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Smart City in the Special Region of Yogyakarta: Development of Transportation Through a Sustainable Approach

Etika Khairina[1,*], Suswanta Suswanta[2], Mochammad Iqbal Fadhlurrohman[3]

[1] *Department of Social Sciences and Humanities, Putera Batam University, Batam*
[2] *Department of Government Affairs and Administration, Jusuf Kalla School of Government, Universitas Muhammadiyah Yogyakarta*
[3]*Department of Government Affairs and Administration, Jusuf Kalla School of Government, Universitas Muhammadiyah Yogyakarta*
[*]*Corresponding author. Email: etikakhairina@gmail.com*

ABSTRACT
Sustainable transportation is a concept of sustainable urban development without harming future life. To realize Yogyakarta as a Smart City. Sustainable Transportation is a dimension/sector of Smart City which is also an agreed global concept. This study aims to determine how the implementation of Sustainable Transportation in DIY in realizing Smart City in DIY. In this study, the application of transportation in the concept of sustainability is seen from the economic, environmental, and social aspects. This research is qualitative descriptive research using the Interview, Observation, Documentation method and supported by the Nvivo 12 Plus application as a supporter of the author in the analysis. The results of the paper show that the implementation of sustainable transportation in DIY has not been fully implemented by the concept of sustainability. This is evidenced by the imbalance in the implementation of development/policy in the concept of sustainability (Economic, Social, Environmental). Based on the identification of the characteristics of the sustainability aspects of transportation in Yogyakarta, it indicates that the concept of sustainability emphasizes more on the economic and environmental aspects so that the social aspects are still neglected. Therefore, Smart City in the dimension of Sustainable Transportation has not been implemented as in the concept of Sustainability.

Keywords: *Smart City, Sustainable Transportation, Special Region of Yogyakarta.*

1. INTRODUCTION

Sustainable transportation is part of implementing Smart City. Smart City is one of the city development models in realizing the concept of sustainable transportation transportasi [1][2] which plays an important role in various functions of the city with the aim of ensuring effective resource management and improving the quality of people's lives [3][4]. Transportation is one of the most needed means of movement in urban areas to serve several community activities which is also an important means in people's lives as a liaison to all aspects of life. Sustainable transportation is transportation that meets the transportation and mobility needs of today without compromising the ability of future generations to meet those needs [5][6][7]. The importance of the application of the concept of sustainability in transportation is motivated by several phenomena in society such as the increasing number of vehicles, the rapid changes in urban land use, decreased interest in public/public transportation, lack of pedestrian access, and bicycle users so that it will indirectly encourage dependence. on private transport.

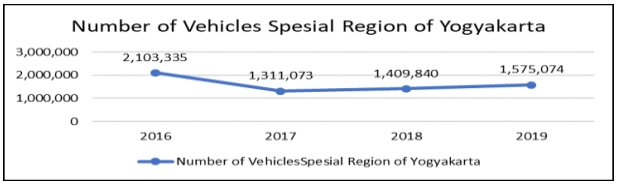
The concept of Sustainable Transportation is indeed a relatively new concept to be studied, most research or studies focus more on aspects of infrastructure development, and technology development and there are still few that include institutional, human resources, and implementation aspects as direct implementation actions by the government. realizing Smart City from the aspect/dimension of Sustainable Transportation. This paper is important to study because the Special Region of Yogyakarta (DIY) is experiencing problems in the transportation sector such as other big cities, phenomena such as an increase in population, a high number of vehicles, and the use of technology that has not been maximized. One of the problems lies in meeting the needs and services to the demands of the community. [3][8]. For this reason, the concept of sustainability becomes a new tool/instrument and concept in overcoming urban problems.

Table 1. Population and Population Density in The Special Region of Yogyakarta

No	Name of Regency/City	D.I Yogyakarta Population				Total density D.I Yogyakarta			
		2017	2018	2019	2020	2017	2018	2019	2020
1	Kulon Progo	421.295	425.758	430.220	434.483	718.6	726.21	733.83	718.6
2	Bantul	995.264	1.006.692	1.018.402	1.029.997	1.963.63	1.986.17	2.009.82	2.032.15
3	Gunung Kidul	729.364	736.210	742.731	749.274	491.04	495.64	500.03	504.44
4	Sleman	1.193.512	1.206.714	1.219.640	1.232.598	2.076.32	2.099.29	2.121.78	2.144.32
5	Kota Yogyakarta	422.732	427.498	431.939	435.936	13.007.14	13.153.78	13.290.43	13.007.14

Source: BPS DIY,2020

Based on BPS data in 2020 (Table 1) above, it can be seen that every City/Regency in DI Yogyakarta experiences an increase in population every year, until 2020 the population reaches 3,882,288 people, it can be seen that the density also increases every year the number of 18,835.43 people/km², the first density was occupied by the city of Yogyakarta. The population is getting higher and the density is increasing every year. Furthermore, the growth of private transportation in Yogyakarta is quite high, the growth of these vehicles is not balanced with roads and the development of environmentally friendly technologies. The number of DIY vehicles until 2019 can be seen in the graph below



Source: Transportation Department, DIY 2019

Figure 1. Number of vehicles in the Special Region of Yogyakarta

Based on data from the DIY transportation department, in 2019 the number of vehicles in Yogyakarta was 1,575,074. The number of vehicles from 2016 to 2017 had decreased, but until 2019 the number was increasing. car growth is estimated at 4% per year and motorbikes at around 6% per year (Dishub DIY, 2019). The same was said by [9] The high number of vehicles in Yogyakarta is not balanced with the volume of roads, resulting in congestion, In 2016 the DIY Province road segment was 760.45 Km long. Provincial road. In addition, all vehicles use fuel oil (BBM) which is very limited in number because it is sourced from nature so that it not only affects the environment but also socially. Based on the Air Pollution Standards Index (ISPU) in 2015 that the Air Pollution Index with Healthy/Good Status is only 30.5, one of which is influenced by Congestion originating from vehicles. Problems related to population or the high number of residents pose limitations to the government in providing services and ensuring a decent urban life. The high number of vehicles in DIY causes problems of traffic density, congestion, and air pollution.

The sustainable transportation policy itself is regulated in the Yogyakarta Special Region Regulation No. 8 of 2015 concerning the pattern of regional transportation development. Article 2 clearly states that transportation must be based on sustainability. Other regulations that discuss sustainable transportation are contained in the Regional Regulation of the Special Region of Yogyakarta Number 3 of 2018 concerning Regional Medium-Term Development Plans intending to develop and develop sustainable transportation to create D.I. Yogyakarta is a livable city and people can enjoy and use transportation comfortably. The scope and discussion of this paper will focus on land transportation, it is based on considering the jargon attached to the Special Region of Yogyakarta as a special area and also one of the tourist cities and student cities. In the future (sustainable) the impact comes more from land transportation.

2. METHOD

The method used in this study is a qualitative description. This type of qualitative research is an approach used to explore and understand a central phenomenon [10], qualitative approach will be based on concepts will explore involving and conduct in-depth case-oriented studies [11]. The location of this research was carried out in D.I Yogyakarta seeing that the City of Yogyakarta has similar existing conditions with other cities. Besides, the city of Yogyakarta is a tourist city and a student city. The data in this paper are sourced from primary data and secondary data. Primary data is data in the form of original research document data collected from actual conditions where when the event occurred, it

is called primary data [12] Primary data comes from interviews with several informants, namely Development.

Planning Agency at Sub-National Level (BAPPEDA) DIY, Department of Transportation D.I.Yogyakarta, and also agencies in the field of transportation services. Secondary Data is data collected from other sources which can be in the form of readings or literature and various other data sources [10], secondary data in this paper comes from publications from related organizations or institutions besides that it can also be in the form of government attachments, journals and study results and other texts related to research. The data analysis technique in this paper uses triangulation which is then assisted by a supporting application, namely NVivo-12 Plus.

3. BASIC THEORY

3.1. Regional Development and Transportation Issues

The transportation system has a close relationship with regional development, this is explained by [13] An activity takes place in an area while the transportation system provides facilities or bridges so that the activity can take place. According to [14] The unsustainability of the urban transportation system can be understood from three fundamental aspects, namely environmental, social and economic quality. Regional issues that can be related to transportation problems include traffic congestion, the increasing proportion of personal use, high accident rates [15]; [9]. Inefficient fuel consumption, decreased air quality caused by the increase in CO2 emissions produced by transportation which can affect public health and the environment [16]. The ratio of road area to city area (Density) which is not followed by the development of the Intelligent Transportation System (ITS) in the use of technology is still minimal [5], become problems that arise in these aspects.

Urbanization is one of the triggers for these problems, according to [17]; [18] Urbanization can be understood as the proportion of the population in an area so that it greatly affects the progress and economic level of a region. Complex activities in an area/city coupled with the population cause the needs and roles contained therein to increase [19] then this growth is not followed by the development of environmentally friendly technologies [9]. A mixture of alienation, isolation and inequality, crime and environmental problems such as pollution and congestion, and an ineffective and efficient service [20]. According to [21] The problem of human activity and dynamics is indeed essential, but according to him, the main problem is more about the implementation, management, and control of the transportation infrastructure itself which is concerned with aspects of Human Resources (HR), Natural Resources (NR) and Aspects of Financial Resources (AFR). The next trigger was delivered by [15] In his study, he revealed that errors in traffic management can trigger inefficiencies that hinder economic activity, diverse urban movement patterns related to urban economic activities, therefore a balance of providers of facilities and infrastructure in the transportation sector is needed.

3.2. Sustainable Transportation (Smart Mobility)

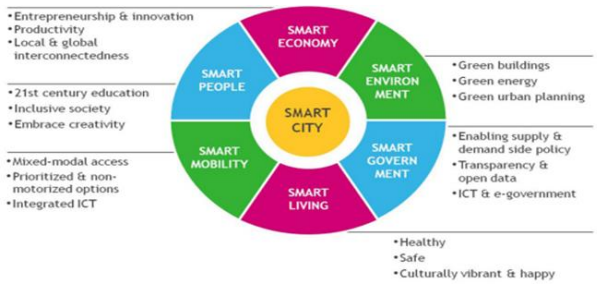
Sustainable transportation is a reflection of the concept of sustainable development in the transportation sector. According to [22] In general, the concept of sustainable transportation is an effort to meet the needs in transportation to encourage environmentally friendly technologies. Conceptually, sustainable transportation is part of the development and implementation of Smart City [5]; [6]; [7]. There is much national and international research/study on sustainable transportation. Sustainable transportation is an effort to meet the mobility needs of generations without compromising the ability of future generations to meet their mobility needs. [23]; [24]; [22]. According to [15] sustainable transportation is a transportation system that will not cause negative impacts so that it can be anticipated by future generations such as fuel use, vehicle emissions, safety levels, congestion, and social and economic access. The same is said [5] that sustainable transportation is a concept of sustainable urban development without harming future life. According to [25] There are 3 components of sustainable transportation that are interconnected, namely environmental, social and economic.

Based on the exposure of studies that have been carried out from several studies, the requirements or characteristics of Sustainable Transportation according to: [26], [13] Readiness in sustainable transportation/smart mobility needs to look at five aspects, including local accessibility. Multimodal access International accessibility, Information & Communication technology infrastructure supporting mobility, and sustainable and safe transportation. [24]; [27] Indicators of sustainable transportation in three aspects, namely: Environment, transportation that does not endanger public health and ecosystems. Economy, transportation that can guarantee the fulfillment of costs. Social, transportation that can minimize the rate of accidents, congestion, feasible to live in and rich in social capital. [6]; [28] Enable secure and consistent access to the basic needs of society, human health and ecosystems with the aim of ensuring future stability and ICT utilization.

3.3. Smart City

Smart city or often called Smart city is a concept of sustainable city development that is becoming a global agenda [29]. Several studies understand the smart city concept as an effort to take advantage of the existence of Information and Technology in the development of city governance. like According to [30] assumes a smart city or what is known as a smart city as a strategy to restore cities to be able to stimulate and adapt to socio-economic changes through information and communication technology features. According to [4] Smart City as a smart city, creative with the help of digital technology which is then supported by the ability to include elements of relations between stakeholders. Smart cities will have the ability to interact through digital sophistication and will focus thinking on innovation [31], [32].

Different things were conveyed in several studies, the Smart City Concept Not only focused on technological sophistication, another understanding was conveyed by [3]; [8] According to him, a smart city is a concept of using human resources, infrastructure, and social capital as well as modern telecommunications to realize sustainable economic growth, [33] high quality of life with wise resource management through participatory government. The Smart City concept understood in this study is a systematic effort to understand the initiatives that the government has and the role played by the government to make cities smarter, including in dealing with existing transportation problems, not just exploring the existence of Technology, Information and Communication to become more effective and efficient. Most studies are more directed and focus on the city exploring Information and Communication Technology (ICT) to become smarter. The character of each dimension is expressed by [26] which can be seen in the image below



Source: [16]; [34]

Figure 2. Scope of Smart City Dimensions

4. FINDINGS AND DISCUSSION

4.1. Sustainable Transportation Policy in DIY

Sustainable transportation can be seen from several aspects, namely economic aspects, environmental aspects, and social aspects. Then in each of these aspects will see Information and Communication Technology Infrastructure as Supporting Mobility as an instrument or means in the transportation development system. As for the sustainability in the transportation sector carried out by the DIY Government, among others.

4.1.1. Economic Aspect

The simplest economic aspect in the concept of sustainability is seeking services from the transportation system so that it can support urban activities that can increase regional accessibility that is efficient and productive. [24]; [9]; [35]. The determination of the condition of the Accessibility road in the DIY region is determined based on the Decree of the Governor of DIY Number 118/KEP/2016 concerning the Determination of the Status of Provincial Roads. Based on data from BPS and Bappeda of Yogyakarta Province in 2016, an assessment of the condition and condition of roads in Yogyakarta Special Region has been carried out, road conditions in Yogyakarta can be categorized into 2 types of road conditions, namely Steady and Unsteady conditions.

Table 2. Accessibility of DIY Region

Road Condition	Road Length		Road Condition	Road Length	
	Km	%		Km	%
Great	554,53	72,92	Good	333,205	43,82
			Medium	221,325	29,1
Not Steady	205,92	27,08	Light Damage	140,37	18,46
			Heavy Damage	65,55	8,62
Amount	**760,45**	**100,00**		**760,45**	**100,00**

Based on the table above, it can be seen that the provincial road network is 554.53 Km with good and moderate status, or about (70%) DIY road conditions are in a steady-state and the rest are in unstable condition with Slightly Damaged and Heavy Damaged status of 205.92 Km if unsteady conditions accumulated almost 30%. Furthermore, the economic aspect is measured by transportation services at affordable prices and with high capacity. In meeting the mobility of the people, the DIY Transportation Service has created the Trans Jogja program with Bus Rapid Transit services. The Bus Rapid Transit service has launched an application that can support the economic aspect for sustainability, namely the launch of the Teman Bus application in September 2020 which can be downloaded on the App Store or Play Store. Friends of the bus are the

implementation of the Bus Transit Service (BTS) program, a road-based public transportation development program in urban areas that uses technology with a non-cash system.

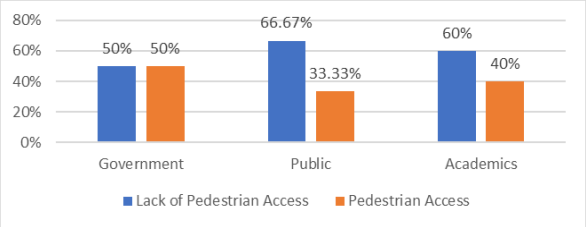
4.1.2. Social Aspect

The social aspect can be realized by doing several things in transportation development including Public Transportation Services for All Levels of Society/Community Equality. Public transportation in D.I.Y is the Trans Jogja Bus. Urban public transportation (bus transportation) is known as Trans Jogja (TJ) and is implemented with the Buy the Service (BTS) system and Regular urban transportation. Transportation Transjogja DIY amounted to 110 transportation while urban transportation amounted to 187 Fleet. The mechanism for assigning or operating the two types of transportation is based on Government Regulation Number 74 of 2014 concerning Road Transportation (Article 110). In 2016 there was a transfer of operations from PT Jogja Tugu Trans to the operation of a BUMD named PT Anindya Mitra Internasional (AMI). Urban transportation with the BUY the Service (Trans Jogja) system amounts to 17 routes/feeders with a total of 11 routes that are actively operating. In addition to Trans Jogja, the urban area of Trans Jogja is served by regular urban transportation, the operation of which is by the Regulation of the Governor of DIY Number 23 of 2014 concerning the Regular Urban Route Network, in which there are 5 (five) routes namely Kopata (59 Armada), Puskopkar (56), Kobutri (27), Aspada (40), Damri(5).

The form of services that can be included in sustainable transportation for the public can be seen from several aspects, namely: in terms of service, Drop Point, and the condition of the Trans Jogja fleet itself. Based on observations, it turns out that in terms of service, some bus stops are not easily accessible by people with disabilities. This can be seen from the condition of the high bus doors so that it is difficult to reach those who are not like the general public. Furthermore, the Drop Point as a place to wait for the arrival of the bus provided by the Transportation Service is not all accessible to people with disabilities. To maximize the efficiency level of the transportation system, the DIY government conceptualized a Transport Demand Management (TDM) strategy. Transport Demand Management is a step chosen by the D.I Yogyakarta government to suppress private vehicles and encourage more effective, healthy, and environmentally friendly modes of transportation as well as improve the economy. Furthermore, there are two types of efforts chosen to improve the efficiency of the transportation system, namely Push and Pull. Push is an effort to make the use of private vehicles less desirable, while Pull is an effort used to make the mode of transportation more attractive and attractive. The next service developed is Park and Ride as a parking facility at the public transport node specifically for Trans Jogja users. Park and Ride is a transportation infrastructure facility, serving to raise/unload vehicle passengers (can be in the form of bus transportation or train transportation) combined with vehicle parking facilities (bicycles, motorbikes, or cars), so that passengers can change modes from private vehicles to private vehicles. public transportation to get to the city center. This policy has been in operation since 2008. In 2008 4 locations have been designated as Park and Ride facilities serving urban public transportation, namely: Prambanan Terminal, Ngabean Parking Park, Dongkelan Terminal, and Gamping Terminal.

4.1.3. Environtmental Aspect

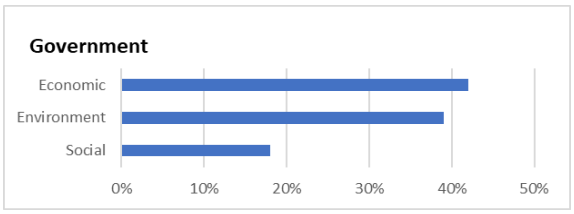
Improving public safety and health as a result of the impact of transportation is one form of sustainable transportation that cares about the future environment. Environmental aspects can be seen from the government's efforts to improve public safety and health. To improve public health and safety, the DIY Transportation Service has created an environmentally sound transportation scheme for Yogyakarta, namely the vehicle technology scheme and fuel. The pollutant contained in the vehicle exhaust gas is Carbon Monoxide (CO), fuels such as hydrocarbons and organic lead are released into the air due to evaporation of the fuel system. Province of D.I. Yogyakarta has established ambient quality standards consisting of primary ambient air quality standards used to protect humans and secondary ambient air quality standards used to protect animals and plants. Some of the activities that have been carried out by the ranks of the DIY Regional Government, assisted by the police, are public transport emission tests (by the DIY Transportation Service and private vehicle emission tests (by the Police), air quality monitoring, and an electric bus trial by the DIY Regional Government. in collaboration with LIPI to produce a bus prototype, which will later be able to replace the Urban Bus (Trans Jogja). Furthermore, the availability of services for pedestrians (pedestrians). To see the implementation of the Pedestrian Path, identification was carried out using a Crosstab Query-Rate (%) content collected through analysis sourced from online media, which talked about the implementation of pedestrian services from the results of interviews and studies that had been carried out.



Source: Crosstab NVivo12

Figure 3. Results of Crosstab Query Analysis of Pedestrian Access.

Based on Figure 3, the results of the crosstab above, according to the Government, pedestrian access in DIY is carried out around 50%, based on community satisfaction as users, the lack of pedestrian access is higher, approaching 65%, while the access that is fulfilled is only about 35%. Meanwhile, from the perspective of academics, from the results of the study, the lack of pedestrian access is higher with a value of about 60%, while only 40% of pedestrian access is fulfilled. Based on the graph above, it can be seen that Pedestrian Access is still lacking in implementation. Furthermore, to see the extent to which the implementation of sustainable transportation is implemented in the DIY area, see the Query-Rate Crosstab below.



Source: Crosstab NVivo12

Figure 4. Crosstab Analysis Results of The Implementation of the DIY Sustainability Aspect

Based on Figure 4 the crosstab results above, it can be seen that over all from the Economic, Environmental and Social Aspects, sustainability in the transportation sector is still weak in its implementation as evidenced by each value that does not reach 50%. Conceptually, the managerial planning of the DIY Government is good, as evidenced by the existence of policies in every aspect of sustainability, but in its implementation, the economic aspect is the most emphasized aspect in sustainable transportation policies, and the social aspect is the most neglected aspect with the implementation of around 18%. Economic aspect, the government focuses more on transportation services. In the environmental aspect, the government is more focused on public health and safety, while in the social aspect, the government is more focused on implementing efficient transportation. So it can be concluded that in sustainable transportation, the DIY government focuses more on the economic aspect, for that the implementation in every aspect has not been balanced. Meanwhile, sustainability demands a balance between Economic, Environmental and Social [5] The concept of sustainable transportation basically does not harm future generations by balancing development in 3 aspects, namely economic, environmental and social.

5. CONCLUSION

The importance of implementing sustainable transportation must be a concern for it requires some emphasis on the sustainability aspect itself. Economic Aspect: Based on the implementation of Sustainable Transportation in DIY, it shows that from the accessibility indicators the condition of the transportation system has not increased accessibility, even though the road conditions are already stable, but productivity and mobility have not increased accessibility. Social Aspect: The condition of the transportation system has not improved transportation safety even though there has been a government program for high-capacity transportation (Trans Jogja) that has not shown an increase in transportation safety, this is also influenced by the institutional capacity that does not support the realization of sustainable transportation, even though there are programs or policies such as (Push and Pull, Park and Ride, Transport Demand Management). Environmental Aspects: Environmental aspects are influenced by transportation activities in this study, although the value of sustainability in environmental aspects is better than social aspects, the weakness that is very influential in the concept of sustainability for future generations is to encourage the improvement of pedestrian facilities (pedestrian paths). Furthermore, the use of electric vehicle technology and the use of environmentally friendly fuels, as well as strengthening or optimizing traditional transportation such as (Andong, Pedicab, Bicycle). Alternatives to prevent congestion and noise can also be done with an economic approach to motorized vehicle users from inside and outside the DIY area.

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