Analysis on the effect of socio-economic and travel attributes to perceptions of the Trans Koetaradja quality of services

E Safitri1, S Sugiarto2, R Anggraini3, A Achmad4, H Fahlevi5

1Master Student, Department of Civil Engineering, Universitas Syiah Kuala, Banda Aceh, Indonesia
2,3Department of Civil Engineering, Universitas Syiah, Banda Aceh, Indonesia.
4Department of Architecture and Planning, Universitas Syiah Kuala, Banda Aceh, Indonesia.
5Department of Accounting, Universitas Syiah Kuala, Banda Aceh, Indonesia.

*Email: sugiarto@unsyiah.ac.id

Abstract. The urban bus reform namely Trans Koetardja (TK) has been argued and implemented by the Government Aceh as measure to mitigate autos dependency in this region. One basic element of the bus system is that how to attract private vehicle users to switch to TK by providing good bus quality of services. Thus, understanding what factors may contribute to the perceived quality of services is a crucial and need to investigate thoroughly especially in developing cities. Therefore, this paper aims to explore and clarify the relationships among socio-economic attributes and travel behavioural characteristics of the respondents to bus reform quality of services by contemplating latent constructs from bus system operation side. Revealed preference survey 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 exploratory factor analysis (EFA) approach employed to reveal contributing effect of causal loading among socio-economic attributes and travel behavioural characteristics of the respondents to bus reform quality of services. The path coefficient is used to examine causal relationships among latent variables and its contributing factors. The results of the analysis explore that the significant correlation between the observed variables of bus system and the latent variables happened to the variables of time of arrival and bus to the comfort of the bus stop and bus.

1. Introduction

The dependence of the people in Banda Aceh on private vehicles has resulted in an increased commuting trip and caused certain traffic manifested problems to the city. The tremendous of daily commuting trips could cause congestion, economic losses, emissions, noise, and increase the potential for accidents [1-3]. The Government of Aceh through the Aceh Transportation Agency provides a public transportation mode of transportation in the form of a Trans Koetaradja (TK) bus that has improved public transport systems and management, improved service quality that is convenient, fast and on time. Previous studies by [4, 5] explore that the TK is effective in a policy aiming at reducing autos dependency and improving mobility for low-income people, especially for the students. TK is a widely accepted policy by the public, but people somehow do not want to use the bus due to limited bus lines and feeders’ bus. Previous research has approved that the bus reform proposal and implemented like Bus Rapid Transit (BRT) has shown as an effective public transport implementation...
with a remarkable prospect for Jakarta and Yogyakarta [6-7]. Moreover, affording proper 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. Based on previous research [8, 9] the main objective of every public transport provider must be to provide good quality of service for its users. This is intended to retain them and to attract new users. Therefore, the primary thing that needs to be considered by TK providers to attract private vehicle users to switch to TK is to provide excellent quality service. But not all the quality of services offered by TK is in line with user expectations. Therefore, it is important to know the variables that can affect the latent variables of TK service so that TK service providers can provide quality service to the wishes of users. According to previous research [10], variables that can affect latent variables of the quality of public transport services are information about socio-economic characteristics and attributes/behavior of travel. In this study, the latency variable TK service quality will be divided into two parts, namely the latent variable from the bus service and the latent variable from the bus operating system. This refers to previous research [10] where the latent variable of the quality of Tran Santiago services is divided into two parts, namely Bus Line and System. Based on the hypothesis, the purpose of this study is to analyses the relationship between socio-economic characteristics and travel attributes (observed variables) to the latent variable quality of TK services in terms of bus services and bus operating systems.

2. Materials and Methods

2.1. Materials
This research was conducted on three TK bus corridors in Banda Aceh City and Aceh Besar City, namely Corridor 1 (City Center - Darussalam), Corridor 2B (City Center - Blang Bintang) and Corridor 3 (City Center - Mata Ie). Samples were taken using the Revealed Preference technique. Revealed Preference (RP) technique is an approach to respondents in choosing the best alternative by making an alternative situation hypothesis [10].

![Figure 1. The Map of Research Locations: Corridors 1, 2B and 3 Trans Koetaradja](image)

Table 1 illustrates the SP survey consisting of the year of data collection in 2019, survey locations in Banda Aceh and Aceh Besar in three TK corridors, the sampling method was carried out by direct interviews with respondents in the form of TK users, 450 samples, and distribution the sample is done 75% on a workday and 25% on weekend. Table 2 shows questions related to the socio-economic characteristics and the travel attributes of the respondents. Questions related to socio-economic respondents include gender, age, education, employment, income, transportation costs, car ownership,
Driver’s License ownership, motorcycle ownership, and Driver’s License C ownership. Questions related to the respondent's travel attributes include travel destination, frequently used modes of transportation, public transportation that is often used, the frequency of using public transport, the frequency of using private vehicles, bus arrival time and travel time. The basis of the questions in table 2 is sourced from previous research [11].

Table 1. Summary of the SP survey.

| Description                          | Detail                                      |
|--------------------------------------|---------------------------------------------|
| The year of survey                   | 2019                                        |
| Target location                      | Corridors 1, 2B and 3 Trans Koetaradja      |
| Sampling method                      | Direct interview by giving a questionnaire to Trans Koetaradja users |
| Number of Samples                    | 450 Samples                                 |
| Distribution                         | Workday (75%)                               |
|                                      | Weekend (25%)                               |

Table 2. Questions Regarding Socioeconomic Variables and Respondents' Travel Attributes

| ID  | Item                                | Category                                      |
|-----|-------------------------------------|-----------------------------------------------|
| X1  | Gender                              | Dummy 1 for Female, 0 otherwise               |
| X2  | Age                                 | 1 is 20-29, 2 is 30-39, 3 is 40-49…, 6 is >60 |
| X3  | Education                           | Dummy 1 for High School, 0 otherwise          |
| X4  | Work                                | Dummy 1 for Housewife, 0 otherwise            |
| X5  | Income                              | 1 is < 1 million IDR, 2 is 1-2.9 million IDR, 3 is 3-4.9 million IDR, 6 is > 10 million IDR |
| X6  | Transportation fee / month          | 1 is < 250 thousand IDR, 2 is 250 – 725 thousand IDR, > 6 is 2,475 million IDR |
| X7  | Car number                          | 1 is 1-2 unit, 3 is 3-4 unit,…,4 is > 6 unit  |
| X8  | Driver’s License A                  | Dummy 1 for Has driver’s license, 0 otherwise |
| X9  | Number of motorcycles               | 1 is 1-2 unit, 3 is 3-4 unit,…,4 is > 6 unit  |
| X10 | Driver’s License C                  | Dummy 1 for Has driver’s license, 0 otherwise |
| X11 | The purpose of the trip             | Dummy 1 for Shopping, 0 otherwise             |
| X12 | The most commonly used mode of transportation | Dummy 1 for Public transportation, 0 otherwise |
| X13 | Public transportation that is often used | Dummy 1 for Trans Koetaradja, 0 otherwise |
| X14 | Frequency of using public transportation | 1 is 1 day/week,…, 5 is 5 days/week,…, 7 is 7 days/week |
| X15 | Frequency of using private vehicles | 1 is 1 day/week, 2 is 2 days/week,…, 7 is 7 days/week |
| X16 | Waiting time                        | 0 – 5 minute; 6-10 minute; 11 – 15 minute;    |
| X17 | Travel time                         | 6-10 minute; 11 – 15 minute; > 20 minute      |
Table 3. Questions Regarding the TK Latent Variable Quality of Service

| ID | Latent Variables | Questions from Latent Variables |
|----|-----------------|---------------------------------|
| Y1 | Frequency       | The density of passengers on the bus |
|    |                 | Vulnerable for bus arrival times |
| Y2 | Shelter         | Safety aspects of bus stops      |
|    |                 | The eligibility aspect of bus stops |
|    |                 | Ease of locating bus stops      |
| Y3 | Bus conditions  | The cleanliness aspect of the bus |
|    |                 | The bus safety aspect           |
|    |                 | Bus physical condition         |
|    |                 | AC bus condition                |
|    |                 | Facilities for disabled people and pregnant women |
| Y4 | Driver          | Driver's attitude               |
|    |                 | Driver appearance               |
|    |                 | Obedience of drivers in traffic |
| Y5 | Accessibility   | Ease of riding the bus          |
|    |                 | Ease of reaching the bus stop   |
| Y6 | Bus Availability| Bus availability on holidays    |
|    |                 | Night availability of buses     |
| Y7 | Convenience     | Convenience at bus stops        |
|    |                 | Comfort on the bus              |

Table 3. Shows questions related to the latency variable TK service quality using a 4-point Likert scale, there are 7 latent variables of TK service quality, namely:

- Frequency is how the intensity of the bus that passes or stops on the path or corridor is felt by the user.
- Bus stops are how the physical state of the place waiting for the bus arrival is seen from the function, cleanliness, security felt by the user.
- Bus conditions are the physical condition of the exterior and interior of the bus which is related to the user's comfort.
- The driver is what is the appearance and behavior of the bus driver in the user's opinion.
- Accessibility is how convenience is felt by users in entering buses and bus stops.
- Bus availability is how the availability of buses at night and holidays are felt by users.
- Comfort is how comfortable the bus and the bus stop are felt by the user.

In previous studies [3, 11] Likert scale measurements were used for quantitative analysis, then the answer can be given a score, for example strongly agree with a score of 4, agree with a score of 3, disagree with a score of 2 and strongly disagree with a score of 1. Respondents choose ordinal responses of four points on a Likert scale i.e. 1 = very unacceptable up to 4 = highly accepted, then the value 2.5 is used as the minimum value of the acceptable value.

2.2. Method

In this study, the Exploratory Factor Analysis (EFA) is used to determine the relationship between socioeconomic variables and travel attributes with the latent variable service quality TK. EFA is part of Structural Equation Modelling (SEM). SEM is a multivariate statistical analysis technique that combines aspects of factor analysis and path analysis intending to confirm the measurement model and structural model that is built based on certain theoretical studies [12]. The steps in creating an EFA model follow:

- The first step is to determine observable variable data in the form of socio-economic characteristics and travel attributes of respondents taken from the questionnaire processing.
The second step is determining the value of the latent variable taken from the results of the Confirmatory Factor Analysis (CFA) that has been processed in other studies, where the indicators of the latent variable have been processed with CFA to produce a coefficient (loading factor) for each indicator.

- The third step is to enter the coefficient value obtained from the results of CFA into the multiple linear regression equation partially which is then used in this study to determine the value of the latent variable.
- The fourth step is to enter observable and latent variable data into SPSS 25 which will be used as data in the model.
- The fifth step is to open the Amos 24 worksheet.
- The sixth step is to make a path diagram of the EFA model that links the observed variables with latent variables with the Amos 24 application.
- The seventh stage is to call data from SPSS 25 into the Amos 24 application to be entered into the path diagram of the observed variable relationship with latent variables.
- The eighth stage is the run model, if the model is not yet fit, the highest and most correlated Modification Indices (MI) must be eliminated.

Figure 2 shows the hypothetical image model of the relationship between socioeconomic variables and travel attributes to latent variables TK service quality in terms of bus service. Figure 3 shows the hypothetical image model of the relationship between socioeconomic variables and travel attributes to the latent variables of TK service quality in terms of the Operating System.

3. Result and Discussion
Table 4 shows the results of the socio-economic characteristics and the travel attributes of respondents where the majority of respondents were female (69.3%), aged 40-49 years (27.6%), the last educational background was high school (48.7%), employment dominated by housewives (38.4%). Monthly family income between 3 to 4.9 million rupiahs (51.3%), family transportation expenses under 250 thousand (58.7%), car ownership of 1 to 2 units (12.4%), which has a Driver’s License A (11.3%), motorcycle ownership of 1 to 2 units (51.3%) and has a Driver’s License C (32.7%).
Table 4. Socioeconomic Variables and Respondents Travel Attributes.

| Item                                | Category                  | Frequency (Share) |
|-------------------------------------|---------------------------|-------------------|
| Gender                              | Female                    | 312 (69.3%)       |
| Age                                 | 40-49 year                | 124 (27.6%)       |
| Education                           | High School               | 219 (48.7%)       |
| Work                                | Housewife                 | 173 (38.4%)       |
| Income                              | 3-4.9 million IDR         | 231 (51.3%)       |
| Transportation fee / month          | < 250 thousand IDR        | 264 (58.7%)       |
| Car number                          | 1-2 unit                  | 56 (12.4%)        |
| Driver’s License A                  | Has a driver’s license    | 51 (11.3%)        |
| Number of motorcycles               | 1-2 unit                  | 231 (51.3%)       |
| Driver’s License C                  | Has a driver’s license    | 147 (32.7%)       |
| The purpose of the trip             | Shopping                  | 172 (38.2%)       |
| The most commonly used mode of transportation | Public transportation  | 355 (78.9%)     |
| Public transportation that is often used | Trans Koetaradja      | 367 (81.6%)     |
| Frequency of using public transportation | 5 days/week             | 119 (26.4%)     |
| Frequency of using private vehicles | 1 day/week               | 340 (75.6%)      |
| Waiting time                        | 6-10 minute               | 220 (48.9%)       |
| Travel time                         | >20 minutes               | 302 (61.7%)       |

Figure 4 EFA result from the Bus Service
Table 4 further reveals that the majority of respondents have a shopping trip destination (38.2%), the mode of transportation that is often used is public transportation (78.9%), the type of public transportation that is often used is TK (81.6%), the frequency of respondents using TK 5 days in a week (26.4%), the frequency of respondents using private vehicles 1 day a week is (75.6%). When respondents waited for the arrival of the TK bus 6 to 10 minutes (48.9%) and the respondent's travel time was over 20 minutes (61.7%).

The EFA model can be seen in Figure 4, the Goodness Of Fit values are obtained: GFI value of 0.948 > 0.900 good fits, AGFI of 0.909 > 0.900 good fits, CFI of 0.834 < 0.900 closes fit and RMSEA value of 0.079 which shows the results of a good fit [3, 11]. Based on the results of data processing, obtained observable variables that directly affect the latency variables of TK service quality are gender (X1), Age (X2), waiting for the time for bus arrival (X16) and travel time (X17).

The results of the analysis of Figure 4, the multiple linear regression equation models for each latent variable TK service quality is as follows:

\[ Y_1 = 0.08X_1 + 0.02X_2 - 0.05X_{16} + 0.03X_{17} \]  \hspace{2cm} (1)

\[ Y_2 = -0.11X_1 + 0.08X_{16} \]  \hspace{2cm} (2)

\[ Y_3 = -0.03X_1 \]  \hspace{2cm} (3)

Equation (1) shows a positive contribution to the variables X1, X2, and X17 explaining that passengers are female, passengers aged between 40 to 49 and passengers who travel more than 20 minutes feel the accuracy of the schedule and time of arrival of the bus is very important. A negative contribution occurs in variable X16 meaning that passengers who wait for the bus arrival for 6 to 10 minutes feel the accuracy of the schedule and the bus arrival time is less important. Equation (2) shows a positive contribution to variable X16 explaining that passengers who wait for the bus arrival for 6 to 10 minutes feel the safety of the bus stop, the feasibility of the bus stop, location of the bus stop and the information available at the bus stop is very important. A negative contribution occurs at X1 meaning that female passengers feel the safety of the bus stop, the feasibility of the bus stop, location of the bus stop and the information available at the bus stop is not particularly important. Equation (3) shows that the negative contribution that occurs in variable X1 shows that female passengers feel that cleanliness, security, physical condition, and other facilities available on the bus are less important.

| Relationship Between Variables | Estimate | P-value |
|--------------------------------|----------|---------|
| Y2 <--- X1                     | -0.113   | 0.009   |
| Y2 <--- X16                    | 0.085    | 0.001   |
| Y3 <--- X1                     | -0.065   | 0.094   |
| Y1 <--- X1                     | 0.079    | 0.001   |
| Y1 <--- X17                    | 0.027    | 0.009   |
| Y1 <--- X16                    | -0.047   | 0.001   |
| Y1 <--- X2                     | 0.015    | 0.088   |

Table 5 is an estimation result of the relationship model of socio-economic variables and travel attributes to the latency variable TK service quality in terms of bus service, will be explained as follows:

a. Gender (X1) has a negative effect on stop (Y2) with an estimated value of -0.113, this shows that female passengers feel that security, eligibility, location, and information at the bus stop are not especially important.
b. Time for bus arrival ($X_{16}$) 6-10 minutes has an effect on the bus stop ($Y_2$) with an estimated value of 0.085, this shows passengers who are waiting for bus arrival 6 to 10 feel that security, eligibility, location and information available at the bus stop are very important.

c. The female gender ($X_1$) negatively influences the bus convention ($Y_3$) with an estimated value of -0.065, this shows that female passengers feel that cleanliness, security, physical condition and other facilities on the bus are not too important.

d. The gender ($X_1$) of women positively influences the frequency ($Y_1$) with an estimated value of 0.079, this shows that female passengers feel the accuracy of the schedule and time of arrival of the bus is very important.

e. Travel time ($X_{17}$) more than 20 minutes has a positive effect on frequency ($Y_1$) with an estimated value of 0.027, this shows that passengers who travel more than 20 minutes feel the accuracy of the schedule and the arrival time of the bus is very important.

f. Bus arrival time ($X_{16}$) 6-10 minutes negatively influences frequency ($Y_1$) with an estimated value of -0.047, this shows passengers who are waiting for bus arrival from 6 to 10 feel the accuracy of the schedule and bus arrival time is less important.

g. Age ($X_2$) 40 - 49 years has a positive effect on the frequency ($Y_1$) of TK buses with an estimated value of 0.015, this shows that passengers aged between 40 to 49 years feel the accuracy of the schedule and time of arrival of the bus is very important.

![Figure 5](image)

**Figure 5.** EFA result from the Operating System

The EFA model in Figure 5 has shown the Goodness of Fit value obtained: GFI value of 0.995>0.900 good fits AGFI of 0.977>0.900 good fits, CFI of 0.945>0.998 good fit and RMSEA value of 0.044 which shows the results of a good fit. Based on the results of data processing, obtained observed variables that directly affect the latency variable of TK service quality, namely car ownership ($X_7$) and waiting time for bus arrival ($X_{16}$). The results of the analysis of Figure 5, the multiple linear regression equation models for each latent variable service quality TK are as follows:

$$Y_6 = -0.04X_7 - 0.01X_{16} \quad (4)$$

$$Y_7 = 0.06X_{16} \quad (5)$$

**Table 6.** Model Estimation Results are reviewed from the Operating System

| Relationship Between Variables | Estimate | P-value |
|-------------------------------|----------|---------|
| Y6 <--- X7                    | -0.043   | 0.009   |
| Y6 <--- X16                   | -0.009   | 0.092   |
| Y7 <--- X16                   | 0.055    | 0.001   |
Equation (4) explains that a negative contribution occurs in X7 and X16 means that passengers who have 1 to 2 cars and passengers who are traveling to shop feel the availability of buses at night and on holidays is still less important. Equation (5) explains the positive contribution to variable X16 explaining that passengers who are waiting for the bus arrival for 6-10 minutes feel comfort at the bus stop and the bus is particularly important.

Table 6 is the result of the estimation model of the relationship between socioeconomic variables and travel attributes to the latency variable TK service quality in terms of the operating system, will be explained as follows avail:

a. The number of car ownership (X7) 1 to 2 units negatively affects the availability of buses (Y6) with an estimated value of -0.043, this shows that passengers who have cars 1 to 2 units feel the availability of buses at night and holidays are not too important.

b. Bus arrival time (X16) 6-10 minutes negatively affects bus availability (Y6) with an estimated value of -0.009, this shows that passengers who wait for the bus arrival time of 6 to 10 minutes feel the availability of buses at night and holidays is less important.

c. Waiting time for bus arrival (X16) 6 - 10 minutes has a positive effect on the comfort of bus stops and buses (Y7) with an estimated value of 0.055, this shows that passengers who wait for bus arrival 6 to 10 minutes feel comfort at the bus stop and bus is very important.

4. Conclusion
The dominant characteristics based on socio-economic are most respondents are female (69.3%), aged 40-49 years (27.6%), the last educational background is a high school (48.7%), employment is dominated by housewives (38.4%). The family income per month is between 3 to 4.9 million IDR (51.3%), family transportation expenses are below 250 thousand at 58.7%, car ownership of 1 to 2 units is 12.4%, who have Has driver’s license A of 11, 3%, motorcycle ownership of 1 to 2 units is 51.3% and has a Has driver’s license C of 32.7%. Characteristics of the respondents' travel attributes showed the majority of respondents had a shopping trip destination of 38.2%, the mode of transportation that was often used as public transportation at 78.9%, the type of public transportation that was often used as TK at 81.6%, the frequency of respondents use TK 5 days a week 26.4%, the frequency of respondents using private vehicles 1 day a week is 75.6%. The time of respondents waiting for the arrival of the TK bus 6 to 10 minutes was 48.9% and the respondent's travel time over 20 minutes was 61.7%.

The results of the model in terms of bus service show the greatest correlation between socio-economic variables and travel attributes with latent variables occurring at bus arrival time waiting for stops with an estimated value of 0.085 which explains that passengers who wait for bus arrival time are 6 to 10 minutes feel the safety of the bus stop, the feasibility of the bus stop, the location of the bus stop and the information available at the bus stop is very important. Furthermore, finding from the estimated model of the operating system show the greatest correlation between socio-economic variables and travel attributes with latent variables occurring at bus arrival time waiting for comfort at bus stops and buses with an estimated value of 0.055 which explains that passengers waiting for bus arrival time 6 to 10 minutes feel comfortable at the bus stop and the bus is very important. Moreover, a better understanding of travel attribute characteristics is vital for successful transport-related policy implementation for a better society [13-14].

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