The study of headway patterns and level of service in myBAS ridership

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Abstract. The challenge of increasing ridership in public transportation has never been easy. Private vehicles often provide a greater opportunity to travel in rural areas and small cities with low traffic density but not in high-density cities. This paper attempts to identify the factors that affect myBAS service operation in Perlis and provide ratings on its headway patterns. The study focuses on the passengers of myBAS in Perlis and the selected routes were T101, F101, and CF109, with the most access to popular cities. Atlas Ti. (Version 7.0) was used for data analysis and a group of 11 factors affecting service operation were identified. Subsequently, an observation was also made by comparing the schedules published by the operator. Based on United States Highway Capacity Manual 2010 (USHCM 2010), the findings revealed that LOS for headway pattern during peak hour on route T101, F101 and CF109 is in the range of E (30 min to 60 min) with 1 bus arriving per hour. The findings also show "Service available during hour" and by improving the LOS of bus headway, the operator may increase ridership among local citizens. This study will benefit the local authority in achieving the status of the sustainable city towards 2030 in line with the United Nation’s declaration which focuses on green and healthy cities by having good mobility management and promoting better transportation planning as well as increasing ridership among citizens.

1.0 Introduction

Perlis is the smallest state in Malaysia. Having less traffic congestion in most districts and unpopular public transport usage among the citizen has resulted in low ridership in public buses [1]. Prasarana, the service provider, offers the best in serving the public with maximum comfort and strategic locations by supplying the latest buses to appeal to the locals [2]. However, the preferred mode of travel for the locals is still private vehicles which provide the highest level of accessibility [3]. Nevertheless, promoting public bus usage in Perlis may result in a better transportation system, less congestion and less polluted environment as well as reduced carbon footprints.

MyBAS is currently facing the problem of low ridership in its operation in Perlis. The situation is evident through observation and interviews with the locals. Local residents claimed that using the bus service is good but if the route of the bus is unknown, it is troublesome for them to plan their travel. Most locals want to try using the bus since it is the latest bus service in Perlis offering the most comfort among other bus services such as Cityliner and Maraliner. Thus, it is crucial that the service provider improve its public bus service to increase ridership. Local residents also stated that the unpublished bus routes are the most common issues and the service provider needs to publish more
information regarding bus schedules by using banners and pamphlets. Thus, the only way the public can use the bus is by relying on the headway of buses [4]. Headway is the time taken at a bus stop between two buses coming through. Service provider may install a digital board to view the headway of incoming bus to the passenger in giving them a better perception while waiting for the bus to arrive [5]. Improving headway is a sub-item in achieving a good level of service. The level of service of public buses is influenced by various factors such as headway and on-time performance [6]. The objectives of this study are to determine the factors that may affect bus service operation, to investigate headway patterns and to evaluate bus schedule on selected routes. As a result, it will therefore improve the LOS of bus service as well as the ridership among the residents of Perlis.

2.0 Literature Review

Headway pattern of a public bus is stated to affect most of the ridership [7]. This is because a new user of public bus, for example, a foreign tourist who is not familiar with the new transportation system will definitely wait for the bus to arrive without referring to the bus schedule. This is where the headway patterns play an important role. A passenger will never hesitate if the estimated time of the incoming bus is known, for instance, 10 minutes arrival interval. Thus, headway patterns will improve the level of service of a public bus. The level of service of a public bus is influenced by many factors but the most critical are headway and on-time performance [8]. However, passengers often care less on how long the time taken to travel while in the bus will be and consequently neglecting the travel time.

Headway represents the bus period arrival at each station and the time calculated between the incoming buses and if a bus has 10 minutes headway, it is rated as LOS A [9]. In addition, the reliability of bus service operation also focuses on the on-time measures. If the on-time performance has zero differentials between actual and published schedule, it will result in LOS A. Thus, by representing sub-field of the subject, it will be much simpler and gives the public the perception that any issue can be solved in a systematic manner.

According to United States Highway Capacity Manual (USHCM, 2000) as stated in Table 1 LOS for Urban Scheduled Transit using headway patterns, there are five classes of LOS which relate to bus frequency, headway and number of vehicles per hour [9]. In addition, LOS of the bus service operation can also be determined by using on-time percentage. For schedule comparison, USHCM (2000) has provided a table for on-time performance [9]. Table 2 shows the guidelines for the LOS for on-time percentage of the bus schedule.

Table 1. Service Frequency LOS for Urban Scheduled Transit Service

| LOS | Headway (min) | Veh/h | Comment(s) |
|-----|---------------|-------|------------|
| A   | <10           | >6    | Passengers do not need schedules. |
| B   | >10-14        | 5-6   | Frequent service; passengers consult schedules. |
| C   | >14-20        | 3-4   | Maximum desirable time to wait if miss bus/train. |
| D   | >20-30        | 2     | Service is unappealing to choice riders. |
| E   | >30-60        | 1     | Service is available during hour. |
| F   | >60           | <1    | Service is unappealing to all riders. |
Table 2. Reliability LOS for On-Time Performance

| LOS | On-Time Percentage | Comment(s)                      |
|-----|--------------------|--------------------------------|
| A   | 97.5-100           | 1 late bus per month            |
| B   | 95-97.4            | 2 late buses per month          |
| C   | 90.0-94.9          | 1 late bus per week             |
| D   | 85.0-89.9          | 1 late bus per direction per week|
| E   | 80.0-84.9          | 1 late bus per direction per week|
| F   | <80.0              | 1 late bus per direction per week|

However, the focus of this study is the service operation, thus, the route selection suggested is that any suitable route may be selected for the first study on myBAS service operation [10][11]. The on-time percentage calculation is based on a formula from USHCM (2000) as stated below:

\[
\frac{\text{actual journey time} - \text{scheduled journey time}}{\text{scheduled journey time}} \times 100\%
\]

Equation (1) needs to have time calculation in minutes. The percentage may result in negative, which indicates that the bus arrived earlier than scheduled and if it is positive, the bus arrived later than scheduled. From the on-time percentage, LOS is given according to the table from USHCM (2000).

SERVQUAL model is mostly used in various research fields to measure service quality and it is rated as the best method [12]. However, in relation to bus transportation system, TRANSQUAL model offers the best suitability [13]. There are 10 factors with 39 related variables which are accessibility, reliability, responsiveness, understanding, physical facility, environment, image, time and fare. These variables provide the reality of local public buses service quality. Therefore, there is an immediate need for public buses in Malaysia to improve and offers better transportation system while ensuring a sustainable environment to the citizens.

3.0 Methodology
The study’s focus is on myBAS service in Perlis. The target area is Kangar, the capital city of Perlis. Most government administrations and private offices together with supermarkets are located in the city and this makes Kangar a central business district (CBD) in Perlis. Bus stations and bus stops were identified and the public utilising public buses were selected and interviewed. The respondents’ selection was made by randomly asking the people at the bus station/stop on the types of bus are they waiting for. If they were waiting for myBAS, the interview session continued for further questions. In addition, observation was carried out on the facilities provided for public transport users around Kangar and pictures were captured for further analysis. Next, a software known as Atlas Ti, was used to analyse data from the interview sessions. The coding in Atlas Ti was done accordingly, based on the interviews with public bus users and consequently, generating main factors affecting the bus service operation.

MyBAS was chosen because the buses are the most comfortable compared to other public buses such as MARA and Cityliner buses. The selected routes were T101, F101, and CF109 and CF110. The locations of bus stops were observed to give perspective on the facilities provided for the service [13]. These bus stops were the locations where the time was recorded for the headway of the bus. Bus schedule and the headway were calculated. However, the analysis and data presentations were slightly different. The suggested peak hour is within 7.00 to 8.59 a.m. and the off peak hour are within 9.00 to 4.00 p.m. [14]. The passengers were mostly employees from both governments, private sectors as well as students since majority of the respondents do not own private vehicles, and they claimed that the public transport helps them to commute to work daily. The survey was conducted throughout the week (on weekdays and weekends) for the duration of two weeks. The data was analysed and presented in
histogram and line graph. Guidelines from USHCM (2000) were used in providing rating for the data collected in terms of Level of Service (LOS).

The data collected were passenger experiences while using the bus and bus operation schedules. The passengers’ experiences will figure out perception and expectation towards the bus service operation. In addition, secondary data such as published schedules in their websites were also analysed to provide a comparison between real and expected headway. According to the guidelines by USHCM (2000), data rating is described in terms of Level of Service (LOS). The best practice of headway pattern from USHCM (2000) will give the citizens of Perlis the best bus service performance.

The factors that may affect bus service operation were identified through the interview sessions. Each interview session was transcribed and data coding was conducted to identify the factors as expressed by the respondents. Each response contributed to the analysis e.g. the complaint on bus arriving late thus leading to long waiting period and agitating passengers. Overall, the main concerns expressed by passengers include not being aware of the bus schedule and waiting period based on the headway of buses. The data was analysed by transcribing the interview sessions. Each idea, concern and point of view was categorised into different factors affecting service operation. The number of passengers selected was based on the responses of the passengers and ten respondents were selected because the reviews were saturated on the eleventh and twelfth respondents. Respondents’ selection varied in age i.e. from primary and secondary school students to the senior citizens.

4.0 Results and Discussion

4.1 Factors affecting myBAS service operation.

The result from qualitative data collection (via interview sessions) presents a list of factors affecting service operation. Figure 1 showing a bunch of notes representing the voice of the passengers. Based on Figure 1, the most discussed factor from the semi-structured interviews is bus schedule due to the number of notes pointing to bus schedule is the highest number compared to other factors. Passengers could not plan their schedule due to unpublished schedules for the public. The only way to arrange their journey is to observe schedule banners hung around the bus station/stop. Eleven factors were identified in the interview sessions namely bus schedule, bus operator, interior hygiene, distance from destination to bus stops, bus stop conditions, ticketing fare and system, reason(s) to use bus, distance to bus stop from house, waiting time, bus appearance, and journey distance. In addition, the least discussed factor by the respondents is journey distance as most of them did not realise the journey distance while on the bus. These eleven factors may be the benchmark to the service provider to improve their services.

Bus operator also plays an important role to attract more passengers. A kind and helpful bus operator with good driving skills is crucial to give passengers good impression in order for them to promote the services to others. Good bus interior condition offers comfortable travelling experiences to passengers. Bus operator needs to monitor frequently the interior hygiene to avoid the feeling of discomfort among passengers. As for the distance to reach the bus station/stop, most of the respondents felt that the distance to the bus stops and home is reachable. However, some respondents complained about bus stop’s conditions i.e. too old and was never maintained for many years. Some locations do not have appropriate bus stops for the public transport users and this makes using public buses less appealing to public transport users.

Since most passengers are not aware of the bus schedules, the reliability depends on the waiting time. The expectation goes to a shorter waiting time of buses and if there is late arrival, passengers will feel agitated. Passengers were satisfied with the bus fare and the system used which is pay upon entry (before looking for a seat in the bus). Most of the respondents use the bus because it is the only mode of transport available for daily commute. Perlis citizens do prefer to drive private vehicles. Finally, and most importantly, the distance travelled while the passengers are sitting on the bus is not an issue due to the fact that most passengers do not realise how far the bus has travelled during the
journey. All these factors may become the benchmark to service providers to improve and attract more passengers.

Figure 1. myBAS user perception

4.2 Headway pattern of myBAS.
Headway pattern was also calculated to support the qualitative analysis. The data were collected by setting up reference points at every two consecutive bus stops. The data recorded are presented in Figure 2.
The headway patterns for route T101, F101, and CF109 are presented in Figure 2. The scheduled headway for the selected routes is 30 minutes. There are buses that follow the scheduled headway while there are also buses that do not follow the scheduled headway. This is most probably due to factors such as traffic condition, weather condition, and bus condition. The factors contributing to the dependency of public transport is the ownership of private vehicles and its reliability. However, if the public bus can offer good service, people will be more inclined to use public bus instead of driving their own vehicles. During off peak hour, routes T101, F101, and CF109 performed ineffectively when contrasted with alternate routes as shown in Figure 2. Evidently, the number of bus provided does not affect the headway patterns during peak or off-peak hour. Generally, LOS for routes T101 and CF109 performed at the same level when contrasted with different routes. Passengers have to wait for another bus if they miss a bus. Nonetheless, a majority of those who utilise public transport are individuals who have no choice but to sit tight and wait for the buses to arrive. The score of LOS E shows poor execution for the buses’ disparaging routes T101, F101, and CF109. Although the bus is still accessible during the hour, the holding up time is within 45 to 50 minutes. As indicated by [5], the genuine headway must be within ±5 min to 30 minutes so that the passengers will be served according to planned time. The outcomes from perception demonstrate that progress delays brought on street blockage during peak hour. Advance perception uncovered that progress delay off peak hour emphatically identified with diminishment in transport recurrence. Henceforth, the transport administrator ought to target operations control endeavours on transport plan issue to improve their service for the public.

4.3 On-time performance for route T101.

Various data on the operation of the bus such as schedule is one of the factors that contribute greatly to the performance perceived by the public. Thus, it is vital that the collection of data regarding the actual schedule and published schedule is presented. On-site observation is the best data collection method and it is presented in Figure 3 and Figure 4. The route selected was T101 due to it is having most stopping points compared to F101 and CF109 and serves the critical area from Kangar to KTM Arau.
Figure 3 and Figure 4 show weekday’s performance and weekend performance for route T101, respectively. Only two points are shown in the graph because the published schedules only display the time of the bus’ departure and arrival from the origin to the destination on the travel route. On weekends, the on-time percentage is 63.33 % early than the published schedule while in weekday’s bus the on-time percentage is 56.67 % early than the published schedule. According to USHCM (2000), LOS for on-time percentage if there is no late arrival/departure is LOS A for the headway on the selected route. In contrast, earlier arrival results in passengers losing track of their estimated travel time/duration. The on-time percentage headway will benefit the public as they are able to plan their travel wisely.

5.0 Conclusion

In conclusion, there are various factors affecting public transport quality service, for example, bus schedule which was most frequently expressed by respondents (public bus passengers) while most of them are the least concerned with the journey distance. These factors may be the indicators for quality improvement and may increase more in future to suit their policy. Lesser vehicles on the road will help to give the public a greater quality of life. Today, the changes made will give a better quality of living to the next generation.

In improving service operation, the factors above may require improvisation. For example, most passengers strictly rely on bus schedule to plan their journey. Thus, the service provider must publish more bus schedules, on both offline and online media. Banners and flyers on each bus station may offer passengers more flexibility to have a well-planned journey. In addition, by letting the passengers know about the bus schedule, headway of buses may not be a concern. Passengers can predict when the bus is arriving. Thus, waiting time will also not be a burden to the passengers. Training for bus drivers for every quarter in a year may also improve the appealing factor of public bus service. Passengers who have good relation with bus drivers may have greater comfort while riding the bus.
Bus drivers also need to engage in conversations with passengers to identify issues related to the service provided, for instance, to find out if there is any location that may require public bus service. Consequently, this will improve the routes of the bus as well as the ridership of bus. Unpopular routes may be reduced and new routes may be introduced in Perlis according to the needs of the public. This will help to meet the highest demand in some areas in Perlis and at the same time, encourage the locals to travel by using public bus. In conclusion, a close gap between demand and supply together with increased level of service will definitely improve the public bus ridership in Perlis.

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