ISSN 3032-3533
Vol 1, No.1 (2024)

The Role of Transportation in the Development of Medan Urban Areas a Study of Infrastructure and Mobility Patterns

1st Ardiles Hasianta Meka
Postgraduate Student of Urban and Regional Planning
Universitas Pembangunan Panca Budi
Medan, Indonesia
ardymeka0909@gmail.com

2nd Abdi Sugiarto
Master of Urban and Regional Planning
Universitas Pembangunan Panca Budi
Medan, Indonesia
abdi_sugiarto@dosen.pancabudi.ac.id

***Abstract*— Transportation infrastructure plays an important role in supporting urban development, especially in the context of Medan City which continues to experience rapid urbanization. This study aims to examine how transportation infrastructure and mobility patterns contribute to urban development in Medan. Using a mixed qualitative and quantitative approach, this study evaluates the condition of roads, public transportation, and pedestrian facilities and how these elements affect accessibility, connectivity, and community travel patterns. Data were obtained through surveys, interviews with policy makers, and literature analysis on transportation policy and urban planning. The results of the analysis show that adequate transportation infrastructure improves community mobility and encourages local economic growth, while strengthening Medan's attractiveness as a center for trade and investment. This study recommends integrated and sustainable transportation planning to support inclusive and sustainable urbanization.**

Keywords: transportation, urban development, Medan, infrastructure, mobility, accessibility, connectivity, urbanization.

I. INTRODUCTION

Big cities in Indonesia, including Medan, continue to experience increasing economic activity, population growth, and demand for better accessibility. However, like other big cities in the world, Medan also faces various changes and challenges due to rapid urbanization. Rapid population growth has significant consequences, such as traffic congestion, pollution, and reduced open space that can be enjoyed by the community. The increase in population and the need for space for economic, social, and housing activities have driven cities to develop sporadically towards the suburbs. This uncontrolled growth has the potential to cause various urban problems such as congestion, air pollution, and reduced open space that should be enjoyed by the community, Noviyanti, N., & Putra, IM (2023).

Along with the rapid growth of big cities that become centers of high activity as a form of life such as in government centers, trade and/or service industries, it causes high externalities, both positive and negative, Abdi Sugiarto. (2023). Development that is less integrated with transportation infrastructure often results in energy waste and reduces citizen accessibility to various important services and facilities. This problem is increasingly urgent to be addressed with a sustainable approach, such as development with the concept of Transit-Oriented Development and mixed land use, which combines the integration of architecture, transportation, and accessibility in one area. This concept focuses on urban design that is oriented towards human needs, environmentally friendly, and encourages more efficient mobility, Harno, T. (2010). With the TOD concept, for example, it is hoped that new areas can be better connected and minimize the use of private vehicles, thereby reducing pollution, congestion, and dependence on fuel. Trianah, M., et al. (2024).

The development of information and communication technology (ICT) also opens up new opportunities for more efficient urban mobility management. The use of technologies such as mobile applications, smart sensors, and big data analysis can now support transportation planning and provide better information to users. The integration of ICT with transportation infrastructure allows for the creation of urban environments that are more adaptive, efficient, and responsive to the needs of residents. In addition, the adoption of more sustainable lifestyles, such as shared transportation and bicycle use, further strengthens the need for inclusive and environmentally friendly urban planning. These changes also encourage urban architecture that is not only efficient in terms of transportation, but also supports the creation of public spaces that are accessible to all groups in society. Aulia, S., et al. (2024). Here is a map image:

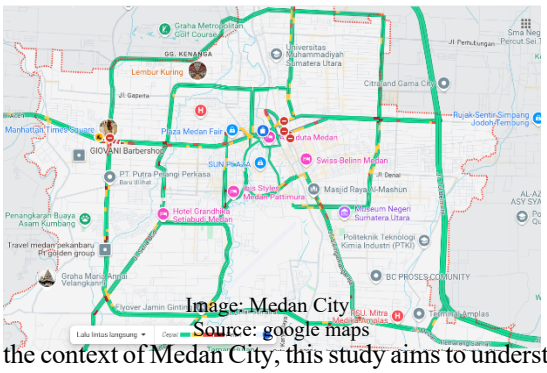

Image: Medan City
Source: google maps

In the context of Medan City, this study aims to understand the role of transportation in supporting the development of more structured and environmentally friendly urban areas.

©2024 Author. Published by ICANEAT. This is an open access article under the CC BY-SA license
(http://creativecommons.org/licenses/by-sa/4.0/)

This study will also examine community mobility patterns and how existing transportation infrastructure can be improved to meet the demands of rapid urban growth, Prayudyanto, MN (2021). It is hoped that the results of this study can provide input for policy makers and city planners to create a more competitive, inclusive, and sustainable Medan for all its citizens. Medan faces challenges in providing transportation infrastructure that can support sustainable and inclusive mobility patterns. Limited infrastructure, congestion, and lack of connectivity between regions are obstacles to realizing optimal urban development. Therefore, it is important to integrate efficient transportation planning with urban spatial planning to ensure equal access for all residents, while reducing the environmental impacts caused by private vehicle-based transportation, Wunas, S. (2011).

The Deli River border area in Medan Maimun District has various potentials including recreation and tourism areas, transportation routes, as a means of education and research, and ecological protection areas, Abdi Sugiarto (2024). By involving all stakeholders at the district/city, provincial, and national levels, a facilitation and participation approach is used to ensure equitable benefits from the results of the preparation, Abdi Sugiarto (2024). With its strategic position, Medan has the potential to become a regional and national trade center on the island of Sumatra. The focus of the physical development of Medan City must be centered on the formation of new industrial and trade areas to improve the quality of life of the community, Abdi Sugiarto (2023). In the midst of increasing urban development, traffic management and the provision of a structured transportation network are very important to overcome various urban challenges such as congestion, air pollution, and environmental degradation. Policies such as Law No. 22 of 2009 concerning Traffic and Road Transportation provide a clear legal basis for traffic regulation and the implementation of integrated and sustainable transportation. This law focuses on meeting transportation safety and comfort standards, which is expected to reduce the negative impacts of rapid urbanization, Weddel, P. (2010).

In addition, Sistranas 2012 or the National Transportation System serves as a guideline in sustainable transportation planning, strengthening inter-regional transportation integration, and supporting the efficiency of the transportation network. This guideline aims to create even connectivity between cities and suburban areas, thereby supporting inclusive economic growth and reducing accessibility inequality, Simonds, JO (1994). In the future, the role of transportation will be increasingly significant in the development of large cities, including Medan, which requires collaboration between the government, developers, and the community. This study will examine how community mobility patterns and existing transportation infrastructure can support the needs of urban growth, as well as provide an overview of a more holistic approach to creating an efficient and sustainable transportation system.

II. LITERATURE REVIEW

Urban area development cannot be separated from the existence of an effective and efficient transportation system. According to Litman (2018), transportation plays an important role in driving economic growth, increasing mobility, and increasing accessibility to various facilities and services. Adequate transportation infrastructure also plays a role in strengthening integration between zones in the city and increasing regional connectivity (Rodrigue et al., 2020). In line with this, Banister (2019) stated that good transportation integration can reduce inequality of access in urban areas and expand economic opportunities for the community.

Studies related to transportation infrastructure in urban areas show that the quality of transportation infrastructure, such as roads, public transportation, and pedestrian facilities, directly affects people's mobility patterns. Good road infrastructure can reduce travel time, increase comfort, and reduce transportation costs for city residents (Boarnet & Crane, 2017). In addition, the provision of effective and affordable public transportation, such as buses and commuter trains, can encourage more inclusive and environmentally friendly mobility, while reducing dependence on private vehicles which have a negative impact on congestion and pollution (Cervero, 2018).

In Indonesia, especially in big cities like Medan, the development of transportation infrastructure has its own challenges. Research by Sugiarto et al. (2020) revealed that increasing urbanization and population growth in big cities in Indonesia have put great pressure on existing transportation networks. In Medan, the increase in vehicle volume and limited road infrastructure have caused congestion that has an impact on mobility efficiency and economic productivity (Putra et al., 2021). Another study by Priatna et al. (2019) showed that the development of transportation infrastructure in Medan also faces challenges related to inter-agency coordination and budget constraints, which hinder comprehensive and sustainable improvement efforts.

To address these challenges, several studies suggest the implementation of sustainable transportation policies that integrate public and environmentally friendly transportation modes with urban spatial planning (Litman, 2018; Banister, 2019). With this approach, it is hoped that a transportation system will be created that not only accommodates city growth but also improves the quality of life of the community. According to Banister (2019), the implementation of sustainable transportation policies can reduce environmental impacts, improve mobility, and support economic development in urban areas more effectively.

Overall, the literature shows that planned and integrated transportation development is essential in supporting a rapidly growing urban area like Medan. By improving transportation infrastructure and implementing sustainability-oriented strategies, Medan is expected to be able to face mobility challenges and optimally utilize economic growth potential.

Formulation of the problem

1. What types of transportation infrastructure are available and how efficient is it in supporting people's mobility?
2. What are the daily travel patterns of Medan City residents and what factors influence the choice of transportation mode?

3. To what extent does transportation infrastructure affect economic growth, accessibility, and people's quality of life?

Research purposes

1. Identifying the type and quality of existing transportation infrastructure and evaluating its efficiency in supporting community mobility.
2. Analyzing daily travel patterns and factors influencing transportation mode choices among the community.
3. Assessing the contribution of transportation infrastructure to economic growth, accessibility, and quality of life of the community.

III. METHOD

The approach in this study uses a qualitative descriptive methodology. The selection of a qualitative approach is in accordance with the research theme which is descriptive in nature. The data collection procedure involves four basic types, namely observation, interviews, documents, and visual images (Creswell, 2013). The qualitative descriptive method is used to obtain secondary data through library methods or document and literature studies. Secondary data are collected from various sources, including books, theses, journals, legislation, the internet, lecture materials, and mass media. Meanwhile, primary data are obtained through in-depth interviews with sources who are experts or related officials who have competence in the field that is the focus of the research, namely transportation.

Data analysis was carried out descriptively with a thematic approach which includes data reduction, data presentation, and drawing conclusions.

Accessibility of Public Transport Terminals in the Development of Medan Urban Transport

According to the Director General of Land Transportation (1993), public transportation terminals function as nodal points in the road transportation network system. Terminals are public facilities used as places for public vehicles to pick up and drop off passengers, as well as to load and unload goods. In addition, terminals also function as places for passenger transfers between modes of transportation that occur due to the flow of human and goods movement, to achieve efficiency in transportation.

In order for activities in the terminal to run smoothly, good accessibility planning is needed to avoid the accumulation of activities at one point. If there is a buildup of vehicles or activities in one location, this can hinder the process taking place in the terminal and have a negative impact on the transportation system in the city. The importance of accessibility cannot be separated from a building, because it greatly determines the comfort of end-user mobility, Salim, AA (2012).

Table 1. Criteria and Indicators for Ease and Comfort of Circulation Aspects

Aspect	Criteria	Indicator
Convenience	All public vehicles can easily enter and exit the terminal area.	The arrangement of parking platforms and parking spaces makes people feel accessible, stable and orderly.
	There are no obstacles when entering the terminal.	Divided into various routes. Platform types: parallel, center, or circumference. For bus lanes located in the loading and unloading area, the width of the bus lane should be adjusted to accommodate two buses.
Comfort	Arrival and departure areas must be separated.	The entrance and exit lanes on public vehicles must remain smooth. Parking procedures for public vehicles do not affect the smooth circulation of vehicles and passenger safety.
	The public transport entry lane is different from the lane for passengers entering.	Each lane for public vehicles has infrastructure or a place used as a departure and arrival, according to the size of the vehicle factor. Cars and transportation are 6 meters, and buses are 11.2 meters.
	Implement 90º, 45º, or 65º parking as well as parallel.	Sidewalks, viaducts, and underpasses are separated by three types of traffic lanes. For sidewalks, the minimum height difference of pedestrian lanes is 20 cm.

Based on Table 1, to achieve convenience in the terminal, if there is no congestion or accumulation of vehicles in the terminal, it is necessary to have different parking arrangements based on the function of the vehicle. This will also determine the ease of vehicle movement, so that it can reduce the risk of cross circulation. To obtain comfort in the terminal, the comfort requirements of the size that must be met are both inside and outside, where each lane must be in accordance with the standard size of each vehicle, namely the width and length of the vehicle and the turning ability of a vehicle, Murlok, EK (1984).

Services in Transportation

The transportation system and space utilization in urban environments will certainly affect each other. All components will develop together. Greater space utilization will affect the number of activities in it, which in turn affects the increasing volume of movement. Thus, the correlation between space utilization and movement volume is positive (abdi sugiarto, 2024)

Service in transportation is a series of activities that are not always visible to the naked eye, but arise from interactions between consumers and employees or other rights granted by service providers to resolve problems faced by consumers or customers. Terminal service standards are guidelines for transportation terminal operators to provide optimal service to terminal service users, Kadir, A. (2006).

According to Law No. 22/2009 concerning Traffic and Road Transportation, there are provisions regarding passenger terminal service standards that cover matters related to minimum service standards. The determination of these minimum service standards aims to ensure equality of opportunity and quality of basic services provided to the community.

In accordance with the Regulation of the Minister of Transportation Number 27 of 2015, the indicators of minimum terminal service standards include safety, affordability, equality, and regularity. Each indicator has limitations as described in Table 3. The terminal service

standard index serves as a benchmark to describe the target size to be achieved by a particular service, both in the form of input, process, results, and service revenue that has been provided.

Terminal service indicators are divided into three categories: passenger service, operator service, and regulator service. Passenger service focuses on the satisfaction and fulfillment of public transportation users' needs, while operator service includes the activities of fulfilling transportation services by operators with available facilities and infrastructure. Regulatory service includes policy standards and regulations that support services to passengers and operators.

Table: 2. Indicators of Minimum Terminal Service Standards in the Development of Medan Urban Transportation

Aspect	Indicator	Information
Safety	Presence of security officers	Ensuring passenger safety in the terminal area
	Adequate evacuation facilities	Provide clear and safe evacuation routes
Affordability	Public transportation access	The terminal must be accessible by various modes of public transportation.
	Strategic terminal location	Place the terminal in a location that is easily accessible to users.
Equality	Facilities for the disabled	Providing facilities that are friendly for people with disabilities
	Non-discriminatory services	All service users must receive the same service without discrimination.
Regularity	Terminal space layout	Ensuring good layout within the terminal to avoid congestion and traffic jams
	Clear service schedule	Provides accurate information regarding departure and arrival schedules.

This table includes indicators of minimum service standards at terminals that are relevant to transportation development in the Medan urban area, and provides information for each indicator.

IV. Result And Discussion

1. The type and quality of existing transportation infrastructure and evaluating its efficiency in supporting community mobility in the city of Medan.

In Medan City, transportation infrastructure includes various types of facilities including highways, public transportation terminals, train stations, and other modes of transportation. Highways in Medan consist of toll roads, arterial roads, and local roads, with some sections that are damaged and require repair to improve traffic flow. Public transportation terminals, such as Amplas Terminal and Pinang Baris Terminal, function as passenger transfer points, but are often congested and lack adequate supporting facilities, such as comfortable waiting rooms and accessibility for people with disabilities. Train stations, although an important part of the transportation network, also face challenges in terms of comfort and integration with other modes of transportation. This evaluation of infrastructure efficiency shows that, despite efforts to improve transportation services, traffic congestion, inconsistent travel times, and user satisfaction are still major concerns. Therefore, better planning and investment in the development of transportation infrastructure in Medan are needed to support more efficient and sustainable community mobility, Ackermans, L., & Poelman, H. (2016). In addition, the quality of transportation infrastructure in Medan City is also influenced by environmental factors and existing government policies. In recent years, Medan has experienced significant population growth, which has resulted in an increased need for efficient transportation. However, many roads are not equipped with safe sidewalks, bicycle lanes, and facilities for other road users, thus hampering public mobility, especially for pedestrians and cyclists.

The quality of public transportation services, such as buses and city transportation, also needs to be improved. Although there are several public transportations operating, many users are dissatisfied due to limited schedules, poorly maintained vehicles, and lack of information on routes and fares. Given these challenges, evaluating public transportation operations and integration between transportation modes is essential to improving efficiency.

2. Analyzing daily travel patterns and factors influencing transportation mode choices among people in Medan city.

Daily travel patterns of people in Medan City are influenced by various factors, including distance, travel time, cost, and convenience. Most Medan residents travel for work, school, or shopping. In this context, analyzing the choice of transportation modes used is very important, considering the diversity of options available, such as public transportation, private vehicles, and ride-hailing services such as Grab, Gojek, Maxim, and Indriver.

One of the main factors influencing the choice of transportation mode is accessibility. People tend to choose the most accessible mode of transportation and can meet their travel needs quickly. Ride-hailing services, for example, offer convenience and ease of booking through an application, making them a favorite choice for many people, especially those with limited time. Users feel more comfortable using this service because they can choose a vehicle that suits their needs, such as a motorbike for short trips or a car for longer trips.

Cost also plays a significant role in determining the mode of transportation chosen. While ride-hailing services offer convenience, the fares charged are often higher than traditional public transportation. Therefore, people who are more budget conscious tend to choose public transportation even though the convenience is not comparable.

In analyzing daily travel patterns and factors influencing transportation mode choice in Medan City, it is important to also consider the demographic aspects of users, such as age, income, and education. For example, younger generations who are more technologically literate tend to be more open to using ride-hailing applications compared to older generations who may prefer traditional public transportation. Income also plays an important role; individuals with higher incomes may prefer services that offer convenience and efficiency, even if they are more expensive. The geographical conditions of Medan City, which has many small roads and dense settlements, also influence transportation mode choice. In some cases, accessibility to public transportation can be limited, especially in suburban areas. Therefore, people often turn to ride-hailing services that are more flexible and can reach locations that are difficult to access by regular public transportation, Iwarsson, S., et al. (2000).

The importance of integration between modes of transport cannot be ignored. Developing an interconnected transport system, for example by providing pick-up and drop-off points for ride-hailing services near bus stops or train stations, can improve travel efficiency and reduce travel time. It can also help reduce congestion, by encouraging users to switch from private vehicles to more environmentally friendly public transport. The availability of information about various transport options, promotions from service providers, and public opinion about the safety and comfort of certain modes of transport can influence individual decisions. Given these factors, a deep understanding of the daily travel patterns of people in Medan City and the choice of transport modes used is essential for developing more effective and responsive transport policies. To encourage the use of more sustainable transport modes, the city government needs to implement policies that support the development of better transport infrastructure. This includes improving public transport facilities, improving roads, and developing safe pedestrian and bicycle areas. With a holistic approach, it is hoped that public mobility in Medan City can be improved, while reducing congestion and negative impacts on the environment, Givoni, M., & Rietveld, P. (2007).

3. Assessing the contribution of transportation infrastructure to economic growth, accessibility, and quality of life of the people of Medan city.

The contribution of transportation infrastructure to economic growth, accessibility, and quality of life for the people of Medan City is very significant. Good transportation infrastructure, including roads, bridges, and public transportation facilities, acts as the backbone in facilitating the movement of goods and people. This not only supports the smooth flow of trade, but also encourages the growth of the local business and industrial sectors.

With efficient transportation infrastructure, logistics costs can be reduced, thereby increasing the competitiveness of local products in the market. For example, good accessibility to ports and markets can speed up the distribution of goods, which in turn contributes to increasing community income and job creation. In addition, integrated transportation infrastructure makes it easier for entrepreneurs to reach consumers and suppliers, increasing business and investment opportunities in the area. Noviyanti, N., & Putra, IM (2023).

High accessibility also has a direct impact on people's quality of life. When people have easy access to a variety of transportation modes, they are better able to reach their workplace, education, and health services. This helps reduce travel time and stress associated with traffic congestion, increasing productivity and life satisfaction. The availability of a variety of transportation modes, such as public transportation, ride-hailing services, and bike lanes, gives people the choice to choose the mode that best suits their needs.

Furthermore, good transportation infrastructure also contributes to the development of more planned urban areas and housing. With adequate transportation routes, new areas can develop, which can increase property values and create a better environment to live in. In addition, environmentally friendly infrastructure, such as bicycle lanes and safe sidewalks, can improve people's quality of life by encouraging active and healthy lifestyles, Trianah, M., et al (2024).

To maximize the contribution of transportation infrastructure to economic growth and quality of life in Medan City, several strategic steps need to be taken. First, infrastructure development must be based on accurate data on community movement patterns and transportation needs, using technology such as data-driven traffic management systems to identify areas for improvement. Second, collaboration between the government, the private sector, and the community is essential. Community participation in transportation planning through public consultation will ensure that their needs are taken into account. Third, promotion of environmentally friendly transportation modes, such as public transportation, walking, and cycling, needs to be done to reduce congestion and pollution, as well as improve public health. Provision of adequate bicycle lanes and pedestrian facilities is also very important. Fourth, increasing connectivity between transportation modes must be considered to ease the transition for passengers. Development of integrated terminals and investment in digital infrastructure, such as real-time transportation booking applications, should also be considered. These steps will help create a more efficient and inclusive transportation system in Medan City.

Continuous assessment and evaluation of transport infrastructure performance is necessary to ensure that all invested efforts produce the expected positive impacts. By involving academics, researchers, and independent institutions in the evaluation process, the government can gain valuable insights for continuous improvement.

V. CONCLUSION

Analysis of transportation infrastructure in Medan City reveals that existing infrastructure plays a crucial role in supporting community mobility, economic growth, and quality of life. Despite the existence of various types and qualities of infrastructure, such as highways, public transportation terminals, and other transportation services, there are still challenges related to efficiency and comfort, including congestion and lack of adequate facilities.

People's daily travel patterns are influenced by several factors, such as accessibility, cost, and convenience, which lead to variations in transportation mode choices, from public transportation to ride-hailing services. Therefore, it is important to improve integration between various transportation modes to create a more efficient and user-friendly system.

The contribution of transportation infrastructure to economic growth and quality of life of the community is very significant. Good infrastructure can improve accessibility and support the development of more planned urban areas. To maximize this contribution, strategic steps are needed, such as data-based development, collaboration between the government, private sector, and the community, and promotion of environmentally friendly transportation modes. In addition, continuous evaluation of the performance of transportation infrastructure is essential to ensure the effectiveness of investment and continuous improvement. With a holistic and inclusive approach, it is hoped that community mobility in Medan City can be improved, which in turn will have a positive impact on economic growth and overall quality of life.

REFERENCES

[1] Abdi Sugiarto, Rini Kustiah Ramadania (2024). Management of Deli Riverbank Land for Sustainable City Development Based on Regional Regulations (RTRW/RDTR) (Case Study: Deli Riverbank, Medan Maimun District), Journal of Economics & Sharia Economics, 7 (1), 618-626

[2] Aulia, S., Anisa, SN, Indah, A., Dipa, MAK, & Panorama, M. (2024). Analysis of the role of infrastructure in economic growth and development in Palembang City. Journal of Economic and Accounting Publication (JUPEA), 4(1).

[4] Arfan Marwazi, Cut Nuraini, Abdiyanto, Abdi Sugiarto & Feby Millanie. (2023). Initial Study of Regional Planning of Medan City. Journal of Research and Multidisciplinary (Armada), 1(12), 1402-1407.

[5] Bintang M Purba, Abdi Sugiarto, Cut Nuraini, Rahmad Dian, & Harry Kurniawan. (2024). Study of Space Utilization for Transportation Systems in the Batang Kuis Urban Area. Darma Agung Journal, 32(4), 188–199.

[6] Central Bureau of Statistics. (2014). Jakarta in Figures 2014. DKI Jakarta. Available online at https://jakarta.bps.go.id/publication/2014/10/21/bb081af3fabf3f5432c74056/jakarta-dalam-angka-2014.html

[7] National Standardization Agency. (2004). Procedures for Planning Urban Housing Environment. SNI 03-1733-2004. Jakarta.

[8] Bappenas. (2012). Facilities and Infrastructure Sector, Chapter V RKP.

[9] Creswell, JW (2013). Research Design: Qualitative, Quantitative and Mixed Approaches (Third Edition). Yogyakarta: Pustaka Pelajar.

[10] Dicky Rahmadani, Cut Nuraini, Abdiyanto, Abdi Sugiarto, & Feby Millanie (2023). Environmental Cleanliness Management Design in Pematang Siantar City, Journal of Research and Multidisciplinary (Armada), 1(2), 1408-1414

[11] Givoni, M., & Rietveld, P. (2007). The access journey to the railway station and its role in passengers' satisfaction with rail travel. Transport Policy, 4(5), 357–365.

[12] Harno, T. (2010). Transit Oriented Development (TOD) as Transport Demand Management (TDM). Directorate of Urban Transportation Facilities Development. Ministry of Transportation, Jakarta.

[13] Iwarsson, S., Jensen, G., & Ståhl, A. (2000). Travel chain enabler: Development of a pilot instrument for assessment of urban public bus transport accessibility. Technology and Disability, 12, 3–12.

[14] Ministry of Transportation of the Republic of Indonesia. (2009). Government Regulation No. 72 of 2009 concerning Railway Traffic and Transportation, Chapter I Article 1 (1).

[15] Ministry of Transportation of the Republic of Indonesia. (2011). Ministerial Regulation No.43 of 2011 concerning the National Railway Master Plan: Policy Direction and Role of National Railways, Investment and Funding Strategy.

[16] Nur Azizah Rangkuti, Cut Nuraini, Feby Millanie, & Abdi Sugiarto (2023) Strategy for Managing Slums in Tebing Tinggi City, Journal of Research and Multidisciplinary Studies (Armada) 1(12), 1426-1432.

[17] Noviyanti, N., & Putra, IM (2023). The Impact of Road Repairs on the Socio-Economic Conditions of the Community of Klumpang Kebun Village, Hamparan Perak District, Deli Serdang Regency. Darma Agung Journal, 31(3), 178-197.

[18] Prayudyanto, MN (2021). Buy the Services Model for Metropolitan City Mass Public Transportation: Are Subsidies Still Needed?. Journal of Land Transportation Research, 23(1), 55-71.

[19] Salim, AA (2012). Transportation Management (10th Edition). Jakarta: PT. Raja Grafindo Persada.

[20] Trianah, M., Saputra, DW, & Irnaninsih, S. (2024). The Influence of the History of the Development of Land, Sea, and Air Transportation in Indonesia and Its Impact on Society. SEMNASFIP.

[21] Weddel, P. (2010). UrbanSim: Modeling Urban Development for Land Use, Transportation and Environment. Journal of the American Planning Association, 68(3), 297-314.

[22] Wunas, S. (2011). Humanist City (Land Use and Transportation Integration). Brilliant Surabaya Indonesia, Surabaya.