Analysis of the *Trans Koetaradja* bus services considering latent variables of bus line services

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Abstract. The Government of Aceh delivers a transport policy measure to combat autos dependency and severe traffic within the city by reforming conventional urban public transportation to modern bus system so-called the *Trans Koetaradja* (TK). The most critical issue for urban bus system is in how to maintenance existing users and attract new ridership’s. In this case, perceived service quality (PSQ) elements such as the easiness, comfort, and safety of bus system has an importance rule in determining user's satisfaction. The PSQ is used in public transport planning and operation as a tool to establish the level of overall user’s satisfaction towards public transport services. Therefore, this study aims to examine the PSQ of the TK bus services by considering unobserved variable such as psychological indicators related to the bus line services from TK’s users. Revealed preference survey within 3 lines of TK was conducted in the mid of 2019. On board survey with a total of 450 samples were distributed and valid used in this study. The multivariate analysis of structural equation modelling so-called confirmatory factor analysis (CFA) is used to deeply explore the behavioral intention of TK users toward the bus service attributes. The CFA result depicts that PSQ resulted to higher user’s satisfaction has significantly statistical relationship with the user intention to the bus services variables of "obedience when stopped", "driver appearance", "air condition", "bus arrival time" and "the satisfaction of supporting bus facilities".

1. Introduction
Growing of vehicle ownership in Banda Aceh city is not comparable with existing road infrastructures. As a consequence, traffic congestion manifests its related problems such as unwarranted travel times, air pollution, additional energy consumption, and driver health [1-3]. The impact of this growing trend in private vehicles coupled with the decline in public transport services in the city of Banda Aceh is the increase in traffic volume, especially on main roads [4]. By bus reform policy so-called *Trans Koetaradja*. It is hoped that it can attract those who will travel by private vehicles to switch to this *Trans Koetaradja* mass transportation. This bus reform is recognized as a valid transport policy to reduce car and motorcycle in the capital city of Aceh [1].

As a mainstay object in overcoming traffic congestion, *Trans Koetaradja* (TK) mass transportation is essential to provide better services to attract and maintain its users. The main problem of every public transportation planning and operation is how public transport providers provide better...
Perceived Service Quality (PSQ) for their users so that by fulfilling this, it can attract and retain public transportation users [5]. The choice of users in utilizing public transportation depends on their preferences and perception of bus services. The opinion of existing service users is substantially manifested from their experience in using these services. The extent of experience using services can also affect the level of user expectations and the approach used to measure service quality is to use SERVQUAL (Service Quality) [6]. By conducting research using the Confirmatory Factor Analysis (CFA) method of PSQ by users viewed from the aspect of bus services, it is hoped that the organizers can make a strategic policy regarding service quality and detailed operations to attract new users of this Trans Koetaradja. Moreover, affording proper of the public transport will serve the efficacy in lessening congestion manifested effect such as reducing CO2 emissions, increasing the efficiency of fuel use, and more equitable mobility [1, 7, 8]. As a reminder that this paper aims to convey several things to explain survey data and profile data as well as the results of the CFA. The results and discussion can be seen at the end of this paper.

2. Materials and Methods

2.1. Materials

The data displayed was taken using a questionnaire survey with answer choice patterns using a Likert scale [3, 9, and 10]. The study was conducted in 2019 with the research location in corridors 1, 2B and 3 of Trans Koetaradja. Line 1 connects Banda Aceh city centre with the Syiah Kuala University campus. Line 2B connects between downtown Banda Aceh and the harbour crossing Ulhee Leue. Line 3 connects downtown Banda Aceh with Mata Ie, where there are many settlements on this path. Banda Aceh City and the Line studied can be seen in Figures 1 and 2.

Respondents consisted of students, employees, and housewives who used the Trans Koetaradja bus in the corridor that was surveyed. A total of 150 respondents in Corridor 1, 150 respondents in Corridor 2B and 150 Corridor 3 were asked about the level of satisfaction using the Likert scale. Table 1 contains information about the Stated Preference survey which contains the survey time, number of samples and research locations. The questionnaire element that was designed to assess the level of satisfaction of bus services consisted of 5 unobserved variables and 23 indicators that were questioned and given codes that can be seen in Table 2.

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| Variable | ID  | Content of Element Question                        |
|----------|-----|----------------------------------------------------|
| Frequency| FR1 | Travel itinerary                                   |
| Frequency| FR2 | Passenger density on the bus                       |
| Frequency| FR3 | Vulnerable Bus arrival time                        |
| Shelter  | SH1 | Safety at bus stops                                |
| Shelter  | SH2 | Protection against weather                         |
| Shelter  | SH3 | Travel information between stops                    |
| Shelter  | SH4 | Bus time information                               |
| Shelter  | SH5 | Bus stop location                                  |

2.2. Methods
The data that has been obtained is then analyzed using descriptive statistical methods, where this method presents the results of the survey through the form of frequency distribution and percentage of the recapitulation results of respondents’ SP questionnaires. Frequency distribution provides both statistical and graphic figures. This frequency is used to see the overall picture of gender, age, final education and type of work.

Likert scale measurement is also used for quantitative analysis purposes, respondents choose an ordinal response of four points on the Likert scale i.e. 1 = strongly opposed to 4 = strongly supported, then a value of 2.5 is taken as the minimum value of an acceptable value [1].

The CFA method is also used in this study, the use of this method aims to test a hypothetical model and find out the vector of indicator variables that are connected by a latent variable that is included in the analysis calculation. This model tests the consistency of measurement theory through data and has the goal of estimating parameters (coefficients, variances, etc.) and assessing the fit of the model (path diagram) made can be seen in Figure 3. Then interpret the latent construct measurement results based on the significance level of loading factor based on the probability (p) and critical ratio values (t-value), which are considered significant if the value of p ≤ 0.05 and t-value ≥ 1.96.
Table 2. Content of Questions Related to TK PSQ (continued)

| Variable | ID | Content of Element Question |
|----------|----|-----------------------------|
| Bus      | BS1| Cleanliness on the bus      |
|          | BS2| Security on the bus         |
|          | BS3| The physical condition of the vehicle |
|          | BS4| Air temperature in the bus  |
|          | BS5| Completeness of tools/accident safety information |
|          | BS6| Supporting facilities contained in the bus |
|          | BS7| Bus destination information |
| Driver   | DV1| Driver's attitude           |
|          | DV2| How to drive a driver       |
|          | DV3| Driver appearance           |
|          | DV4| Driver driving obedience    |
|          | DV5| Obedience dropped passengers |
| Accessibility | ACS1| Ease of accessing bus stops |
|           | ACS2| Ease of accessing the bus   |
|           | ACS3| Ease of changing buses      |

3. Result and Discussion
From Table 3 shows the social-demographic distribution of bus users, with the majority of users 69.3% are women, 1.1% user are 17-19 years, 8.7% are 20-29 years and more than 25% of users are 30-39 years old and 40-49 years old, 21.1% of users are 50-59 years old and 14.2% of users are 60 years above. Looking at the data obtained, 38.4% of Trans Koetaradja bus users are housewives and the latest high school education is 48.7%.
Figure 3. Structural Hypothesis of PSQ

The measurement results of the Trans Koetaradja frequency, respondents felt that the arrival time of the Trans Koetaradja bus was considered important with an average value of 2.72, as well as the itinerary of inter stops was deemed necessary with an average value of 2.56. It is different from the level of passenger density felt by respondents with an average value of 2.49 (negative value), where respondents stated that buses are often empty.

Table 3. Distribution of Socio-demographic

| Item               | Category         | Bus User (%) |
|--------------------|------------------|--------------|
| Gender             | Male             | 30.7         |
|                    | Female           | 69.3         |
| Age                | 17-19 years      | 1.1          |
|                    | 20-29 years      | 8.7          |
|                    | 30-39 years      | 27.3         |
|                    | 40-49 years      | 27.6         |
|                    | 50-59 years      | 21.1         |
|                    | 60 year or more  | 14.2         |
| Last Education     | Elementary School| 2.7          |
|                    | Junior high school| 4.0         |
|                    | High School      | 48.7         |
|                    | Diplomas         | 16.4         |
|                    | Bachelor’s Degree| 24.6         |
|                    | Master’s degree  | 2.9          |
|                    | PhD              | 0.4          |
| Occupation         | Merchant         | 14.7         |
|                    | Non-Government Employee | 20.9 |
|                    | Police/Army/Government Employee | 11.6 |
|                    | Retired          | 6            |
|                    | Housewife        | 38.4         |
|                    | Others (College Student, High School Student) | 8.4 |

Respondents feel that information about travel time between stops is needed by the community when using TK with an average value of 2.74, then respondents feel that the bus stop is suitable to protect from the weather and feel safe when at the bus stop while waiting for the arrival of TK with a value of 2.69 and 2.62 respectively, then information on the arrival time of the bus was responded positively by respondents with a value of 2.57, different from the location of the bus stop location which was 2.42 (negative value) where this explains that the community not yet fully able to find the TK stop with a strategic location.

The majority of respondents consider the condition of air conditioning on the Trans Koetaradja bus is the main thing that is felt in the quality of bus services, this is evidenced by the results of an average value of 3.07, furthermore, facilities for people with disabilities, seniors and pregnant women as well as security in the bus are considered to be met according to the respondent is proved by the same value which is 3.02.

The physical condition of the bus and the level of cleanliness on the bus is considered to be good enough, this is evidenced by the average value of 3.10 and 3.00, then according to the respondent the completeness of accident relief tools is sufficiently fulfilled as evidenced by an average value of 2.99, the existence of route information (running text) on the bus being the last thing felt by respondents to bus service is evidenced by the lowest average value of 2.5. Respondents' perceptions regarding TK bus drivers, TK bus drivers are very disciplined in stops where TK bus drivers will stop at their stops.
as evidenced by an average value of 3.96. The appearance of the driver on the Trans Koetaradja bus was felt to be quite good for respondents as evidenced by an average value of 3.37, then the driver's way of driving on the bus and the driver's attitude were also part of the quality of waiters who felt responsive on the bus. This was evidenced by the average value the same average is 3.02. Then the respondents agreed that the obedience of the drivers in the traffic at this time was very good, it was proven by an average value of 3.00.

| Table 4. Distribution of a 4 Scale Likert Related to Indicator of PSQ |
|---------------------------------------------------------------|
| *Content of Element Question | Mean Likert Scale |
| Travel itinerary | 2.56 |
| Passenger density on the bus | 2.49 |
| Vulnerable Bus arrival time | 2.72 |
| Safety at bus stops | 2.62 |
| Protection against weather | 2.69 |
| Travel information between stops | 2.74 |
| Bus time information | 2.57 |
| Bus stop location | 2.42 |
| Cleanliness on the bus | 3.00 |
| Security on the bus | 3.02 |
| The physical condition of the vehicle | 3.01 |
| Air temperature in the bus | 3.07 |
| Completeness of tools/accident safety information | 2.99 |
| Supporting facilities contained in the bus | 3.02 |
| Bus destination information | 2.95 |
| Driver's attitude | 3.02 |
| How to drive a driver | 3.02 |
| Driver appearance | 3.37 |
| Driver driving obedience | 3.00 |
| Obedience dropped passengers | 3.96 |
| Ease of accessing bus stops | 2.99 |
| Ease of accessing the bus | 3.00 |
| Ease of changing buses | 2.99 |

| Table 5. The Result of Measurement Model |
|----------------------------------------|
| Latent Variable | ID | Estimate | p-Value (%) | t-Value |
|-----------------|-----|-----------|--------------|--------|
| Frequency (FR)  | FR2 | 1.000 | - | - |
| FR3 | 0.520 | 0.001 | 10.042 |
| SH1 | 1.000 | - | - |
| Shelter (SH)    | SH2 | 0.670 | 0.001 | 4.000 |
| SH5 | 1.121 | 0.001 | 5.189 |
| BS1 | 1.000 | - | - |
| Bus (BS)        | BS2 | 0.870 | 0.001 | 5.955 |
| BS3 | 1.610 | 0.001 | 6.103 |
| BS4 | 1.510 | 0.001 | 5.686 |
| BS6 | 1.220 | 0.001 | 6.245 |
| DR1 | 1.000 | - | - |
| Driver (DV)     | DR2 | 1.070 | 0.001 | 24.253 |
| DR3 | -0.170 | -28.9 | -1.060 |
| Accessibility   | ACS1 | 1.000 | - | - |
Variables related to accessibility, the average value of 3.00 on the respondents' assessment of the ease of entering the bus stop is considered to be very high, this shows that the achievement of the bus stop is an important part in the quality of services offered by the TK party, this also applies to the ease of the community get on the bus while at the bus stop and believe that the bus will come with the same average value of 2.99. In the measurement model, there are five latent variables that are built and represent fifteen indicators and have a fit model with Root-mean-square error of approximation (RMSEA = 0.109), comparative fit index (CFI = 0.844), adjusted goodness of fit (GFI = 0.987 ) and adjusted goodness of fit index (AGFI = 0.934) can be seen in Figure 4. In Table 5 there are fifteen variables observed with P-Value < 10% and t-value ≥ 1.96. The fifteen measurement models are explained that the calibration of parameters is standardized (standardized loading factor) by regulating one indicator with a coefficient of 1.

The relationship between indicators and latent variables in Table 4.1 shows that the latent variable "Stop" appears as a perception that shows a positive correlation of all indicators. From the shelter latent variable, the SH1 indicator as a reference variable (comparison), the SH5 indicator obtained the largest estimate value of 121% and followed by the SH2 indicator the estimated value of 67%. Bus latent variables, BS1 indicator as a reference variable (comparison), BS6 obtained an estimated value of 122%, then the BS3 indicator obtained an estimated value of 161%. BS2 indicator obtained an estimated value of 87% and the BS4 indicator obtained an estimated value of 151%. Latent variables Accessibility, ACS1 indicator as a reference variable (comparison), and ACS2 indicator obtained an estimated value of 116%.

From the Frequency latent variable, the FR2 indicator as a reference variable (comparison), and FR3 indicator obtained an estimated value of 52%. In contrast to the latent variable of the driver, not all indicators have a positive value, the DR1 indicator as a reference variable (comparison) and DR2 indicator obtained an estimated value of 107%, different from the DR3 indicator which has an estimated value of -17%. According to obtained data, the inference is the latent variable DR2 has the highest significant value of 24.253> 1.96 represented by indicators of how to drive a driver. Another variable that is the focus of the community is FR3 which has a value of 10.042 > 1.96 with an
indicator of inter-bus lead time. Then the third variable focused on the community is BS6 which has a value of 6.245 > 1.96 with the indicators supporting bus facilities.

Figure 5 shows the results of the parameter calibration values obtained in the relationship between latent variables in the bus service model. There is a positive correlation between SH and ACS variables having a positive contribution value of 0.301, this shows that the satisfaction of Trans Koetaradja users to the provided shelter affects the ease of accessing both the bus stop and the bus and the ease of the respondent in finding the shelter due to being in a place strategic. SH and BS correlate 0.231, this shows that the strategic location of bus stops can make it easier for buses to carry passengers.

**Figure 5. The Relationship among Latent Variables Bus Services and Its Path Coefficient.**

**Table 6. Measurement Model of Bus Line**

| Variable | Coef. | p-Value (%) | t-Value |
|----------|-------|-------------|---------|
| ACS      | <-- SH | 0.301       | 0.001   | 4.011   |
| BS       | <-- SH | 0.231       | 0.002   | 3.096   |
| BS       | <-- ACS| 0.366       | 0.001   | 3.781   |
| DV       | <-- BS | 1.124       | 0.001   | 6.054   |
| FR       | <-- BS | -0.648      | 0.049   | -1.972  |

Furthermore, the relationship between ACS and DV with a loading factor value of 0.301, shows that in making their journey, respondents found it easy to access the TK bus. There is a negative correlation between BS and FR with a value of -0.648. This shows that the certainty of the arrival time of the bus is more influential in providing the level of satisfaction to respondents than the TK bus/fleet itself.
Then BS and DV have a correlation value of 1.124, this shows that the condition of the Trans Koetaradja bus that is good affects the driver in providing optimal service to the respondent. Based on the results of data collection and analysis as stated previously, analyzing the results of a questionnaire that has been recapitulated from 450 questionnaires addressed to people riding the bus Trans Koetaradja Line 1 (City Center – Darussalam), Line 2B (City Center – Ulee Lheu harbor) and Line 3 (City Center – Mata Ie).

Based on the results of the analysis, the multiple regression equation models for each latent variable in testing public perception of the quality of service perceived by users by the TK bus. The first model is bus service, the calibration results are known indicators that have the highest significance (t-value = 24.253) are indicators of “how to drive a driver”. The second indicator is the bus “Vulnerable Bus arrival time” with a value (t-value = 10.042) and the third indicator that is the focus of the community is the “Supporting facilities contained in the bus” (t-value = 6.24). The structural model built on this first modeling can be seen in table 4.5, where not all contributions are positive.

4. Conclusion
The results of the descriptive statistical analysis of community perception indicators showed that of 15 indicators, 13 of them had values above 2.5 from the Likert scale of 4, which means that respondents' perception of Trans Koetaradja services was very positive, except indicators of passenger density and negative bus stop locations with a value of 2.49. This shows that not too many people use Trans Koetaradja buses and the location of bus stops that are less strategic is one of the factors that influence the lack of community interest in using Trans Koetaradja. While the indicator that has the highest level of satisfaction from respondents is "Obedience when stopping with an average value of 3.96", this shows that the discipline of the driver in raising passengers down according to their stop (stop) is the most important PSQ factor for users in using the bus Trans Koetaradja. Then followed "the appearance of the driver with an average value of 3.37" and the last indicator "Air temperature with an average value of 3.07".

Based on the results of measurement analysis with CFA, the multiple regression equation models for each latent variable in testing people's perceptions of PSQ Trans Koetaradja bus users is known to have an indicator that has the highest significance (t-value = 24.253) is an indicator of driver satisfaction. The second indicator is the satisfaction of bus arrival time with a value (t-value = 10.042) and the third indicator that is the focus of the community is the satisfaction of supporting bus facilities (t-value = 6.24). These three variables are strongly related to Reliability Dimension as explained in SERVQUAL [6], these empirical results are consistent with studies in the literature.

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