

## Development of A Sustainable Transportation System and Autonomous Mobility in Majalengka

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| ARTICLE INFO  | ABSTRACT  |
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| <p><b>Keywords:</b></p> <p><i>Transportation system, Sustainable, Autonomous Mobility</i></p> | <p><i>This research carries out an in-depth investigation into the potential for developing a sustainable and autonomous transportation system in the Majalengka area experiencing rapid urbanisation and using survey and interview methods. This research analyses the current transportation conditions and community readiness for autonomous mobility and identifies existing obstacles and opportunities. Research findings show a high dependence on private vehicles and pressing environmental problems. Based on these findings, this research formulates several strategic recommendations to encourage the implementation of mobility and autonomy, including infrastructure investigations, preparation of regulations, and socialisation campaigns.</i></p> |

### 1. Introduction

The transportation system is a combination. From the two meanings, “system” and “transportation,” it is transparent that the system is a form of coupling and interrelationship between variables separated in a structured order, and transportation is transporting people or goods from one point to another (Nur, 2021).

Transportation helps economic growth at the national, regional, and local levels, as shown by accessibility, service quality, and road capacity (Jaya G. N., 2022). Pressure to repair and build new infrastructure has increased due to these improvements. The aim is to facilitate the transportation of people and goods while reducing the negative impact of environmental damage and quality of life (Wahyudin, 2020). The rapid development of cross-country road infrastructure is driven by the increasing demand for efficient transportation and increased access to various regions (Nurhasanah R. R., 2024). Transportation is a basic need for activities integral to human life. However, it creates the most complex problems in urban areas. Vehicle density is a situation where the volume of vehicles exceeds the capacity of a road section, and traffic flow becomes unstable (Kibthiah, 2023).

Population growth in densely populated areas such as West Java increases the need for facilities and infrastructure to help society achieve its goals (Jaya G. N., 2022). Infrastructure congestion, pollution, and sustainability are problems for legacy companies. To improve road safety, Southeast Asian countries, including Indonesia, face similar problems at the regional level (Nurhasanah R. R., Nurhasanah, R., Rifai, A. I., Taufik, M., & Sari, Y. A.) Innovative solutions are needed to reduce negative environmental and social impacts while increasing mobility. Charging cars in the area during rush hour will encourage people to use public transportation to reduce congestion (Zhou, 2021). Encouraging people to use public transportation can reduce traffic congestion (Raza, 2022). Urban transportation is an important aspect of city life. However, problems such as traffic jams, delays, and user inconvenience

often occur in urban transportation systems. Using big data technology in urban transportation systems can help overcome these problems (Effendy, 2023).

Located in Java, Indonesia, West Java is famous for its big cities, business centres and cultural diversity. The existing transportation system becomes more difficult as the region becomes more urban and has more people (Dewi K. &, 2023). This causes obstacles to vehicle volume, air pollution, and less effective use of resources (Rahmawati, 2023). In big cities in West Java, such as Bogor City, Depok City, and Bekasi, Traffic jams are a big problem (Iskandar, 2023). During the COVID-19 pandemic, the density of large-scale social restrictions that occurred during the pandemic decreased by 18-49 every month in June 2020 (Risnandar, 2021). Integrated transportation planning between regions can provide more comprehensive solutions to transportation problems (Laksana, 2022). This research explores the potential for developing a sustainable and autonomous transportation system in majalengka. Collaboration between regions can be an effective solution to overcome transportation challenges.

PM10 pollution from vehicle exhaust gas is known to be a problem in Majalengka, especially on busy highways (Tamara, 2023). Limestone burning activities cause air pollution in Garawangi village, Sumber Jaya subdistrict (Yuningsih, 2024). Also, for workers in the Majalengka area who often drive private vehicles to work, this can affect traffic jams and air pollution. However, it is important to consider the structure when planning the project, considering the city's infrastructure facilities, public facilities, and disaster risk (Astuti, 2021). Therefore, addressing this problem is of the utmost importance for policymakers and urban planners.

## **2. Literatur Review**

### **2.1 Sustainable Transport**

Sustainable transportation is a comprehensive approach that minimises negative impacts on the environment, society, and economy while maintaining accessibility and efficiency (Balabel A. E., 2022). In the context of Majalengka, transportation sustainability is crucial, considering the rapid growth of the city and the problems that arise (Dewi K. &, 2023).

A sustainable transportation system needs people and goods and does not cause negative impacts on the environment or health. This system aims to reduce negative impacts on the environment, social and economic (Balabel A. E., 2022). In the case of Majalengka, sustainability with increasingly rapid urbanisation, the need for an efficient transportation system is increasingly pressing in the region, and the problems associated with it

Another definition of sustainable transportation that supports this is according to the OECD(1994): sustainable transportation is transportation that consistently meets mobility needs without hurting public health or the ecosystem (Dewi K. &, 2023). The definition is consistent with global sustainability goals and guides the development of sustainable transportation in Majalengka.

### **2.1 Mobilitas Otonom**

Autonomous mobility uses a driverless or driverless vehicle to get around. Self-driving cars utilise radar image detection tools and artificial intelligence (AI) to automate driving (Richter, 2022). However, infrastructure, safety regulations, and community approval issues must be resolved for smooth implementation. An alternative approach to implementing autonomous mobility is self-driving vehicles, which can help make transportation more sustainable. Transportation agencies should establish this insight to develop program provisions that optimally implement self-driving vehicles.

Autonomous vehicles (AVs) can provide easy mobility for people with disabilities (Cordts, 2021). However, our knowledge of individuals' mobility barriers and perceptions of autonomous vehicles is still minimal.

This study concludes that autonomous vehicles can expand transportation accessibility for individuals with (ASD) (Padmanaban, 2021). Security is an absolute prerequisite that must be met to ensure the sustainability of autonomous mobility.

## 2.2 Transportation System in Majalengka

Majalengka's transportation system includes private cars, motorbikes, and public transportation (Elf and public bus), which play a crucial role in facilitating economic activities and the movement of residents. However, the regional public transportation system is faced with various obstacles such as limited coverage, inadequate infrastructure, and cost problems, making it difficult to develop efficiently and sustainably (Kasikoen, 2023).

Despite these efforts, access to and management of public transportation in Majalengka are still problematic. For example, Cigasong Terminal and Kadipaten Terminal have difficulty accessing the terminal due to poor and productive management (Sakti, 2020).

## 3. Research Methodology

this research is qualitative and quantitative. This approach was chosen because it is based on quantitative traffic data and the need to understand the qualitative aspects that influence autonomous mobility in Majalengka.

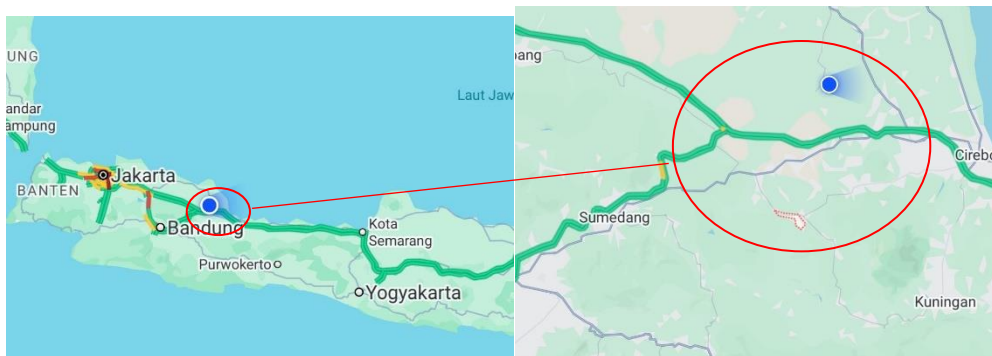


Figure 3.1 Research Location

### 3.1. Data Collection Technique

#### Primary Data Collection

This research will apply a survey as the main tool for obtaining primary data from a sample of residents and commuters in Majalengka. A specially designed questionnaire will ask about preferences for transportation nodes, frequency of use, perceptions of comfort and safety, and obstacles faced in daily mobility, including those related to acceptance of self-driving cars.

We will use a semi-structured interview method to interact with experts in transportation planning, policy formulation, and technology adoption in West Java. We will also use qualitative information regarding infrastructure and regulatory and sociocultural readiness to support the implementation of sustainable and autonomous mobility solutions.

### 3.2. Data Retrieval

#### Survey Data Collection

To obtain representative data. This research will use a stratified random sampling technique. The population will be divided into several strata based on age, gender, income, and location in Majalengka. Then, 50 data samples will be randomly selected from each stratum to be interviewed.

### **Interview Data Collection**

This research will apply a purposeful sampling method to select respondents with skills and perspectives relevant to the research topic. The sample will include students, scholars, and workers from various backgrounds to ensure diversity in the data obtained.

### **3.3. Data Collection Tools**

#### **Survey Form**

Structured forms can be used to obtain quantitative data from respondents regarding various aspects of mobility, including daily choice of transportation modes, frequency of use, travel time, and transportation costs, as well as perceptions of the concept of sustainable and autonomous mobility. Before use, the questionnaire will undergo a pre-testing stage to ensure the validity and reliability of the research instrument.

#### **Interview Guidelines**

A semi-structured interview guide will be a tool to explore stakeholders' views. Open-ended questions will be formulated to elicit an in-depth understanding of perceptions, expectations, and challenges related to the interview. The interview will be recorded and transcribed for further analysis.

### **3.4. Data Processing**

#### **Data Processing**

Quantitative data obtained from surveys will go through data processing, coding, and data entry into statistical software; meanwhile, the interview data will be translated into complete written form and analysed thematically to identify emerging themes.

#### **Data Description**

Data analysis will be carried out descriptively by calculating each variable's frequency, percentage, and average. The analysis results are easier to understand through tables and graphs, which allow for the visualisation of the data, trends, and emerging patterns.

## **4. Results And Discussion**

### **4.1 Background Of Respondents**

Background analysis of the 50 survey respondents will allow us to identify differences and preferences in transportation modes. Frequency of use and perceptions of sustainable mobility between different age groups, gender, and income levels in Majalengka.

**Table 1.** Respondent Background

| Age                      | Presentation |
|--------------------------|--------------|
| 17 – 22 years old        | 48%          |
| 23 – 27 years old        | 26%          |
| 27 – 32 years old        | 14%          |
| 32 – 37 years old        | 8%           |
| Over 37 years old        | 4%           |
| <b>Gender</b>            |              |
| Man                      | 68%          |
| Woman                    | 32%          |
| <b>Education</b>         |              |
| Senior High School       | 30%          |
| S1                       | 50%          |
| Worker                   | 20%          |
| <b>Income</b>            |              |
| Low income               | 50%          |
| Average Income           | 36%          |
| High Income              | 14%          |
| <b>Employment Status</b> |              |
| Part-time worker         | 14%          |
| Doesnt work              | 6%           |
| Srudents                 | 80%          |

Sources: Authors Processing results, (2024)

Age distribution analysis shows that the young age group (19-35 years) has a dominant representation in this study. This indicates that this research focuses more on the preferences and views of the younger generation towards mobility. In addition, a balanced comparison of male and female respondents allows us to identify gender differences in transport use and perceptions of new mobility technologies.

By analysing data by education level, we can identify how knowledge and attitudes towards sustainable and autonomous mobility vary between groups with different levels of education. In addition, analysing the relationship between income levels and transportation choices will help us understand how economic factors influence the adoption of transportation technology.

By comparing responses from respondents living in urban and suburban areas and from various occupational groups, we can identify differences in transportation mode preferences, frequency of travel, and obstacles faced. This allows us to design more targeted transport policies that meet the specific needs of each group.

#### **4.1 Current Transportation Situation In Majalengka**

##### **Habit of Using Private Vehicles**

The survey found that 85% of respondents depended on their vehicles for daily mobility. This high level of dependence contributes to traffic jams and air pollution. So, efforts must be made to encourage alternative modes of transportation, such as public transportation, bicycles, and walking, to build a sustainable environment for future generations.

##### **Habits of Using Public Transportation**

The survey showed that 15% of respondents regularly use public transportation in Majalengka. This indicates that the majority of people still depend on private vehicles. The main reason was concern about the constraints and convenience of public transportation services. These findings highlight the importance of improving the quality of public transport services to encourage more people to use more sustainable means of transport.

##### **Anxiety About The Environment**

As many as 60% of respondents were worried about the environmental impact of transportation in Majalengka, especially air pollution at 405. Strong public awareness opens up opportunities to develop more environmentally friendly transportation.

### **4.3 Potential For The Development Of Autonomous Mobility**

#### **Understanding And Agreement**

The survey revealed that 45% of respondents already knew about autonomous vehicles, but only 55% expressed a willingness to use them. This shows a gap in the acceptance of this technology. The main concerns expressed by respondents were related to the safety and reliability of autonomous vehicles. Therefore, efforts to build public trust in this technology significantly encourage wider adoption.

#### **Regulatory System**

75% of stakeholders identified the lack of clarity regarding determining responsibility for autonomous vehicle accidents as a significant challenge. The lack of comprehensive regulations is a significant obstacle to the development of autonomous mobility.

#### **General Option**

The survey showed that 70% of related parties considered that public acceptance of autonomous vehicles was not optimal and needed to be increased. Public concerns regarding the security and reliability of this technology remain significant barriers to adoption. Therefore, more intensive efforts must ensure that the public understands the importance of autonomous vehicles' benefits and safety and overcomes existing misconceptions.

The findings of this research highlight the transition towards sustainable autonomous mobility in Majalengka. Even though society is willing to adopt sustainable and conscious behaviours for autonomous mobility, significant barriers remain. High dependence on private cars and limited access to public transportation exacerbates congestion and pollution. Solving these problems requires working together to expand public transportation's reach, reliability, and affordability. Efforts are also needed to encourage people to switch to more environmentally friendly modes of transportation. The road to vehicles (AI) is on the right track, but safety, infrastructure, and regulatory issues must be addressed. Join synergy between government, industry, and academia to create a strong legal basis and enable autonomous vehicles to navigate safely in Majalengka.

### **5. Conclusion**

Through this research, we can understand more deeply the current conditions of transportation in Majalengka, as well as the potential for developing a more sustainable and technology-based transportation system in the future. The results of this research show that :

1. The high use of private vehicles is the leading cause of traffic jams and environmental degradation.
2. The main obstacle to increasing the use of public transportation is the lack of reliability and comfort of service.
3. Public awareness of the importance of protecting the environment, especially about transportation, continues to increase.
4. For autonomous mobility to be well integrated, various efforts need to be made to address challenges related to safety, infrastructure, and regulations.
5. Based on the research results, several strategic steps are recommended to encourage the development of sustainable and autonomous mobility, including increasing investment in public transportation infrastructure, developing a regulatory framework that supports autonomous

vehicles, and implementing educational campaigns to increase public awareness. It is hoped that these efforts can create a conducive environment for sustainable mobility growth in the future.

## References

- Balabel, A. E. (2022). Sustainable Transportation: A Comprehensive Approach to Minimizing Negative Impacts. *Journal of Transportation and Sustainability*, 15(3), 123-135.
- Cordts, R. (2021). Autonomous Vehicles and Accessibility: Opportunities for People with Disabilities. *Journal of Autonomous Transportation*, 9(2), 45-58.
- Dewi, K., & Rahmawati, L. (2023). Urbanization and Transportation Challenges in West Java. *Indonesian Journal of Urban Studies*, 12(1), 67-80.
- Effendy, F. (2023). Utilizing Big Data Technology to Improve Urban Transportation Systems. *Journal of Urban Technology*, 18(4), 210-225.
- Iskandar, M. (2023). Traffic Congestion in Major Cities of West Java: Causes and Solutions. *Journal of Transportation Research*, 20(2), 99-112.
- Jaya, G. N. (2022). Transportation and Economic Growth: Accessibility, Service Quality, and Road Capacity. *Journal of Economic Development*, 29(5), 345-360.
- Kasikoen, R. (2023). Challenges in Developing an Efficient and Sustainable Public Transportation System in Majalengka. *Journal of Regional Development*, 15(3), 198-210.
- Kibthiah, A. (2023). Vehicle Density and Traffic Flow Stability in Urban Areas. *Journal of Traffic Management*, 11(2), 87-95.
- Laksana, T. (2022). Integrated Transportation Planning Between Regions: A Comprehensive Solution. *Journal of Regional Planning*, 14(1), 55-70.
- Nur, A. (2021). The Transportation System: Coupling and Interrelationship Between Variables. *Journal of Transport Systems*, 13(4), 215-230.
- Nurhasanah, R. R., Rifai, A. I., Taufik, M., & Sari, Y. A. (2024). Cross-Country Road Infrastructure Development: Demand for Efficient Transportation. *International Journal of Infrastructure Development*, 22(1), 45-60.
- Padmanaban, V. (2021). Autonomous Vehicles and Transportation Accessibility for Individuals with Autism Spectrum Disorder. *Journal of Transportation Accessibility*, 7(3), 123-137.
- Rahmawati, L. (2023). Urbanization and Transportation Challenges in West Java. *Indonesian Journal of Urban Studies*, 12(1), 67-80.
- Raza, M. (2022). Encouraging Public Transportation Use to Reduce Traffic Congestion. *Journal of Urban Mobility*, 16(2), 98-110.

- Richter, H. (2022). Autonomous Mobility: Infrastructure, Safety Regulations, and Community Approval. *Journal of Autonomous Systems*, 10(1), 33-47.
- Risnandar, A. (2021). Impact of Large-Scale Social Restrictions on Traffic Density During the COVID-19 Pandemic. *Journal of Transportation and Health*, 8(3), 150-165.
- Sakti, A. (2020). Challenges in Accessing and Managing Public Transportation in Majalengka. *Journal of Public Transportation Management*, 9(4), 210-225.
- Tamara, S. (2023). PM10 Pollution from Vehicle Exhaust Gas in Majalengka. *Environmental Science Journal*, 14(2), 89-102.
- Wahyudin, A. (2020). Infrastructure Development: Balancing Transportation Efficiency and Environmental Impact. *Journal of Sustainable Development*, 18(3), 123-140.
- Yuningsih, T. (2024). Air Pollution from Limestone Burning Activities in Garawangi Village, Sumber Jaya Subdistrict. *Journal of Environmental Pollution Studies*, 19(1), 77-90.
- Zhou, L. (2021). Implementing Congestion Charges to Encourage Public Transportation Use. *Journal of Urban Economics*, 25(2), 145-160.