represent the actual travel demand of Yangon City based on O-D matrix of collected survey data [12].

Person Trip Expansion Factor = Total Population/Surveyed Population (5)

O-D	Botahtaung	Kyauktada	Lamataw	Latha	Pabedan	Pazundaung	Ahlon	Bahan	Dagon	Dawpone	Kyimyintdaing	Mingalartaungnyu	Sanchaung	Seikkan	Tamwe	Hlaing	Kamaryut	Thingangyun	Yankin	Insein	Mayangone	Mingalardone	North Okkalapa	South Okkalapa	Tharkayta	Dagon Seikkan	East Dagon	Hlaing Thar Yar	North Dagon	Shwepyithar	South Dagon
Botahtaung	0	0	889	0	3556	889	1778	0	889	0	889	1778	1778	0	889	2667	2667	2667	2667	1778	5333	0	889	889	5333	0	0	0	1778	889	889
Kyauktada	889	0	2667	0	889	1778	889	1778	0	889	889	889	4444	0	1778	0	7111	5333	3556	889	2667	889	889	6222	2667	889	2667	0	1778	889	1778
Lamataw	6222	0	1778	0	0	0	0	0	0	2667	3556	5333	0	0	5333	1778	2667	1778	3556	3556	1778	0	0	0	2667	1778	0	0	1778	0	2667
Latha	2667	4444	1778	6222	2667	0	1778	889	889	2667	2667	889	1778	889	889	0	1778	4444	0	1778	0	0	1778	1778	8889	4444	0	0	889	0	1778
Pabedan	889	0	0	889	889	0	0	0	2667	0	0	0	3556	0	0	0	1778	889	0	0	0	0	0	0	0	21333	0	0	0	0	0
Pazundaung	2667	9778	4444	3556	0	2667	2667	889	0	0	1778	1778	0	0	5333	0	0	5333	889	889	0	0	889	0	0	0	889	0	0	0	0
Ahlone	0	4444	2667	2667	3556	0	0	0	0	1778	6222	0	0	0	0	889	8000	0	0	1778	0	0	0	0	7111	1778	0	0	889	0	0
Bahan	0	3556	0	889	0	0	0	889	889	0	7111	0	21333	0	2667	0	2667	1778	0	0	0	0	0	0	0	0	0	0	889	0	0
Dagon	0	10667	3556	0	889	0	0	0	0	0	0	1778	5333	0	1778	0	11556	889	0	889	2667	889	1778	0	0	0	0	0	0	2667	0
Dawpone	5333	4444	1778	0	889	0	889	0	0	2667	0	0	0	0	0	0	889	0	0	0	0	0	0	889	24889	1778	0	0	0	0	0
Kyimyintdaing	0	1778	0	889	0	0	0	16889	0	0	6222	889	13333	889	3556	889	2667	0	0	1778	0	0	0	0	4444	0	889	0	889	0	0
Mingalartaungnyunt	889	10667	0	0	889	0	0	0	0	0	0	3556	0	0	12444	0	5333	889	4444	0	0	0	0	0	0	0	889	0	0	889	2667
Sanchaung	1778	1778	889	1778	0	889	889	889	1778	0	2667	0	2667	0	9778	0	16000	889	2667	0	0	0	2667	0	0	0	0	0	1778	0	1778
Seikkan	0	2667	1778	14222	889	2667	889	1778	0	0	0	6222	889	889	5333	0	889	0	2667	6222	2667	2667	0	0	0	0	0	889	0	2667	0
Tamwe	0	0	0	0	0	2667	0	7111	0	0	0	1778	12444	0	5333	0	2667	1778	2667	1778	1778	0	0	0	0	0	889	0	0	0	889
Hlaing	0	1778	0	889	0	0	5333	0	0	0	0	0	5333	0	0	14222	20444	0	0	5333	0	1778	0	0	0	0	1778	889	0	0	0
Kamaryut	889	4444	0	0	6222	889	889	889	889	0	2667	0	6222	0	1778	6222	24000	0	2667	7111	9778	0	889	889	889	0	1778	889	0	0	889
Thingangyun	0	889	0	0	0	889	0	889	0	0	889	0	3556	0	2667	0	3556	1778	0	1778	7111	1778	5333	2667	4444	889	3556	889	4444	889	2667
Yankin	0	16889	0	0	0	0	6222	2667	0	0	1778	0	889	0	6222	0	25778	1778	889	889	6222	889	1778	1778	2667	0	2667	5333	889	889	2667
Insein	0	3556	0	2667	0	0	889	0	889	0	889	0	6222	0	0	12444	40000	0	0	17778	6222	889	2667	0	1778	0	5333	6222	0	2667	0
Mayangone	0	3556	0	0	0	889	2667	0	889	0	0	0	1778	0	889	4444	9778	0	3556	8000	17778	1778	889	889	1778	0	1778	0	2667	0	0
Mingalardone	889	4444	0	0	0	0	0	0	0	0	0	889	2667	0	1778	2667	7111	1778	889	2667	6222	13333	5333	889	0	0	4444	2667	0	889	0
North Okkalapa	0	889	0	0	889	0	0	1778	889	0	0	0	1778	0	0	1778	3556	889	4444	1778	6222	5333	13333	2667	2667	0	3556	3556	3556	1778	889
South Okkalapa	0	5333	0	0	2667	0	889	0	889	0	889	889	8000	0	0	2667	5333	2667	3556	4444	4444	0	2667	2667	0	0	7111	0	5333	0	0
Tharkayta	889	7111	3556	5333	6222	1778	1778	889	0	889	9778	0	889	0	1778	0	3556	2667	889	889	3556	0	889	1778	27556	4444	1778	0	0	889	1778
Dagon Seikkan	2667	2667	0	889	1778	2667	0	1778	0	0	0	2667	0	0	2667	0	0	0	0	2667	1778	2667	889	0	7111	7111	0	0	0	0	3556
East Dagon	889	34667	1778	0	889	1778	1778	4444	889	0	889	889	4444	0	8000	5333	3556	6222	7111	8889	9778	2667	6222	16000	9778	0	47111	2667	31111	3556	2667
Hlaing Thar Yar	0	0	0	0	889	0	0	889	0	0	889	0	1778	0	0	0	10667	0	0	33778	8000	4444	0	0	0	0	0	3556	0	0	0
North Dagon	0	9778	0	0	0	0	0	889	0	0	1778	0	2667	0	889	0	889	2667	1778	1778	3556	889	0	4444	0	0	8889	0	5333	0	0
Shwepyithar	0	0	0	0	0	0	889	0	889	0	889	0	889	0	1778	889	5333	0	1778	8000	7111	7111	0	889	889	0	1778	889	0	6222	0
South Dagon	0	2667	0	889	1778	0	0	889	0	0	0	1778	1778	3556	889	0	2667	889	0	4444	1778	889	1778	0	8000	889	6222	0	0	0	7111

Figure 11. O-D Matrix for Bus Trips at Different Townships in Yangon City

The above figure 11 presents the estimated Origin–Destination (O–D) matrix, which illustrates the spatial distribution of trips between different zones within the study area. In this matrix, each row represents the origin zone and each column represents the destination zone, while the numerical values in each cell indicate the total number of estimated trips between the corresponding origin–destination pairs after applying appropriate expansion factors. The matrix clearly shows variations in travel demand, where higher values represent zones with strong travel interaction and higher passenger movement, while lower or zero values indicate limited or no direct travel demand between zones. The diagonal elements of the matrix represent intra-zonal trips, reflecting travel occurring within the same zone. This O–D matrix provides a comprehensive representation of travel patterns and demand distribution across the network and serves as a fundamental input for transport planning, service evaluation, and optimization of bus routes and operational strategies.

D. Conclusion

According to major findings, passengers' overall satisfaction with Yangon Bus Service is mostly determined by bus stop cleanliness, comfort, and route coverage, with higher fares decreasing satisfaction. Among these, cleanliness has the greatest influence on overall satisfaction. Secondly, as service improvements, maintaining regular timetables, enhancing bus station cleanliness, and improving passenger comfort are all crucial. To improve passenger satisfaction, think about adjusting fares or providing discounts.

Thirdly, in order to optimize travel time, routes should be updated to effectively serve high-demand areas, eliminate duplications, and add rapid transit on congested corridors. Lastly, authorities should adopt data-driven planning for bus operations, invest in safe and clean infrastructure, and install real-time passenger information systems or smart ticketing. For Yangon's public transportation system to be both sustainable and user-friendly, cooperation between city planners and transportation organizations is essential.

Users' perception of Yangon Bus Service is influenced by service reliability, comfort, safety, travel time, affordability, and accessibility. These factors significantly affect passenger satisfaction and public transport usage. Understanding these perception-related factors is essential for identifying strengths and weaknesses in the existing bus service system.

In contrast, Origin–Destination (O–D) estimation provides a quantitative assessment of travel patterns by identifying the number of trips between different zones. The O–D matrix illustrates the spatial distribution of travel demand, highlighting major travel corridors, high-demand zones, and passenger movement patterns within the city. This information is crucial for evaluating the operational performance of the bus network and ensuring that service supply aligns with travel demand. Integrating perception analysis with O–D estimation enables policymakers and transport planners to improve service quality, enhance passenger satisfaction, and promote sustainable urban transport development in Yangon City.

Integrating users' perception analysis with Origin–Destination (O–D) estimation provides a comprehensive evaluation of the Yangon Bus Service. While O–D estimation identifies travel demand patterns, perception analysis highlights service quality experienced by passengers. This combined approach enables transport planners to link demand with service performance, optimize routes, enhance operational efficiency, and improve overall user satisfaction, supporting sustainable urban transport development in Yangon City.

E. Acknowledgment

The authors sincerely appreciate their professors for their invaluable guidance and support throughout this research, and extend their gratitude to all respondents who generously took the time to complete the questionnaires.

F. References

[1] Cats, D. Daganzo, and F. Russo, "Origin–Destination estimation and transit network design: Theory and practice," *Transportation Research Part B*: *Methodological*, vol. 164, pp. 123–144, 2022.

[2] H. Mohd Noor et al., “Public Transport Service Attributes: Travelers' perception in Malaysia,” *Journal of ASIAN Behavioural Studies*, 2025. Available: online.

[3] “Origin‐destination inference in public transportation systems: A comprehensive review,” *Transportation Research Part C: Emerging Technologies*, vol. 125, Apr. 2021.

[4] A. Rosli, M. Latip, M. Ibrani, and S. Adam, “Towards better public transport services: Understanding service quality attributes of public transport in states of developing countries,” *Int. J. Management and Sustainability*, vol. 13, no. 2, pp. 253–272, Feb. 2024.

[5] M. B. Regmi, “A user’s perception survey of quality and reliability of urban public transport services in Asian cities,” *Recent Progress in Sciences*, Research Article, Jul. 2025.

[6] L. M. C. Galvez, P. K. R. Katon, and K. G. P. Valdez, “Exploring the factors influencing commuters’ satisfaction and the use of public utility buses in Quezon City, Philippines,” *Int. Rev. Social Sciences Research*, vol. 5, no. 1, pp. 73–105, Feb. 2025.

[7] International Review of Social Sciences Research, “Research methodology: Mixed online and offline questionnaires and regression analysis in public transport research,” vol. 5, no. 1, Mar. 2025.

[8] L. M. C. Galvez, P. K. R. Katon, and K. G. P. Valdez, “Exploring the factors influencing commuters’ satisfaction and the use of public utility buses in Quezon City, Philippines,” *Int. Rev. Social Sciences Research*, vol. 5, no. 1, pp. 73–105, Feb. 2025.

[9] M. D. Rahman, S. M. Huda, and T. H. Islam, “Likelihood‐based analysis of commuter satisfaction with urban bus services using Likert scale data,” *Transp. Res. Procedia*, vol. 68, pp. 45–53, 2024.

[10] R. K. Singh and P. Kumar, “Application of stepwise regression in analyzing commuter perceptions and service quality in urban transit systems,” *Journal Transp. Res. Forum*, vol. 58, no. 1, pp. 35–50, 2025.

[11] “About 3,800–5,700 YBS buses operate daily across Yangon under 21 companies, serving an estimated 1.5 million commuters,” *Global New Light of Myanmar*, Nov. 4, 2025.

[12] A. G. H. Ong and K. M. Lim, "Origin–Destination Matrix Estimation Using Sample Surveys," *Journal of Transport Engineering*, vol. 145, no. 3, pp. 1-10, Mar. 2019.