Examining Trans Banyumas' Passenger Accessibilities Against Smart Mobility Initiatives

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Abstract.
The operation of Trans Banyumas is a significant progress for Banyumas Regency in the field of transportation due to modern technology adaptation. It is in line with the smart city idea launched by the district government, which will encourage the growth of urban areas that provide comfort, convenience, and safety in the movement between communities. Smart mobility in smart cities addresses transportation difficulties such as routes, digital services, and traffic forecasts. One of the main strategies to improve accessibility in Trans Banyumas services is to initiate smart mobility. This study aims to analyze the accessibility perceived by passengers on the Trans Banyumas service towards smart mobility readiness. The analysis method in this study uses the ANOVA test and the data collection was carried out using a questionnaire to 320 passengers. The results showed that demographic and accessibility factors significantly affect Trans Banyumas services. Most passengers are satisfied with Trans Banyumas services. However, Trans Banyumas needs to add services such as parking areas, unavailability of gender-appropriate seating, optimizing the availability of bus stop buildings in several areas, inadequate road sidewalks in several corridors, and improving the *Teman Bus* and e-money applications for payment. The limitations of this research is only focused on accessibility. Therefore, this research needs to add more variables to gain a more general understanding of mapping BRT services under the smart mobility initiative.

Keywords: Accessibility, Passenger, Smart Mobility, Trans Banyumas

1. INTRODUCTION

Community often use land transportation and must provide quality services to meet its mobility needs [1]. The service must pay attention to passenger comfort, where the quality of transportation services will affect passengers [2]. In services, many activities in a process cause direct interaction from one person to another or a physical machine to provide customer satisfaction [3]. The provision of public transportation is expected to solve congestion and mobility difficulties in urban areas. One of the public transportation is Bus Rapid Transit (BRT). In December 2021, the Government of Banyumas Regency officially launched Trans Banyumas, which assists the Ministry of Transport in the *Teman Bus* program [4]. The *Teman Bus* program includes a

transportation service under BRT management that is similar to Palembang, Solo, Bali, Medan, and Yogyakarta [5]. The operation of Trans Banyumas is an excellent big step in transportation for Banyumas Regency because Trans Banyumas is transportation equipped with modern technology.

Moreover, using ICT technology, Banyumas Regency initiated a smart city [6]. The smart city concept can combine physical, social, and economic infrastructure to create livable and efficient urban areas. In addition, using smart cities will encourage the development of cities that offer comfort, convenience, and security to facilitate people's mobility [7]. In a smart city, smart mobility is related to transportation issues such as routing, digitization services, road traffic prediction, municipal decisions, and strategies based on ICT. Mobility is one of the leading choices for a more sustainable transportation system [8]. Mobility is the use of technology in the sustainable transportation sector by minimizing social and economic impacts and reducing driving accidents that have the potential to arise [9]. Technology in smart mobility can make public transportation more comfortable, safe, and reliable to attract people's interest in using public transportation modes [10] to support the smart mobility establishment.

Accessibility is a transportation parameter to measure transport quality [11]. The accessibility to transportation facilities have an acceptable impact on the level of enthusiasts of transportation services and make road users switch to using public transportation [12]. The accessibility parameter is the ease of time, cost, and effort in moving between places or areas within a system. It can also measure comfort and convenience in accessing a location [13]. According to the importance of public transport accessibility indicators, it is necessary to evaluate whether passenger accessibility indicators are based on a smart mobility perspective on Trans Banyumas services. The study aims to assess passengers' preferences for Trans Banyumas service to support their accessibility in smart mobility initiatives. Accessibilities will focus on service corridors, timeliness, bus arrival information, and payment systems. The study adds new insight to determine passenger accessibility based on smart mobility initiatives in Trans Banyumas services. Preferences can be a suggestion for BRT providers to provide more services supporting smart mobility. In addition, the government can use it as guidance to help BRT facilities by improving BRT facilities to enhance passenger accessibility.

2.   Related Work And Methodology

2.1   Related Work

One indicator of public transportation facilities that can be considered is access to the facilities. The accessibility of transportation facilities will impact the level of enthusiasts of transportation services and make road users switch to using public transportation [12]. The accessibility must provide convenience and comfort for passengers, such as the availability of buses, the arrival of fast and precise buses, the service of friendly officers, and officers who comply with the rules [14]. The criteria that affect accessibility to BRT shelters are waiting time at the bus stop, the distance

between the bus stop and the intersection, the distance between bus stops, mileage index, population density, and land value [15]. In addition, travel time and costs also affect transportation accessibility [16]. The technical requirements for accessibility in a sustainable transportation system are safety, comfort, and ease of accessing all of these indicators so that they are well connected. In this case, Trans Banyumas can be the answer to promoting sustainable cities under smart city initiatives.

Moreover, the smart city is an innovative city concept that can connect physical, social, and economic infrastructure in an integrated manner by utilizing ICT technology to create an efficient and livable city [17]. The application in smart cities will encourage the creation of cities that provide security, convenience, and comfort in carrying out community mobility [7]. One of the pillars of the smart city is smart mobility. Mobility is related to transportation issues such as routing, digitization services, road traffic prediction, city decisions, and strategies based on information and communication tools and technologies. Mobility is one of the main options for a more sustainable transportation system [8]. The Three essential categories are needed to implement smart mobility: accessibility, sustainability, and ICT [18]. Table 1 shows a framework of accessibility parameters in Trans Banyumas services.

Table 1. Accessibility Parameters

Category	Code	Indicator	Category	Code	Indicator
Accessibility	A1	Approved information shared	Service	A12	Distance and speed sensors
	A2	Fast arrival time		A13	Seating available by gender
	A3	The arrival time is punctual.		A14	Friendly attitude of the driver and officers
	A4	Become a faster transport.		A15	Orderly driving
	A5	Easy to switch vehicles		A16	Effective QR barcode
	A6	There is a parking area near the bus stop.		A17	Excellent service from the bus friend application
	A7	The bus stop is easy to reach		A18	Payment using e-money
	A8	Affordable rates	Sustainable	A19	Easy top-up smart card information
Safety	A9	Safety equipment is available		A20	Trans Banyumas cares about the environment.
	A10	There is CCTV inside and outside the bus		A21	There are bus stops at each stop.
				A22	Adequate walkways
	A11	Protection of passengers from crime		A23	Using environmentally friendly fuel

Table 1 mentions the parameters used to determine the effect of passenger

accessibility on Trans Banyumas services on smart mobility initiatives, including accessibility, safety, service, and affordability. The first category is accessibility, which functions to find out the comfort passengers feel when using Trans Banyumas. The second category is safety, looking for the protection and safety of passengers when using Trans Banyumas. The third category is a service to measure services provided to passengers, and the fourth category is sustainability, which is to find out future innovations related to Trans Banyumas.

2.2   Methodology

The method used was quantitative. The data was collected using a questionnaire to 320 Trans Banyumas passengers. The questionnaire was divided into demography and accessibility preference against smart mobility initiatives. The demography included which corridor they traveled, gender, age ratio, occupation, private vehicle types, and travel purpose. The accessibility preferences are shown in Table.1 The Analysis of Variance (ANOVA) test was conducted to determine the effect of passenger accessibility on Trans Banyumas services toward smart mobility initiatives. Before conducting ANOVA, the study performed test instruments to meet the data criteria such as validity, reliability, and normality. The software used to perform calculations uses Minitab 19 software using alpha 0.05. The hypothesis was set below:
H1: Passenger accessibility significantly affects Trans Banyumas services in smart mobility initiatives.

3.   Result And Discussion

3.1.   Trans Banyumas passengers' demography

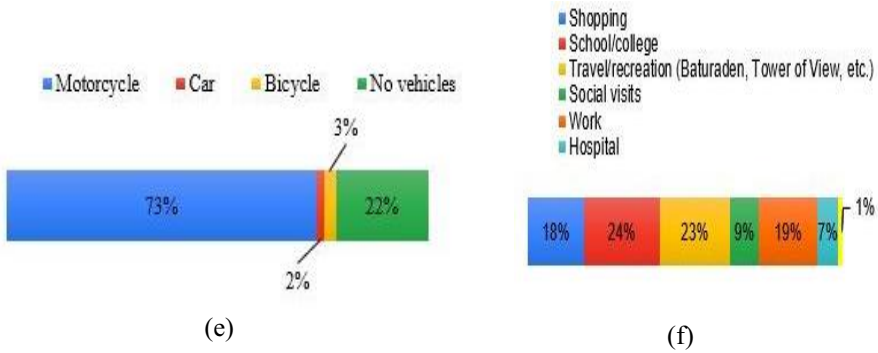(a)

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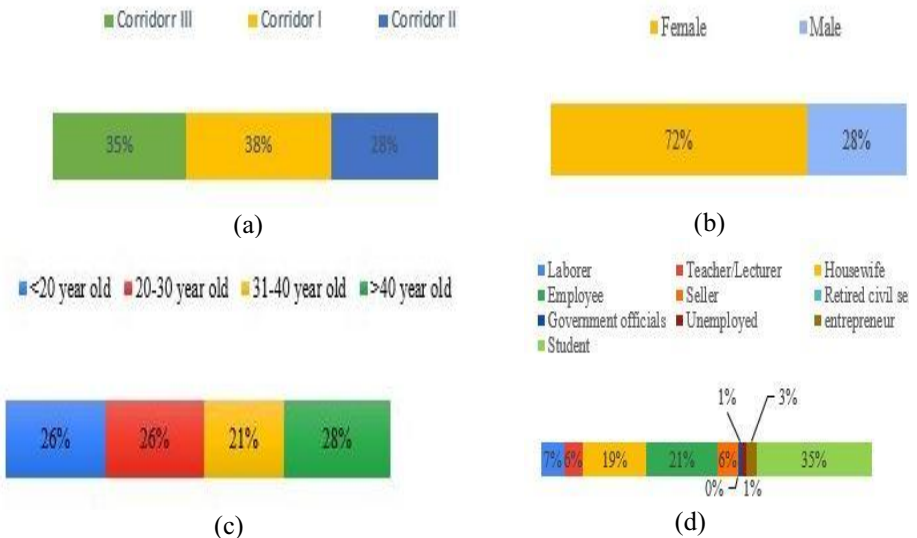
Fig. 1. Demographics of respondents including frequently used corridors (a), gender (b), age (c), job (d), private vehicle ownership (e), travel purpose (f)

Demographics of Trans Banyumas passengers can be seen in (Fig 1). Trans Banyumas has three corridors, namely Corridor I from Pon Market to Ajibarang Bus Station, and the bus service is from 05.00 am to 07.00 pm, Corridor II from Notog Bus Station to Baturaden. The service starts from 04.45 am to 5.30 pm, and corridor III from Bulupitu Purwokerto Bus Station to Kebondalem Bus Station, and the service begins at 05.00 am to 6:35 pm. According to Fig.1 (a), the common corridor used was Corridor I (38%), then Corridor III (35%). and Corridor II (28%). The respondent demographics based on gender were dominated by female passengers (72%) (Fig.1 (b)). It showed women tend to travel by public transportation rather than private vehicles. The age ratio was dominated by those above 40 years old (28%), followed by the age ratio less than 20 years old and more than 20 to 30 years old (26%), and the age ratio from 31 to 40 years old (21%) (Fig. 1 (c)). The employment status of Trans Banyumas passengers in Fig. 1 (d) was dominated by students (35%) because students were free of charge, and the bus passed many schools and universities in Banyumas. In addition to employees (21%), housewives (19%) are followed by laborers, sellers, government officials, entrepreneurs, and retired civil servants, whose percentage is 7% to 0%. Fig. 1 (e) showed that most passengers own motorcycles (73%) and do not own vehicles (22%), cars (2%), and bicycles (3%). The last is Fig. 1 (f), which shows the category of travel destinations was dominated by going to school (24%), followed by tourism (23%), work (19%), shopping (18%), and the remainder was to hospitals and social visits.

3.2.   Instrument Test Result

The research test instruments were processed to meet the criteria for the final analysis phase. The test consists of a validity test, a reliability test, and a normality test. Results showed that the validity test has a p-value below 0.05. It means the data used in this study is valid. The reliability test results can be seen from the Cronbach's alpha value and can be declared reliable if the alpha value exceeds 0.6. The Cronbach's alpha results showed 0.8433. It means the data was reliable. The final stage is the data normality test to determine whether the data obtained is normally distributed. The study

used skewness and kurtosis values. The skewness value is 0.30, and the kurtosis value is 1.51. The data obtained were normally distributed because the skewness values are between -2 and +2, and the kurtosis values are between -7 and +7 [19].

3.3. ANOVA Result

Table 2 shows the results of calculations using ANOVA. Age ratio factor has significance responses to A1, A4, A15, A14, A22, A12, A17, and A23. It means the age ratio factor tends to gain fast and punctual arrival times with the ease of providing information from Trans Banyumas. They prefer public transportation to travel even though have to wait around 15 minutes. They appreciated drivers' friendly attitude to make them feel safe. However, the *Teman Bus* app that shall include bus positions, unmet their travel needs.

Furthermore, the gender factor has significance with responses A11, A15, A20, and A21. There is different perceptions between men and women regarding passenger protection against crime. Women tend to choose safe transportation. In addition, women thought Trans Banyumas was environmentally friendly because many passengers switched from private vehicles to Trans Banyumas. Women passengers need bus stops with a building facility to protect them from rain and sunlight while waiting.

Table 2. Test Results

Sig. factor	Code	*P*-value	Sig. factor	Code	*P*-value
Age	A1	0.025	Private Vehicle Ownership	A4	0.017
	A4	0.002		A6	0.029
	A15	0.001		A8	0.011
	A14	0.042		A9	0.001
	A22	0.002		A10	0.000
	A12	0.000		A11	0.000
	A17	0.005		A16	0.003
	A18	0.000		A17	0.000
Gender	A11	0.005	Frequently used corridors	A4	0.002
	A15	0.033		A5	0.008
	A20	0.007		A8	0.000
	A21	0.025		A9	0.044
Job	A2	0.017		A13	0.018
	A7	0.009		A14	0.015
	A23	0.036		A15	0.001
Travel Purpose	A3	0.036		A19	0.017
	A14	0.031		A21	0.011

| A23 | 0.003 | | A22 | 0.035 |
| | | | A12 | 0.000 |

Occupational factors affect the responses of A2, A7, and A23. It means that the work factor significantly influences the fast arrival time where the work of passengers is dominated by students and employees who need prompt arrival time. The passenger thought the bus stop was easy to reach because Trans Banyumas stops are available at public places such as schools, hospitals, and department stores. In this preference, they thought Trans Banyumas had not used environmentally friendly fuels. The responses A4, A6, A8, A9, A10, A11, A16, and A17 significantly influence private vehicle ownership. It means the passengers who have private vehicle owners thought that Trans Banyumas is faster than other public transportation. They need parking near the bus stop because most passengers have motorbikes. They chose Trans Banyumas due to the affordable Trans Banyumas fares, installed CCTV, and e-payment transactions. The responses A3, A14, and A23 significantly influence the travel destination factor. It indicates the travel destination factor significantly influences the punctual arrival time because students dominate Trans Banyumas passengers to go to school. Students can predict when the bus will arrive and depart. They agree with the friendly attitude of the drivers and it demonstrates environmentally friendly fuel. Moreover, the A4, A5, A8, A9, A13, A14, A15, A19, A21, A19, and A12 responses have significantly corridor factors. It indicates Trans Banyumas is faster than other transportation and it has affordable fares, and friendly driver attitudes regarding safety.

3.4.   Trans Banyumas Passenger Mobility Patterns

Fig. 2 (a) shows that most passengers or respondents chose the Ajibarang Bus Station as the place of departure, followed by the Bulupitu Bus Station, Pon Market, and Ajibarang Hospital Bus Stop. Fig. 2 (b) depicts the most frequent destinations for passenger trips: Pon Market, Bulupitu Bus Station, and Ajibarang Hospital Bus Stop. Ajibarang Bus Station, Bulupitu Bus Station, and Pon Market are the most preferred choices for passengers as departure stops and destinations due to supporting facilities such as adequate waiting rooms and sufficient parking space. Furthermore, most students, teachers, lecturers, and employees work in Ajibarang or Purwokerto because those Bus Stations are transit places.
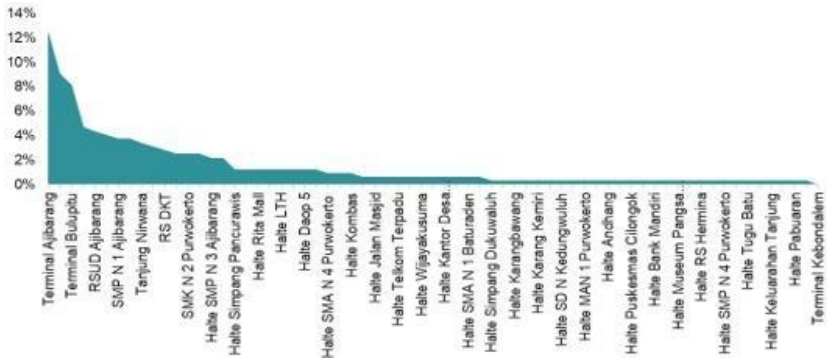
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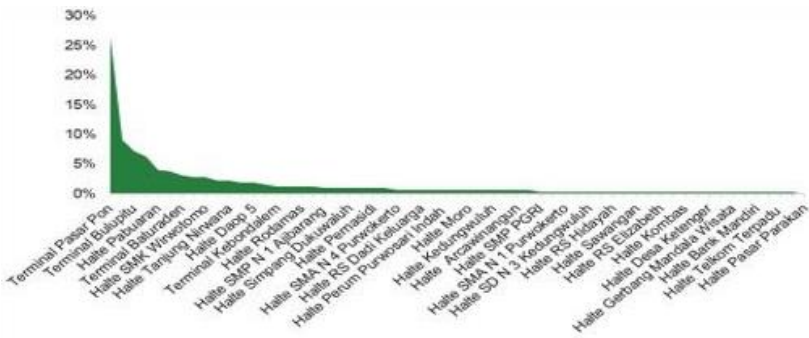
(b)

Fig. 2. Departure point (a) and destination point (b) in percentages

3.5.   Finding Implications And Recommendations

The smart city is an innovative concept connecting physical, social, and economic infrastructure in an integrated ICT technology to create an efficient and livable city. The smart city implementation will encourage the creation of a town that provides security, convenience, and comfort in carrying out community mobility [7]. One pillar of a smart city is smart mobility. Smart mobility is one of the leading choices for a more sustainable transportation system by issuing digitalization services, road traffic prediction, municipal decisions, and strategies based on information and communication tools and technologies [8]. Trans Banyumas is a smart mobility-based public transportation, and one indicator of good public transportation facilities is the ease of access to these services and the necessity for the community [20]. The main thing in transportation is accessibility. It measures how easy to move between locations or areas and feel comfortable reaching the place [13]. In addition, to gain excellent transportation accessibility, demands for service quality are essential to gain customer satisfaction [21], even in the smart mobility era. Therefore, the public transport providers' service level is compulsory to gain customer convenience [22].

Demographic factors significantly affect passengers' responses regarding accessibility against smart mobility initiatives. The elements are age ratio, gender, occupation, private vehicle ownership, travel purpose, and frequently used corridors. The age ratio and gender prefer public transportation over personal vehicles. It is shown that a particular age ratio understands on how to employ Trans Banyumas because the provided information is appropriately shared [23]. In addition, as most passengers showed, women are unique in their daily mobility and prefer to travel using public transportation for a long time [24].

Furthermore, demographic factors such as vehicle ownership, occupation, trip purpose, and frequently used corridors significantly affect the speed and timeliness of bus arrival, ease of access to bus stops, ease of switching vehicles, affordable prices, and available parking areas. It is shown that Trans Banyumas fares are cheap when compared to using private vehicles within similar destinations. Trans Banyumas Bus Stops are easy to reach, but the problem is the parking area within the bus stops. Passengers must use their motorcycles or ride-hailing trips to reach nearby bus stops.

Regarding security, passengers feel safe when using Trans Banyumas services. This result is significant with factors of gender, which are dominated by women who are vulnerable to crime [25]. However, Trans Banyumas shall consider the unavailability of seats according to gender, especially since women dominate Trans Banyumas passengers. In addition, the ease of using e-payment shall be improved because it was found that some passengers experienced problems [26]. Regarding sustainability, Trans Banyumas gets a positive perception from passengers because the projection is to build pro-environment transportation. However, the government has tried to use environmentally friendly fuels, such as electric buses in Trans Surabaya. The sustainability shall consider the unavailability of bus stop buildings in some areas and inadequate road pavements in some corridors.

Moreover, demographic factors significantly influence smart mobility initiatives in Trans Banyumas, such as speed sensors and safe distances, e-money payments, and QR barcodes. The use of technology will enhance Trans Banyumas service. Some passengers complained that the *Teman Bus* app unmeeted the needs of passengers, such as the accuracy of the position and departure schedule from Trans Banyumas. Some passengers do not understand the use of this application and even some of them do not installed yet the app. Therefore, the provider's managers shall improve the utilization of the app to maximize the passengers' requirements.

4.   Conclusions

The study determines the effect of accessibility based on the perspective of the smart mobility initiative of Trans Banyumas. The views were influenced by their demographics, such as age, gender, job, owning private vehicles, travel purposes, and corridors. The result showed that most of the passengers were satisfied with Trans Banyumas services, but to support the smart mobility initiative, the Trans Banyumas Provider shall add more services such as parking areas, unavailability of seats according to gender, unavailability of bus stop buildings in some areas, and inadequate road pavements in some corridors, and improvement *Teman Bus* app and e-money for

payment. Furthermore, the limitation of this study is focused on accessibility only. Future studies shall add more variables to gain a more general understanding of mapping The BRT service. Future research can evaluate the progress of the smart mobility initiative in Trans Banyumas. The evaluation will impact passengers' accessibility. The improvement can be measured from smart mobility readiness, especially for improving the BRT infrastructure and service by the BRT operators. By enhancing the BRT service quality, Trans Banyumas will be a leader in public transportation to support sustainable transport in Banyumas and can be a model for other cities that implement BRT.

Acknowledgment

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