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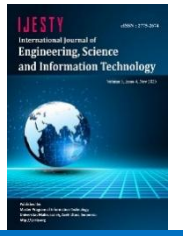

Influence of Online Transportation on Mandatory and Maintenance Activities in Banda Aceh

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Abstract

Online transportation has experienced significant growth and has become a vital element in the daily activities in Banda Aceh. Services such as Maxim, Grab, Kururio, Mr. Delivery, Sidoom, and Umma offer convenient access to transportation, goods delivery, and food services, illustrating the growing integration of digital technology into daily urban mobility and lifestyle patterns. In the context of fast-paced urban life, these platforms significantly influence the mobility patterns of the community, both in mandatory activities (such as working and studying) and maintenance activities (such as shopping, picking up children from school, and others). This study highlights the significance of examining how online transportation influences community life. It aims to assess its social, economic, and environmental impacts, identify key determinants of user preferences, and evaluate its overall contribution to improving quality of life within the evolving dynamics of urban mobility. This study employed a mixed-methods approach by integrating quantitative and qualitative techniques, with surveys serving as the primary instrument for data collection. The results indicate that the use of online transportation is influenced by factors such as income, travel time, age, gender, and household size. In terms of service preferences, Food and goods delivery dominates usage (42.9%), followed by motorcycle ride-hailing (38.1%) and cars (19%). These findings underscore the increasing significance of online transportation services in meeting daily needs and enhancing urban mobility, particularly in the areas of goods and food delivery. The results also indicate that public perceptions of the environmental impacts of online transportation remain balanced. While respondents value the improved accessibility and convenience offered by online transit, they are aware of its negative externalities, particularly its role in exacerbating traffic congestion and air pollution.

Keywords: *Online Transportation, Mandatory Activities, Maintenance Activities, Socioeconomic, Environment.*

1. Introduction

Advancements in information and communication technology have transformed various aspects of human life, including the transportation sector. In recent years, online transportation services, including ride-hailing cars, motorcycle taxis, and other application-based services, have emerged as a preferred choice for fulfilling daily mobility needs [1]. The growing penetration of mobile devices and internet access has accelerated the widespread adoption of these platforms among the public.

The rise of online transportation has significantly influenced how individuals travel and plan their daily activities [2]. Its popularity is primarily driven by the convenience and accessibility offered through mobile applications, which enable users to book transportation at any time and from anywhere with just a few taps on their smartphones. This ease of access, combined with transparent pricing and multiple payment options, makes online transportation more appealing compared to conventional modes [3][4].

Beyond convenience, online transportation has improved travel efficiency. Advanced routing algorithms and vehicle-type selection contribute to shorter and more predictable travel times, benefiting users with tight schedules who require timely arrivals [5]. However, the rapid expansion of these services also poses challenges. Increased vehicle numbers may exacerbate traffic congestion, while traditional transportation providers face declining passenger demand [6].

Considering the significant impacts observed, it is essential to conduct a deeper analysis of the positive and negative effects of online transportation services, particularly in the context of daily activities [7]. This issue is not only related to user convenience, but also involves government policy and the broader socioeconomic consequences arising from these changes. Such an analysis will provide a more comprehensive understanding of how online transportation influences mobility patterns, shapes social behavior, and contributes to economic dynamics, while also creating challenges that require regulatory attention and sustainable solutions [8].

2. Literature Review

Online transportation has emerged as a global phenomenon that has revolutionized the way people access transportation services. The advent of app-based platforms, such as Grab, Maxim, and Mr. Delivery, along with other online transportation services, has significantly transformed the mobility patterns of urban communities.

2.1. Transportation

Transportation is the process of moving people or goods from one location to another using specific means or facilities. It involves the transfer of individuals and commodities from their point of origin to their destination by means of vehicles as a mode of conveyance. The primary objective of transportation is to support the social, economic, and cultural activities of society [9].

In general, transportation plays a crucial role in facilitating human mobility and the distribution of goods, ultimately driving economic growth and regional development. In an urban context, transportation serves as a vital link connecting activity centers such as residential areas, workplaces, schools, and other public facilities. Alongside advancements in information technology, the transportation sector has transformed into a digital-based system, widely known as online transportation, which enables users to book transport services via mobile applications. This transformation introduces new levels of efficiency to modern urban mobility systems [10][11].

Online transportation represents a form of digital transformation within the transportation sector, allowing users to request transportation services through internet-based applications. This service has experienced rapid growth in major cities across Indonesia, thanks to its convenience, efficiency, and comfort. Based on vehicle mode, purpose of use, and service system, online transportation can be categorized into several types[12].

2.2. The Characteristics of Travelers

Socioeconomic factors, including income level, education, occupation, age, and vehicle ownership status, strongly influence travelers' characteristics. These factors determine the choice of transportation mode, travel frequency, trip purpose, and travel time[13].

1. Income
   Income level has a significant influence on the choice of transportation mode. High-income individuals tend to use private vehicles or premium transportation services, whereas low-income individuals are more reliant on public transportation or more economical modes [14].
2. Education
   Education level affects awareness of efficiency, safety, and the environmental impacts of transportation choices. Individuals with higher education levels are more likely to consider sustainability and comfort when selecting a mode of transportation [15].
3. Type of Occupation
   The type of occupation has a significant influence on travel frequency and timing. Formal workers generally engage in routine commuting on every working day, following fixed schedules and consistent routes. In contrast, informal or freelance workers tend to exhibit more flexible travel patterns, with variations in both frequency and timing depending on their work demands and personal arrangements. This distinction highlights how employment structures shape daily mobility behavior and contribute to broader patterns of urban transportation. [16].
4. Age and Gender
   The productive age group (20–45 years) constitutes the dominant users of transportation services, including online transportation. Furthermore, male and female preferences in choosing transportation modes often differ, particularly in terms of safety and comfort considerations [17].
5. Vehicle Ownership
   Private vehicle ownership status also influences the tendency to use public or online transportation. Individuals without personal vehicles are more likely to depend on public transit or app-based services [18].

2.3. Classification of Activities

In transportation studies, it is explained that trips originate from households and are undertaken within a spatial and temporal context. Travel activities are generally classified into three categories: mandatory, maintenance, and discretionary [19]. Work and school activities are considered compulsory or mandatory activities that individuals are required to undertake. Activities such as daily or non-daily shopping, transporting or picking up children or other people, and similar tasks are categorized as maintenance activities. The principle is clear: if any household member engages in such tasks, it falls under the scope of maintenance activities. Meanwhile, activities such as recreation, social visits, and other leisure-oriented engagements are classified as discretionary activities, which may be conducted either individually or in groups.

Both maintenance and discretionary activities can be performed at the individual or household level. Individual activities generally serve personal needs, although they are not always carried out alone. Household activities arise from the needs of the family and may be undertaken either independently or collectively. Household maintenance activities can be further divided into three subcategories: shopping, pickup/drop-off, and other maintenance activities. Shopping is essential for meeting household needs, such as Food, clothing, household supplies, and related items. Pickup/drop-off refers to transporting individuals from one location to another, most importantly, children, particularly for school or daycare purposes. Other maintenance activities, such as visiting a bank, are classified similarly as single-purpose activities. The need for such other maintenance activities occurs less frequently [20].

3. Methods

This study focuses on several districts within the city of Banda Aceh. The research approach is directed explicitly toward online transportation users, examining their socioeconomic characteristics and travel behavior, while also taking a broader perspective on the potential environmental impacts.

3.1. Data Source

This study utilizes several sources of data:

1. Primary Data
   Primary data were obtained through direct field surveys, which involved distributing questionnaires (utilizing both direct interviews and Google Forms). The collected data relate to trip production and the socioeconomic characteristics of respondents, including household size, income level, number of household members working or attending school, type of occupation, gender, and type of vehicle used [21].
2. Secondary Data
   Secondary data was obtained from literature reviews and relevant government agencies. These include population statistics sourced from the Central Statistics Agency of Banda Aceh City.

3.2. Data Collection Methods

Sampling refers to the process of selecting a relatively small subset of a population that adequately represents the whole. To ensure representativeness, a suitable sampling strategy is necessary. Given the heterogeneity of socioeconomic characteristics across strata or regions, subjects must be drawn proportionally from each stratum in proportion to its population size. Therefore, this study employs Proportional Sampling (also known as proportional allocation or stratified proportional sampling) to obtain a representative sample [22]. The data collection methods in this study are briefly presented in Figure 1 below.

Fig 1. Stages of Sample Collection.

Data collection was conducted during working hours by directly visiting respondents (home interviews) to observe on-site conditions, as well as through Google Forms to expedite the field data acquisition process. The sample size was determined using Slovin's formula with a 95% confidence level [23].

3.3. Data Analysis

To obtain valid and reliable results, this study employed a correlation test combined with a data calibration process using STATA 13 software. The analysis proceeded in three stages: first, respondents' activities were classified into two groups, namely worker and non-worker activities, to distinguish patterns based on socioeconomic status; second, each activity type was grouped by level or category and assigned numerical codes to transform qualitative data into a quantitative format suitable for statistical processing; and third, the coded data were tabulated according to the research variables and subjected to statistical analysis. Correlation tests were applied to examine the strength of associations between employment status and types of activities, as well as among the activities themselves. Calibration was performed to enhance data accuracy and reduce measurement error. The dependent variable (Y) in this study was defined as the type of activity, whereas the independent variables (X) included trip production and socioeconomic factors. To assess the influence of these independent variables on the dependent variable, multinomial logit analysis was conducted in STATA 13, enabling the development of a predictive model of community activity types and the formulation of utility function equations for each activity category under investigation.

4. Result and Discussion

Based on the results of data analysis from 400 respondents, several independent variables were found to influence mandatory and maintenance activities in the context of online transportation usage, namely income level (X_1), travel time (X_2), age (X_3), gender (X_4), and household size (X_5).

4.1. Results of Socioeconomic Characteristics Data

Based on the data processing results, the socioeconomic characteristics of respondents using online transportation in Banda Aceh are as follows:

1. Age
   In terms of age, the majority of online transportation users fall within the productive age range of 26–35 years, as illustrated in Figure 2 below:

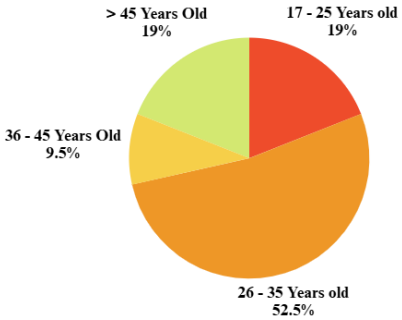

Fig 2. Age Characteristics of Online Transportation Users.

The dominance of online transportation service users within the 26–35 age group, as shown in Figure 2 above, indicates that this service is predominantly utilized by individuals in their productive phase, a period when people are generally active in employment,

higher education, or other social and economic activities. This age group typically exhibits high mobility and tends to be more engaged with and familiar with technology, including the use of digital applications for online transportation services.

2. Income
   The most significant proportion of online transportation users have an income ranging between more than IDR 5 million and IDR 3–4 million, as shown in Figure 3 below:

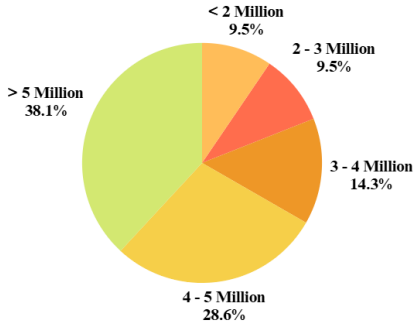

Fig 3. Income Characteristics of Online Transportation Users.

The data above indicate that the majority of online transportation users are individuals with upper-middle income levels, particularly those with a monthly income exceeding IDR 5 million and those earning between IDR 3 million and IDR 4 million. This group generally possesses sufficient financial capacity to consistently utilize online transportation services, which, despite being more expensive than conventional public transport, offer greater comfort, time savings, and ease of access.

Moreover, this income group tends to be more receptive to digital technology and a practical lifestyle, enabling them to adopt online transportation applications more readily as part of their daily routines. Consequently, online transportation services are economically more accessible and relevant to individuals with upper-middle income levels.

3. Household Size
   The survey results show that the most frequent users of online transportation come from households with more than five members, as illustrated in Figure 4 below:

Fig 4. Household Size Characteristics of Online Transportation Users.

The results indicate that households with more than five members tend to use online transportation services more frequently than those with fewer members. Several factors may explain this pattern. First, larger families often have diverse mobility needs, such as picking up children from school, shopping, or commuting to work, all of which require flexibility in terms of time and mode of transportation. Online transportation services offer a fast, convenient, and readily accessible solution, making them the preferred choice for large families to meet their complex and demanding mobility requirements. Second, the high number of family members using online transportation suggests a widespread acceptance and adaptation to technology within the household, from younger members to adults. This also reflects the integration of online transportation into the daily routines of large families, particularly in urban areas. Consequently, households with more than five members represent a promising segment for online transportation providers due to their high and varied mobility needs.

4.2. Types of Online Transportation Frequently Used

The types of online transportation most frequently utilized for various activities by the residents of Banda Aceh are presented in Figure 5 below:

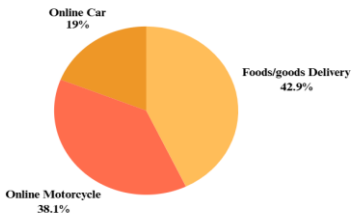

Fig 5. Types of Online Transportation.

The findings of this study indicate that the most frequent use of online transportation services among the community is for ordering Food or goods, accounting for 42.9% of usage. This reflects a shift in public needs—from merely traveling between locations to fulfilling daily

necessities conveniently through delivery services. Meanwhile, motorcycle-based ride-hailing services rank second at 38.1%, indicating that they remain a primary choice for individual travel, particularly in densely populated urban areas where speed and flexibility are essential for short-distance trips.

The data also reveal that only 19% of respondents use online car services, which may be attributed to their higher cost compared to motorcycle ride-hailing and users' tendency to choose this service for specific purposes such as group travel, unfavorable weather conditions, or enhanced comfort. Overall, these findings suggest that the public is increasingly using online transportation not only for point-to-point travel but also to support daily consumption and logistics activities efficiently and practically.

4.3. Challenges in Using Online Transportation

Online transportation does not always provide complete convenience for users in Banda Aceh. Several challenges are frequently encountered in the field, as presented in Table 1 below:

Table 1. Challenges Faced by Online Transportation Users

Number	Constraint	Percent
1	Unstable prices	30.56%
2	Long waiting time	34.56%
3	The driver canceled the order	2.36%
4	Discomfort	2.75%
5	Application error	6.76%
6	Communication issues with the driver	0.00%
7	Inaccurate pickup location	16.26%
8	Others	6.76%

The results presented in Table 1 above indicate that most users experience two primary challenges when using online transportation services: long waiting times (34.56%) and fluctuating prices (30.56%). These two aspects are of particular concern as they significantly affect travel convenience and efficiency. Long waiting times may occur due to a limited number of available vehicles during specific periods or heavy traffic conditions. Meanwhile, price instability often arises from service providers' implementation of dynamic pricing systems.

Another notable challenge is inaccurate pickup locations (16.26%), which can hinder the meeting process between passengers and drivers. In addition, application errors (6.76%) and other complaints (6.76%) indicate that technical issues persist and require attention to enhance service quality. Complaints related to comfort (2.75%) and driver cancellations (2.36%) were reported at lower percentages but still warrant attention as they pertain to overall service quality. Interestingly, communication with drivers (0.00%) was not perceived as a problem by respondents, indicating that the in-app communication feature is considered adequate. Overall, these survey results provide valuable insights for online transportation service providers to prioritize improvements, particularly in enhancing time efficiency, ensuring price stability, and increasing pickup location accuracy.

4.4. The Impact of Online Transportation on the Environment

The study's findings, presented in Table 2 below, reveal several environmental impacts resulting from the increased use of online transportation services in Banda Aceh.

Table 2. Indicators of the Environmental Impact of Online Transportation Based on Respondents' Perceptions

Number	Indicator	Average Rating
1	Increase in the number of vehicles	3.9
2	Additional traffic volume on roads	3.38
3	Traffic congestion	3.05
4	Online transportation helps reduce private vehicle usage	3.1
5	Online transportation is more efficient than private/public vehicles	3.43
6	Online transportation contributes to gas emissions and air pollution	3.24
7	Air quality deterioration due to high vehicle numbers	3.1

Note: 1 = Strongly Disagree, 5 = Strongly Agree

The data presented in Table 2 indicate that the public holds a relatively strong perception regarding the increase in the number of vehicles on the road, with an average rating of 3.90. This is the highest score among the assessed indicators, suggesting that the growth in vehicle numbers—both private and public transportation—has been perceived as quite significant by the community. The increase in traffic volume also received a high rating (3.38), indicating that the rise in the number of vehicles directly contributes to traffic density across various areas.

Although traffic is perceived as dense, the congestion level only scored 3.05, which falls into the moderate category. This may suggest that the public does not yet view congestion as a significant issue, or that congestion has become an accepted part of daily life.

Another notable finding is that online transportation is considered more efficient than private or public vehicles, with a score of 3.43. This reflects public appreciation for the convenience and flexibility offered by online transportation services. However, the perception of

online transportation reducing private vehicle usage remains relatively low (3.10), indicating that its presence has not yet significantly diminished people's dependence on private vehicles.
Regarding environmental impact, respondents rated 3.24 for the statement that online transportation contributes to gas emissions and air pollution. Furthermore, the perception that air quality deteriorates due to the increasing number of vehicles received a score of 3.10. Although this figure is not as high as other indicators, it still reflects public awareness of environmental issues, particularly the adverse effects of vehicle growth on air quality.

4.5. Results of Running Several Independent Variables

Based on the analysis of several independent variables used to assess the impact of online transportation on mandatory and maintenance activities, the base outcome results are presented as follows:

1. Utility Equation for the Base Outcome of Mandatory Activities
   Based on the analysis conducted on the reviewed activities, the results are presented in Table 3 below:

Table 3. Utility Equation for the Base Outcome of Mandatory Activities

X	Coef	Z_{Stata} ≥ 1,96	p > |z| < 0,05
Work Activity (U_1)			
Income (X_1)	-2,775	2,22	0,022
Age (X_3)	2,558	2,23	0,020
Gender (X_4)	-1,367	3,25	0,000
Const	1,156		
School Activity (U_2)			
Travel time (X_2)	2,255	3,65	0,001
Gender (X_4)	-1,223	2,44	0,016
Const	-15,255		

   a. The equation for Activity 1 (Work Activity) is:
      $U_1 = 1{,}156 - 2{,}775\ X_1 + 2{,}558\ X_3 - 1{,}367\ X_4$
      The interpretation of the above equation is as follows:
      1. The constant value (α) indicates that if income, age, and gender are all zero, the likelihood of respondents using online transportation for work purposes is 1.156.
      2. The regression coefficient for variable X_1 (income) is −2.775, indicating that an increase in income decreases the likelihood of respondents using online transportation more frequently, assuming other independent variables remain constant.
      3. The regression coefficient for variable X_3 (age) is positive at 2.558, indicating that as respondents' age increases, their frequency of using online transportation also increases by 2.558, assuming other variables remain constant.
      4. The regression coefficient for variable X_4 (gender) is −1.367, indicating that the majority of online transportation users for work activities are male, assuming other variables remain constant.
   b. The equation for activity 2 (School Activity) is:
      $U_2 = -15{,}255 + 2{,}255\ X_2 - 1{,}223\ X_4$
      The interpretation of the above equation is as follows:
      1. The constant value (α) indicates that if travel time and gender are both zero, the likelihood of using online transportation for school activities is −15.255.
      2. The regression coefficient for variable X_2 (travel time) is positive at 2.255, meaning that greater regularity in travel time for school activities increases the likelihood of respondents using online transportation by 2.255, assuming other variables remain constant.
      3. The regression coefficient for variable X_4 (gender) is negative at −1.223, suggesting that, assuming other variables remain constant, the majority of online transportation users for school activities are male.

2. Utility Equation for the Base Outcome of Maintenance Activities
   Based on the analysis conducted on the reviewed activities, the results are presented in Table 4 below:

Table 4. Utility Equation for the Base Outcome of Maintenance Activities

X	Coef	Z_{Stata} ≥ 1,96	p > | z | < 0,05
Child Pickup/Drop-off, Household Service Tasks, and Social Activities (U_0)			
Income (X_1)	2,335	2,23	0,020
Age (X_3)	-0,758	2,20	0,026
Number of Family Members (X_5)	2,235	3,21	0,000
Const	1,276		
School Activity (U_2)			
Travel time (X_2)	1,285	3,29	0,001
Gender (X_4)	-1,230	4,48	0,000
Const	-15,814		

The equation for Activity 0 (Child Pickup/Drop-off, Household Service Tasks, and Social Activities) is:
$U_0 = 1{,}276 + 2{,}335\ X_1 - 0{,}758\ X_3 + 2{,}235\ X_4$
The interpretation of the above equation is as follows:

1. The constant value (α) indicates that if income, age, and number of family members are all zero, the likelihood of respondents using online transportation for maintenance activities is 1.276.
2. The regression coefficient for variable X_1 (income) is 2.335, indicating that an increase in income increases the likelihood of respondents using online transportation more frequently, assuming other independent variables remain constant.
3. The regression coefficient for variable X_3 (age) is negative at −0.758, indicating that younger respondents are less likely to use online transportation for maintenance activities, assuming other variables remain constant.
4. The regression coefficient for variable X_4 (number of family members) is 2.235, indicating a positive relationship between the number of family members and the likelihood of more frequent online transportation use, assuming other variables remain constant.

4. Conclusions

Based on the findings of this study, several conclusions can be drawn as follows:

1. The characteristics of online transportation users in Banda Aceh, in terms of both mandatory and maintenance activities, are influenced by several factors, including income, travel time, age, gender, and number of family members. Income significantly affects the use of online transportation, as individuals with higher incomes tend to utilize online transportation services more frequently for essential activities, such as work and school, as well as for daily needs, including shopping and personal errands. Demographic factors (age, gender, and number of family members) also shape travel patterns. Younger individuals and those in their productive working years are more likely to use online transportation for daily activities. However, differences in preferences exist between genders in the use of such services. At the same time, the number of family members can determine whether trips are undertaken collectively or individually, which in turn influences the frequency and purpose of online transportation use. Travel time is a primary consideration when using online transportation for daily activities. These services are often chosen for their time efficiency, particularly by those with tight daily schedules.
2. The most common purpose for using online transportation in Banda Aceh today is to order Food or goods, accounting for 42.9% of usage. This indicates a shift in public needs—from solely moving between locations to fulfilling daily necessities conveniently through delivery services. Meanwhile, online motorcycle taxi services rank second at 38.1%, showing that they remain the primary choice for individual travel, especially in densely populated urban areas where speed and flexibility are essential. Online car-hailing services occupy the third position at 19%, which may be attributed to their relatively higher cost compared to motorcycle taxis, as well as the tendency for users to choose them for specific needs such as group travel, unfavorable weather conditions, or enhanced comfort.
3. The public's perception of the environmental impacts of online transportation reflects a diverse range of views, encompassing both positive and negative perspectives. This underscores the need for regulatory measures to promote sustainable practices, such as implementing stricter emission standards and integrating transportation into more comprehensive urban mobility planning. Furthermore, increasing public awareness of environmental issues is essential for achieving a more environmentally friendly transportation system.

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