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Faculty of Civil Engineering

ACEE 2015

International Conference on Advances in Civil and Environmental Engineering

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Preface

This Conference Proceedings volume contains the written version of the presentations from participants in the first International Conference on Advances in Civil and Environmental Engineering (ACEE 2015) held on the 28-30 July 2015 in Penang Island, Malaysia. The Conference aims to provide a platform for scholars, researchers, practitioners, and professionals from all around the world to present the state-of-the-art reviews of rapidly-developing and exciting areas, report the latest significant findings and developments in all the major fields of Civil Engineering and Environmental Engineering.

The Editorial Committee members have been working hard to meet the deadline of review and editing. The conference proceedings consists of 79 papers and divided into five sessions. All accepted papers covered a wide variety of discipline in civil and environmental engineering that covered Structural and Earthquake Engineering, Geotechnical and Geology Engineering, Construction Management and Building Technology, Water Resources and Environmental Engineering, Materials Engineering, and Highway and Transportation Engineering.

We would like to express our sincere appreciation to all the reviewers for their hard works, precious times and endeavour in reviewing the manuscripts. Also, we would like to thank the authors, participants and speakers for their great contributions to the success of ACEE 2015.

Dr. Kuan Woei Keong

Editor-in-chief of ACEE 2015

July 2015

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FACTORS AFFECTING SERVICE QUALITY OF RAPID PENANG BUS OPERATION AND PASSENGER SATISFACTION

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Abstract

Providing an efficient public transportation with limited resources available is a challenge in a developing country such as Malaysia. Over time, the number of users of public transport decreases gradually due to the lack of service quality provided. This situation leads to the increasing number of private vehicles and reduction in the usage of public transport. To find out more about this situation, some researchers shift the method of measurement from the typical method to multi-method that focuses on the passengers' satisfaction. The TRANSQUAL Model is the new model that was used as a tool in this study to investigate the passengers' satisfaction factor that emerges in the area of study. Findings reveal that out of 10 factors of TRANSQUAL, only 6 factors and 27 variables were found to be significant. The factors are reliability, environment, accessibility, time, responsiveness, safety and security. In terms of overall satisfactions, the service performance level of Rapid Penang in Seberang Perai, Pulau Pinang is moderate. Although the system is efficient, it is still inadequate to attract people to use their service. Some improvements are needed in order to make buses as a preferred mode of travel.

Key words: Rapid Penang, Bus Performance System, Passenger Satisfaction, Public Transport, Service Quality, TRANSQUAL Model.

1. Introduction

Each country must provide significant services that serve the population growth because they will contribute to a positive impact on the socio-economic development of the nation. To sustain economic growth in our country, it is important for the government to perform an efficient transportation system. By enhancing and increasing the networks of the transport system, it will enable to support economic growth, the growing populations and diverse expectations of

urban activities [1]. In addition, the government should provide sufficient policies to reduce traffic emission as well as give some alternatives to ensure the sustainability of transportation system in Malaysia.

Malaysia is now faced with the challenge of rapid motorization and modernization due to urbanisation. With easy ownership of private vehicles, a higher proportion of the urban society in Malaysia is now switching to depend on the use of private vehicle [2]. Unfortunately, the increasing number of private vehicle leads to the reduction in the use of the public transport. This situation has also contributed to major problems for many urban countries such as congestion, pollution and increasing number of statistic for car accidents.

To some extent, the refusal of people to use public transportation is due to the socially degraded mode of transport [3]. These conditions and services have been declining and need high political will to bring the reputation and image, especially in Penang. Public transportation has a lack of sole responsible body for planning and implementing the appropriate policy which leads to the deficiencies of public transport service quality and operation.

Thus, this study focuses on the quality service measure of public transportation by determining the factors and attributes that lead to the improvement of the transportation system as well as passengers' satisfaction. This study focuses on Rapid Penang bus transportation that operates at route 702 and 709 in Seberang Perai, Pulau Pinang. The findings aim to contribute to improve the bus service performance towards a better service and image, as well as encourage more people to use public transportation as the main transport in Seberang Perai.

2. Literature Review

Researches on public transportation have been conducted around the world. One of the factors that is very important in measuring quality of service is passenger satisfaction. In Malaysia, several researchers have attempted to explore the quality of service provided by bus operators as perceived by the passengers. According to Ismail et al, 2012 [4] in their study on service quality attributes in Kuala Lumpur and the Klang Valley, it was found that the quality of public transport is inadequate and below expectation, and emphasized that some improvements need to be done. In addition, a research by RapidKL bus agency focuses on several parameters that influence passengers' satisfaction towards RapidKL bus service [5].

According to Litman, T. 2013 [6], the conventional method only focuses on speed, convenience and affordability of motor vehicle travel but it is different compared to the measurement for new methods or paradigms which consider a wider range of mode, objectives, impacts and improvement options. It is a more comprehensive and multimodal analysis and implements a higher demand for management solution.

Many researchers have attempted to define and model the quality because of the difficulties involved in delimiting and measuring the constructs. The most well-known model in developing service quality measure is SERVQUAL [7]. Measuring the service quality is one of the best methods in determining the effectiveness of the services provided and has a contribution to market share and returns of investment. In fact, quality measurement is widely used in many sectors

nowadays. The model shows the important activities of the organisation which influence the perception of service quality.

The SERVQUAL Model requires customers to rate their expectations with their perception of service quality and a score is obtained by subtracting customers' expectation. It is represented by the gap between the customers' perception of the actual service performance level and their expectation of the service quality [8]. The five service qualities of the SERVQUAL Model are reliability, responsiveness, assurance, empathy and tangibles.

Consequently, TRANSQUAL Model [9] is a new modified used to measure service quality, especially in bus transportation system. The passengers can express their perception based on the services that have been provided. This model offers 10 factors with 39 variables that are related to the service quality of bus transportation towards passenger satisfaction. The factors are accessibility, reliability, responsiveness, understanding, physical facility, environment, image, time and fare. Findings that show only the strong and constant variables were sustained while the rest were eliminated.

Thus, this study tries to adapt the initial concept based on the TRANSQUAL Model to determine the factors that influence the service quality on specific routes within the study area. The findings will be used to improve the bus transportations system as well as act as a benchmark to other researchers to conduct similar studies in the future.

3. The Study Area

The first stage of study was gathering the information about Rapid Penang as well as the past and the current issues on bus transportation. The second stage was selecting the study area and the potential routes that will be investigated.

Both of the routes are located in Seberang Perai, and the first route is 702 which start from Penang Central to Bukit Mertajam Plaza shown in Fig. 1 while the second route is 709 which start from Penang Central to Sekolah Menengah Kebangsaan Machang Bubuk shown in Fig. 2. The study area is about 237.17 km². It consists of several towns such as Bandar PERDA, Seberang Jaya, Auto City, Perai and Bukit Mertajam. The Seberang Perai Tengah district faces a phenomenon where the development is growing rapidly due to the industrial and business growth. The first Penang Bridge is the gate to enter the Penang Island. Besides that, there are a few tourist attractions such as Mengkuang Dam, CheroK To'Kun Hill and Birds Sanctuary in Seberang Jaya.

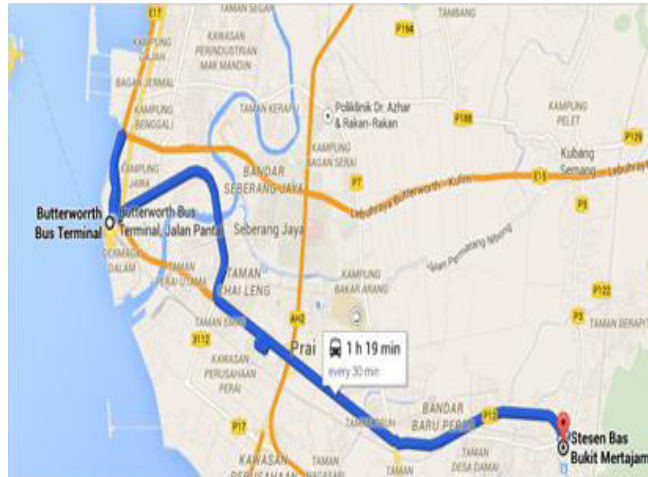


Fig. 1. Route 702 from Penang Central to Bukit Mertajam Plaza
(Source: Google Map, 2015).

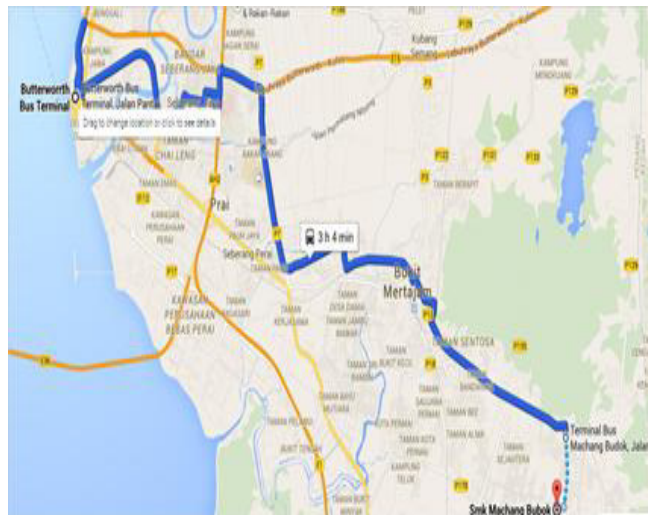


Fig. 2. Route 709 from Penang Central to SMK Machang Bubuk
(Source: Google Map, 2015).

3.1. Survey and observation

Two approaches that were implemented in the data collection are quantitative and qualitative surveys. Questionnaires and interviews were carried out in the data collection in order to determine the passengers' satisfaction regarding the Rapid Penang bus transportation. The questionnaires were distributed among the Rapid Penang bus users. The passengers also answered the questionnaires through the Internet where the questionnaire forms were provided using Google Driver. Overall, there were 115 respondents who gave positive feedbacks by answering the questionnaires.

An observation was conducted during the visit at the bus stops and bus stations. From the observation at the bus stops, the bus characteristics, environment, route surrounding, terminal surrounding, fares and road characteristics were determined. The data collection during the visit such as service provided, schedule board and location, fare and the numbers of buses were measured. Pictures were also taken in different situations to provide enough evidence.

3.2. Data analysis

A few stages were considered when performing the data analysis. The first is presenting the demographic results, followed by routes characteristics and finally the factor loading obtained. The data were analysed using the Factor Analysis to determine which attribute are lying strongly based on factor loading. The TRANSQUAL Model development process was used as a guideline for data analysis and data extraction using SPSS Statistic 17 with the aim to measure the service quality of bus public transportation system.

4. Results and Discussions

The services that are being provided to Rapid Penang passengers are important in order to meet the passengers' satisfaction. These services include ticketing system, the accessibility for the disabled OKU and information centres. Public infrastructures and facilities such as bus terminals, bus stops and pedestrian walkways are also important. This is because, providing good infrastructures and facilities can lead to passengers' satisfaction. From the observations that were carried out, an improvement and regular maintenance of some facilities should be done because they were found to be in unsatisfactory condition.

4.1. Demographic analysis

The respondents were randomly chosen to answer the questionnaires. From the data obtained, there were 115 respondents, in which the female respondents (58.5%) were more than male respondents. However, the highest number of respondents according to their race is the Malays (76.5%), followed by other races (15.7%), Indians (5.2%) and Chinese (2.6%).

In response to the question on the age, it was found that the age range of 21-40 years (76.5%) scored the highest, followed by the age below 20 years (13.9%). and age 41-60 years (3.5%). The lowest score is the age of more than 60 years with 1.7%.

As for occupation status, 89.6% of the respondents were students. This is followed by 4.3% with other occupation status, 4.3% from the private sector and 3.5% were from the government sector. Those who were from the retired and housewife status made up of 1.7% and 0.9% respectively.

Based on the data collection, 83.5% of the respondents do not have any income. Those with the income below than RM500 and income within the range of RM501-RM1000 have the same percentage of respondents with 5.2%. The respondents with the income range between RM1001-RM2000 scored 6.1%.

Overall, 74.8% of the respondents have a vehicle license, while the other 25.2% of respondents do not have a vehicle license. For vehicle ownership, 73.9% of the respondents do not have a vehicle, 19.1% have a motorbike and 7.0% have a car. All the data is tabulated in Table 1.

Table 1. Demographic Data.

Item	Demographic	Frequency	Percentage (%)
Gender	Male	48	41.7
	Female	67	58.3
Race	Malay	88	76.5
	Chinese	3	2.6
	Indian	6	5.2
	Other	18	15.7
Age	Below 20 years	18	13.9
	21 – 40 years	88	76.5
	41 – 60 years	4	3.5
	More than 60 years	2	1.7
	Missing	5	95.7
Occupation Status	Students	103	89.6
	Government	4	3.5
	Private	5	4.3
	Housewife	1	0.9
	Retirees	2	1.7
Monthly Income	No income	96	83.5
	< RM500	6	5.2
	RM501 – RM1000	6	5.2
	RM1001 – RM2000	7	6.1
Vehicle Licenses	Yes	86	74.8
	No	29	25.2
Vehicle Ownership	No	85	73.9
	Motorbike	22	19.1
	Car	8	7.0

4.2. Bus characteristics analysis

The performance of the bus transport for this research was determined based on the passengers' experience. From the data collection, most of the respondents reached the first bus stop by walking (87%). Therefore, the accessibility of the bus stop is one of the important facilities that should be provided. From the observation, the bus stops within the research area were easy to identify, the benches were sufficient and could cope with the capacity of bus passengers. However, some of the bus stops did not fulfill these criteria due to the small space of the bus stop location, while some did not even have a bus stop. Therefore, the facilities should be maintained periodically via maintenance work in order to keep them in good condition.

Bus schedule plays an important role to the passengers. Bus schedule allows them to manage their travel schedule and reduce their waiting time. Unfortunately, 80% of the respondents did not know the bus schedule and only 19.1% did. Rapid Penang has provided the bus schedule for every route inside the bus which is located at the back of the driver's seat. Passengers can also get the bus schedule from the Rapid Penang website. However, sometimes the bus takes a longer time than scheduled due to the certain traffic conditions such as congestion, accidents, environment (heavy rain) and other reasons. As a result,

26.1% of the respondents had to wait for the bus for more than 20 minutes and only 7.8% waited for less than 5 minutes.

From the result, the highest bus frequency is about 21-30 minutes involving 29.6% of the respondents and 25.2% did not answer this question because they were not sure of the answer. The frequency of the bus service is the one of performance measures that should be observed. Frequency of the bus is the rate of bus arrivals or departures at a station or bus stop. Frequency is often valued as the number of buses per time distance [10]. As a result, a bus that arrives too late or too early can cause a bunching of buses [11].

Travel distance from origin to destination corresponds to the travel time on the bus. This is because longer travel distance will result in longer travel time on the bus. Other factors that influence the travel time on the bus are road and traffic conditions. Road conditions such as heavy rain and congestion also reduce the bus speed. Besides that, boarding and alighting will cause delay and will also influence the travel time.

Bus transfer refers to the number of passengers that needs to change buses to reach their destination. Sometimes passengers need to change the bus more than once to reach their destination. This situation occurs when the bus at their place has no access to their destination. Based on the data collection, more than 26.1% of the respondents had to change buses to reach their destination, followed by 1.7% respondents who needed to change the bus for more than 3 times and 3.5% for 2 times. 20.9% of the respondents did not need to change buses to get to their destination.

Bus ticket is referred to the bus fare which passengers need to pay before boarding the bus. There are two approaches, in which the first one is cash and second is monthly ticket. Malaysian Citizens under the category of senior citizens (*warga emas*), the disabled (OKU) and school children only available if wearing uniform is eligible for the concession of fare tickets [12]. The bus fare increases depending on the travel distance. Based on the survey, the current new fare was implemented by Rapid Penang bus agency. The first 7 km of the travel distance costs RM 1.40 for normal passengers and RM0.70 for Malaysian Citizen. Most of the respondents were satisfied with the fare structure that is used by Rapid Penang.

Bus transport becomes a mode of choice for the respondents because it offers a lower fare 45.2% of the respondents. The interior design of the bus also attracts passengers to use the bus, mainly because of its convenience and comfort. The buses are designed with good ventilation and furniture chair, access for the disabled and standing area. Unfortunately, if the maximum capacity of the passenger is reached, the passengers feel uncomfortable because the bus is too crowded and the ventilation inside the bus becomes poor. This situation basically happened during the weekend. Table 2 shows the summary of the bus characteristic results.

Table 2. Bus Characteristics.

Item	Criteria	Percent (%)
How did you arrive at the bus stop?	Walking	87
	Sent	3.5
	Drive	3.5
	Bus	6.1
Distance from home to the bus stop	0 – 50 m	31.3
	51 – 200 m	19.1
	201 – 400 m	22.6
	>401 m	6.1
How long have you waited for the bus?	1 – 5 min	7.8
	6 – 15 min	23.5
	16 – 20 min	23.5
	>20 min	26.1
	0	19.1
Do you know the bus schedule?	Yes	19.1
	No	80.9
Bus frequency	5 -10 min	7.0
	11 – 20 min	16.5
	21 – 30 min	29.6
	31 – 40 min	9.6
	41 – 50 min	7.8
	>50 min	4.3
	0	25.2
One-way travel distance to destination	< 5 km	21.7
	6 – 10 km	32.2
	11 -15 km	12.2
	>15 km	9.6
	0	24.3
The time on the bus Missing	< 20 min	41.7
	21 -40 min	29.6
	41 – 50 min	6.1
	< 50 min	2.6
Number of bus interchanges	0	20.0
	No need	56.5
	1 time	20.9
	2 times	3.5
	3 times	1.7
	0	17.4

4.3. Analysis and results

The purpose of the Cronbach's Alpha analysis is to determine the consistency of the items that were analysed. The result from the reliability analysis shows that there was no item needed to eliminate during performing the reliability analysis using Cronbach's Alpha analysis. Cronbach's Alpha value is 0.952 with 39 items shown in Table 3. This means that the correlation between the items is good with the instrument index of the research [13].

Table 3. Test for all Scale of Reliability Cronbach's Alpha.

Reliability Statistic		Scale Statistic		
Cronbach's Alpha	N of items	Mean	Variance	Standard Deviation
0.952	39	121.430	493.299	22.210

After that, the study proceeded with the KMO and Bartlett's Test. Referring to Table 4, the test shows 0.842 (more than 0.500) has no multicollinearity problem [14]. The analysis continues with Bartlett's Test of Sphericity to determine whether the correlation between the items is significant before proceeding to the analysis factor. The signification of the test is $p < 0.05$. As a result, the correlation of the items is significant for analysis factor.

Table 4. KMO and Bartlett's Test.

Kaiser-Meyer-Olkin Measure of Sampling Adequance		0.842
Bartlett's Test of Sphericity	Approx. Chi-Square	2304.4751
	Df	351
	Sig.	0.000

The item was extracted using the Principle Component Analysis. There were 6 factors given eigenvalues equal to 1.0 or more than 1.0. These factors give 37.127 percent for total variance changes. The remaining factors that have less than 1.0 eigenvalues were eliminated from the factor list. After that, the factor was continued by orthogonal rotation through Varimax Rotation shown in Table 5. The function is to rotate the factors to maximise the loading on each variable and minimise the loading on other factors [14, 15].

Table 5. Eigenvalues and Percentage of Variance Changes.

Com	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% Var	Cum%	Total	% Var	Cum%	Total	% Var	Cum%
1	10.024	37.127	37.127	10.024	37.127	37.127	4.819	17.848	17.848
2	2.887	10.691	47.819	2.887	10.691	47.819	4.530	16.779	34.628
3	2.406	8.911	56.730	2.406	8.911	56.730	3.144	11.645	46.272
4	1.915	7.092	63.821	1.915	7.092	63.821	3.125	11.573	57.846
5	1.488	5.509	69.331	1.488	5.509	69.331	2.500	9.259	67.104
6	1.169	4.330	73.661	1.169	4.330	73.661	1.770	6.556	73.661

Note: Com = Component (Factor), Var = Variance, Cum = Cumulative

After the modification, the item was rearranged. Some items were deleted due to duplication and possible removal of these factors. The final check for reliability test of the data was performed using Cronbach's Alpha. Table 6 shows the final Cronbach's Alpha of 0.930 after 12 items were removed.

Table 6. Final Cronbach's Alpha for Reliability Scale.

Reliability Statistic		Scale Statistic		
Cronbach's Alpha	N of items	Mean	Variance	Standard Deviation
0.930	27	82.48	239.481	15.481

From Table 7, the results of Reliability scale of Cronbach's Alpha value for Reliability (0.909) has the highest consistency, followed by Environment (0.912), Safety & Security (0.889), Responsiveness (0.880), Accessibility (0.808) and Time (0.734).

Table 7. Final Cronbach's Alpha for Each Factor Reliability Scale.

Factors	Cronbach's Alpha	Mean	Standard Dev.	Variance	No. item
Reliability	0.909	12.36	3.174	10.635	4
Environment	0.912	22.81	5.087	25.875	7
Safety & Security	0.889	20.78	6.091	37.101	7
Responsiveness	0.880	11.23	3.174	10.071	4
Accessibility	0.808	9.89	2.211	4.891	3
Time	0.734	5.42	1.567	2.458	2

From the results shown, although Reliability falls on the highest consistency, Accessibility and Time falls under second last and last in the consistency of the final Cronbach's Alpha reliability scale.

From the factor analysis, out of 10 factors and 39 items in the TRANSQUAL Model, only 6 factors and 27 items were strong in this study area to determine service quality indicator of bus transport presented in Table 8. The highest factor is Reliability (0.823), followed by Accessibility (0.776), Time (0.770), Environment (0.750), Responsiveness (0.746) and the last factor is Safety and Security (0.710).

Table 8. Factor Loading with 6 Factors and 27 items.

Factor	Item	Factor Loading
Reliability (0.823)	26. Bus departs right on schedule	0.909
	27. Dependable bus schedule	0.893
	25. The bus arrives right on schedule	0.851
	28. Bus driver that abides by the law, is patient and courteous	0.638
Accessibility (0.776)	22. Site/situation for bus transfer before arriving to the destination	0.784
	21. Distance from home to the bus stop	0.778
	23. Distance between the first arrival and the actual destination	0.766
Time (0.770)	58. Arrival time of the bus	0.803
	57. Waiting time in the bus before arriving to the destination	0.747
Environment (0.750)	53. Level of noise pollution that is generated by the bus from the bus	0.862
	50. Level of temperature inside the bus	0.809
	54. Image of the bus company	0.772
	55. Bus image improvement through advertisement and promotion	0.726
	52. Level of air pollution emissions from buses	0.717
	48. Level of bus cleanliness, both interior and exterior	0.693
	56. Level of foreign language mastery among the driver/company staff.	0.669
Responsiveness (0.746)	29. Willingness of driver/company staff to provide assistance when needed	0.856
	30. Providing immediate response on required information of the users	0.822
	31. Easily accessed information (fares, schedule and maps)	0.694
	32. Willingness of driver/company to understand the users' needs	0.612
Safety & Security (0.710)	43. Presence of police and security force in the designated area	0.865
	42. Individual safety from criminal dangers at the bus terminal and bus stop	0.847
	44. Appropriate lighting to prevent crimes at the designated area	0.812
	45. The risk of harassment from other passengers	0.792
	37. Safe and easy to recognize/identify the bus stop	0.598
	36. Facilities at bus terminal	0.581
	41. WiFi facilities in bus	0.550

From the overall data collection, passengers' perceived satisfaction is 46.96% while 34.78% felt that the bus service performance is moderate. Only 5.22% of the passengers were strongly satisfied with the system but 12.17% passengers were dissatisfied of the system, followed by 0.9% who was strongly dissatisfied.

5. Conclusion and Recommendations

The study found that passengers' satisfaction is an important method that should be taken into consideration when measuring the effectiveness of the bus industry

in order for it to be sustained. The results from the factor analysis reveal that 6 factors and 27 items are significant in the area of study and the highest factor score is Reliability, followed by Accessibility, Time, Environment, Responsiveness and the last factor is Safety and Security.

The findings show that although passengers are satisfied with the service, which is Reliability and Accessibility of bus service, the lower factors Safety and Security are still unsatisfactory. From the observation, it seems that the surrounding area of the bus station at Bukit Mertajam Plaza is dark and dangerous of crimes, especially at night, because there is not enough lighting to prevent criminals and also no monitoring from the police. Moreover, there are insufficient facilities at the terminal such as no pedestrian crossing or flyover to cater to the demand of passengers reaching to the bus stops which make passengers feel uncomfortable.

It is also found that those from the low income category use this service the most and [3], the rejection in the usage of public transport will lead to the socially degraded mode of transport. The absence of a responsible body in the planning of a good policy prolongs the scarcity.

In order to increase passengers' satisfaction, public transportation should be further improved with an immediate action and some new policies need to be considered. There are a few suggestions that can be made as follows;

Short-Term Actions (Immediate Effect)

- a. Creating awareness of the benefits of taking public transport for work and leisure through advertising media is one of the best approaches. Media is a fast method to introduce the public transport as the preferred mode of transport. Besides that, media can educate people in changing their mind set regarding public transportation [9].
- b. Providing training programmes for bus drivers and staff to improve the public transport system and services. The driver and staff is the person that directly cooperates with the passengers and provides an immediate response or required information when needed. Therefore, via the suggested training programmes, the service can be improved before it is delivered to the passengers. Besides that, the performance of bus transportation can be improved by considering the passenger loyalty, passenger perception and passenger expectation in delivering the service [9].
- c. Providing a centralised depot for bus services and maintenance. The buses should be maintained regularly to prevent any hazard that may happen such as accidents. Through maintenance, the operational performance of the buses can be maintained in providing efficient services to the passengers.

Medium Term Actions (within 1 to 5 years)

- a. The existing bus stations and terminals for Penang Central and Bukit Mertajam should be improved based on the guidelines for the design of the bus terminal [2].
- b. Specific meeting areas must be defined at the bus station or bus terminal to reduce congestion around the bus station.
- c. A proper signage must be provided at the user convenience areas and also on each bus.

- d. The pedestrian walkway with disable-friendly design must be considered.
- e. The security of users must be taken care of and the lighting system must be maintained regularly.
- f. All existing bus stations might have to be upgraded or relocated to other suitable places.

Long-Term Action (5 years and more)

- a. Bus operators should provide exclusive bus lanes which can reduce delays and increase bus speed. In addition, the punctuality and arrival time of the bus will be systematic and efficient.

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