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The Analysis of University Sustainable Transportation Driving Factors

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Abstract

Sustainable transportation is a means of transportation implemented by UGM and UII whose policies are stated in the Strategic Plan of each University. This sustainable transportation is implemented as a form of Green Campus. This study aimed to determine the factors driving the selection of Sustainable Transportation in the UGM and UII areas. This type of research used a quantitative approach. The types of data used in this research were primary data and secondary data. The data collection method in this research used the questionnaire method distributed to 200 respondents consisting of students, lecturers and staff in each university. The data analysis method used was the factor analysis method to find the driving factors for sustainable transportation, namely convenience, health, benefits, costs, weather, security, reliability, travel time, convenience, and routes. The results of this study found 3 factors which drove the sustainable transportation, namelys of efficiency, consisting of reliability, travel time, convenience, and routes, facility factors consisting of safety, benefits, health and comfort, and non-physical factors, consisting of weather and costs.

Keywords: ***Sustainable Transportation, Environment, Green Campus***

Abstrak

Transportasi Berkelanjutan merupakan sarana transportasi yang diterapkan oleh Universitas Gadjah Mada dan Universitas Islam Indonesia yang kebijakannya tertera pada Renstra masing-masing Universitas, Transportasi Berkelanjutan ini diterapkan sebagai wujud dari Green Campus. Penelitian ini bertujuan untuk mengetahui faktpr pendorong pemilihan Transportasi Berkelanjutan di kawasan Universitas Gadjah Mada dan Universitas Islam Indonesia. Jenis Penelitian ini menggunakan pendekatan Kuantitatif. Jenis data yang digunakan dalam penelitan ini adalah data primer dan data sekunder. Metode pengumpulan data dalam penelitian ini adalah dengan metode Kuisioner dan disebarkan ke 200 responden yang terdiri dari mahasiswa, dosen dan tendik di masing-masing unniversitas. Metode analisis data yang digunakan metode analisis faktor untuk menemukan faktor pendorong Transportasi Berkelanjutan yaitu Kenyamanan, Kesehatan, Keuntungan, Biaya, Cuaca, Keamanan, Keandalan, Waktu Tempuh, Kemudahan, dan Rute. Hasil Penelitian ini menunjukan 3 faktor yaitu Faktor Efisiensi yang terdiri dari Keandalan, Waktu Tempuh, Kemudahan, dan Rute. Faktor Fasilitas yang terdiri dari Keamanan, Keuntungan, Kesehatan dan Kenyamanan. Faktor ketiga yaitu Faktor Non Fisik yang terdiri dari Cuaca dan Biaya.

Kata Kunci: Transportasi Berkelanjutan, Lingkungan Hidup, Kampus Hijau

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INTRODUCTION

Transportation becomes the most important requirement for the wider community. In the 21st century, transportation seems contributing to environmental negative effects, such as causing casualties, causing noise, damaging property, and the environment. In a large scale it is called Global Warming. In addition, the risk of global warming in the future is expected to get worse so that the worst effects will be felt by future generations (Zein, 2018).

To determine the environmental quality in Indonesia, the government refers to the Environmental Quality Index (IKLH) which was introduced in 2009. This index is a performance index of national life management. In the IKLH calculation there are 3 indicators, namely river water quality, ambient air quality, and land cover quality.

IKLH has Air Quality Index to see the transportation effects. Motorized vehicle activities that produce carbon emissions can cause air pollution, resulting in a decrease in air quality (Nurmaningsih, 2018). That way will automatically increase air pollution which will have an impact on human health and the environment. The following table of the Air Quality Index in 33 Provinces in Indonesia from 2014-2019 can be seen on table 1 (see appendix 1).

We can see from table 1, the AQI trend in almost 33 provinces from 2014-2019 constantly increased every year. In contrast, several provinces, such as the Riau Islands, Jambi, and DI Yogyakarta tended to decrease, especially in the last 2 years. Several reasons underlaid this decline. First, there was forest wildfire happened in Riau and Riau Islands, affecing Jambi province. Second, the main cause of the decline in IKU in Yogyakarta Province was due to hearvy carbon emissions from motor vehicle fumes (Gloria, 2020).

DI Yogyakarta Province is an area with high mobility and is the 4th busiest province in Indonesia after Jakarta, Bandung, and Malang for its tourism (Kompas.com, 2018). According to the Special Region of Yogyakarta Transportation Agency, the high volume of motorized vehicles occurs due to high migration from outside the region to work there. The growth of vehicles in Special Region of Yogyakarta or DIY will continue to increase every year.

In Yogyakarta City, there found an increase in the number of cars by 4% and motorbikes by 6% due to tourism activity, while DIY native themselves have an average of 120,000 new vehicles each year (Department of Transportation of the Special Region of Yogyakarta, 2019). There are several areas causing the decline in AQI in the Special Region of Yogyakarta, namely Sleman Regency, Depok Subdistrict, and Ngaglik Subdistrict. Sleman contributes to the highest level of congestion. It has 17 subdistricts, covering Depok Subdistrict and Ngaglik Subdistrict which have got densed population.

Depok subdistrict has a strategic location which is in the center of the Sleman Regency government. More than 15 universities are located in Depok and Ngaglik Subdistricts, such as Universitas Gadjah Mada (UGM), Universitas Negeri Yogyakarta (UNY), Universitas Islam Indonesia (UII), and others which annually bring in thousands of students from various parts of Indonesia and increase the volume of motorized vehicles used.

To achieve sustainable Development Goals (TPB/SDGs) Indonesia, the Indonesia government prioritizes the principle of inclusiveness of implementation, namely by involving government and non-government elements, such as universities so that more people are involved. According to the Minister of National Development Planning/Head of Bappenas, the tri dharma of higher education, including education, research, and community service can contribute directly to the effort to achieve the SDGs in Indonesia (Ministry of National Development Planning/Bappenas, 2019).

Green Campus Program is one of the Go Green movements to overcome global warming which is applied to the campus area. According to the Ministry of Environment, it is hoped that the Green Campus will play an active role in helping to solve environmental problems in their respective regions so that they can advance the welfare of the community (A'isah, 2016).

The involvement of higher education institutions helps the government reduce the level of global warming by launching a Green Campus. This Green Campus is implemented in various aspects, namely health, environment, and health and safety aspects. The environmental aspects themselves consist of greening, efficient use of energy, water, waste management, and transportation.

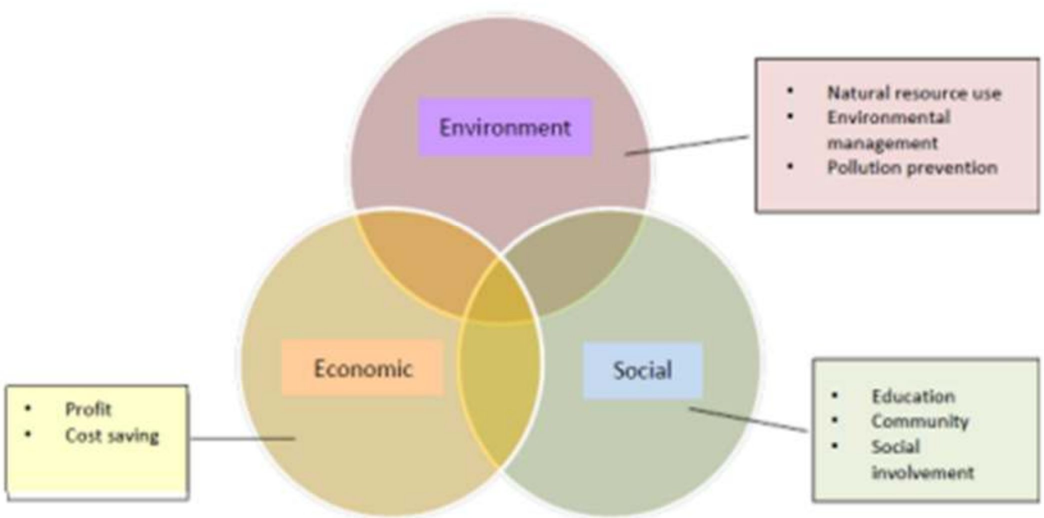

Figure 1. The Diagram Assessment of UI Green Matric
Source : Data Processed, 2020

The successful implementation of the Green Campus program is not only physical achievement but changes in the attitude and mindset of all elements of the higher education academic community towards the environment. With the physical achievements and socio engineering, the Green Campus program will be successful.

The success of the Green Campus program will help reduce Carbon Emissions that can endanger the health and the environment (Quways, 2015). The indicators for the creation of a Green Campus include policies from campus management that are oriented towards environmental management, saving water, reducing air pollution levels, reducing the level of paper and electricity use, greening green open spaces (RTH), maintaining cleanliness and environmental comfort, creating pollution-free campus (Prihanto, 2014).

Universities that implement Green Campus have standardization as the designation of the Green Campus label. One of the initiation programs is UI GreenMetric. UI GreenMetric was founded in 2010 and to date. 719 universities have joined UI GreenMetric by following the parameters on the figure 1.

Table 2. The Top 10 Rank of Green Campus According to UI Green Metric 2019

Rank	University	Skor
1.	Universitas Indonesia	8025
2.	Institut Pertanian Bogor	7775
3.	Universitas Gadjah Mada	7625
4.	Universitas Diponegoro	7600
5.	Institut Teknologi Sepuluh November	7550
6.	Universitas Negeri Semarang	7400
7.	Universitas Sebelas Maret	7050
8.	Universitas Islam Indonesia	6925
9.	Universitas Telkom	6550
10.	Universitas Padjajaran	6475

Source : UI Green Metric

As seen from the diagram on figure 1, there are 3 aspects of the program, namely environmental aspect, economic aspect, and social aspect. Environmental aspect is developed into Natural Resources, environmental management, and pollution prevention. Social aspect consists of the development of education, community, and community service.

Economic aspect covers profit and the level of fees of Yogyakarta universities that are included in the UI Green Metric, namely UGM and UII. Universities that have become Green Campus titles, including UGM and UII will automatically try to implement Sustainable Transportation by the Strategic Plan of each University. Those two campuses are also named as the top 10 greenest campuses in Indonesia.

Table 2 shown the rankings of the top 10 greenest campuses according to the UI Green Metric in 2019. Based on table 2, DIY has two campuses ranked in the top 10 greenest campus by UI Green Metric, namely UGM and UII. Apart from that, UGM also got the 47th place in world rank. Table 3 shown the points obtained by UGM based on UI Green Metric.

From table 3, it can be seen that UGM got quite low points on indicators of energy and climate change, water use, and transportation. That way made UGM focus on developing water harvesting, increasing the amount of water infiltration, developing internal transportation (shuttle service), using solar panels, and building an energy audit system. In the table 3 we can see the total points on transportation from 1275 to 1150 in 2019 with a percentage of 70.83.

From table 4 transportation points have increased from year to year in the last 5 years. This showed very good for the implementation of green campus at the UII. However, the results of the points above do not guarantee that the reality. The existing sustainable transportation system at UII remains not good indicated by motorbikes passing through the campus area.

Regarding UI green metric, UGM has launched a campus bicycle program. Finally, in

2013, the computerized system began to be applied to campus bicycle lending, but there was another problem, namely the negative response from students to the computerized system. Returning a bicycle that must be at the initial location was quite inconvenient for students. Besides, the computerized system also did not guarantee the safety of the campus bicycle itself.

Table 3. UI Green Metric Ranking of UGM

Year	Setting & insfrastructure	Energy & Climate Change	Waste	Water	Transportation	Education	Total Score
2018	825	1075	1425	725	1275	1525	6850
2019	900	1300	1500	1000	1150	1625	7625

Source : UI Green Metric

In 2020, campus bicycle program was still implemented by UGM. There was a problem with campus bicycle lending, but this could be fixed by the application "gamaRC" and support from the UGM engineering faculty in form of electrical mass transportation. This transportation is for the campus area only to create green transportation. This electric car transportation was supposed to be inaugurated in early 2020, but due to the Covid19 pandemic, the launch of electric cars was delayed.

Table 4. UI Green Metric Ranking of UII

Year	Setting & infrastructure	Energy & Climate Change	Waste	Water	Transportation	Education	Total Score
2015	682	1050	1200	595	826	545	4898
2016	1031	1070	1200	365	955	491	5112
2017	682	1408	1203	320	1012	546	5171
2018	1200	1350	1200	550	1050	1200	6550
2019	650	1400	1050	800	1275	1750	6295

Source : UI Green Metric

UII ideas to develop Green Transportation emerged initially in 1995-2010 by planning public transportation mode in form of river bus and on-campus transportation (Badar, 2016). Then, UII made the UII Master Plan for 2013-2035, namely by planning to build campus vehicles integrated into public transportation. In addition, this campus has provided bus stops to reduce the use of private vehicles.

The solution to reducing private vehicles in UII campus area can be carried out through a push strategy with restrictions on parking space, relocating the parking lot to be far from the faculty building, building paths that rotate the campus for private vehicles. Initially, campus bikes were already running on the UII campus, but the attraction of students to use campus bicycles was very lacking so that many bicycles were neglected.

We can see that the two campuses, UGM and UII, have run the Green Campus well. The facilities to support the success of the Green Campus have also been well considered. These two campuses also rank quite well in the UI Green Matric and the points obtained from several categories were also high. However, several things need to be improved from these two campuses, namely the transportation system. Both campuses already have very good strategies for developing green transportation, but these were not in line with the facilities and willingness of the campus residents to reduce the use of motorized vehicles.

RESEARCH METHODS

This research useed a quantitative type approach. Data collection techniques in this study used primary and secondary data. The primary data were obtained through distributing questionnaire to collec data on the demographic profile of respondents, transportation used by respondents in the campus environment, factors that encourage the choice of transportation to respondents, and respondents' opinions on sustainable transportation improvement.

The respondents in this study were students, staff, and lecturers from UGM and UII. Meanwhile, the secondary data in this study were the rankings of the green campus of UGM and UII which were obtained from the UI Green Metric web, the number of AQI obtained from the Environmental Service website, the number of lecturers, and students obtained from the websites of UGM and UII.

The method of analysis used in this research was factor analysis. Factor analysis is a technique for analyzing the interdependence of several variables from the relationship between several variables under study into fewer factors than the variables studied (Suliyanto, 2005).

This study used Confirmatory Factor Analysis (CFA) covering the following tests such as Kaiser Meyer Olkin of Sampling (KMO) Test, Barlett Test Spericity, MSA (Measure of Sampling), and etc. Kaiser Meyer Olkin of Sampling (KMO) test is an index of the comparison of the distance between the correlation coefficient and the partial correlation coefficient. If the sum of the squares of the partial correlation coefficient is small compared to the sum of squares of the correlation coefficient, the KMO value is close to 1.

The Barlett Test of Sphericity is a statistical test used to test the hypothesis of uncorrelated variables in a population with the population correlation matrix is an identity matrix. Each variable that is perfectly correlated with ($r = 1$) but if not at all correlated with the others ($r = 0$). The KMO and Barlett Test have several things, namely, the KMO number must be above 0.5 and the significance must be below 0.05.

The Measure of Sampling (MSA) test is the used to measure homogeneity between existing variables and perform re-filtering between variables so that only the variables that meet the requirements can be further processed. Its number must be at 0-1. With the criteria MSA = 1, the variable can be predicted that there is no error by other variables.

Principal Component factor analysis is to simplify the observed variables by reducing their dimensions. It is done by eliminating the correlation between the independent variables through the transformation of the independent variables into new variables that are not correlated at all.

Criteria for Determining the Number of Factors is a factors that have more than one eigenvalues will be retained and factors that have eigenvalues less than 1 are not better than the original variable. The last eigenvalues greater than or equal to 1 are chosen as the extraction stop point. Meanwhile, scree plot is a graph that shows the relationship between the factors and their eigenvalues.

Rotation Factor is the rotation process that aims to simplify factors and improve interpretation ability. There are two methods for factor rotation in factor analysis, namely the orthogonal method and the oblique rotation method. Interpretation of Factor Analysis Results is a test that was done by judging from the value of the loading factor obtained from each variable by comparing the loading factor and also the variables in the formed factors.

Significant Determination Criteria Factor Loading is explained by SOLOanalysis in BMDP statistical software using the level of significance ($\alpha = 0.05$) set in the rules as the identification of significant factor loading based on sample size. Naming Factor test were done by looking at an underlying and sufficiently representative of the nature of the initial variables collected on one factor. The step used is to apply generalizations to these variables.

RESULTS AND DISCUSSION

This study used primary data through distributing questionnaires. There were 27,449 students, lecturers, and students from UGM, and around 28,305 students, lecturers, and students from UII. From this population, 100 respondents were taken from each university consisting of students, lecturers, and staff. Table 5 is the questionnaire distribution data that have been analyzed. This study used primary data by distributing questionnaires to 200 respondents from UGM and UII, including students, lecturers, and staff from.

Table 5. Respondent Data Analysis

Questionnaire Data	Total
Distributed questionnaires	205
Not submitted	2
Incomplete questionnaire	-
Lost	-
The questionnaire can be processed	203

Source : Data Processed, 2020

The respondent data on the transportation use profiles and events were also analyzed. The followings are the profile data on the use of transportation and events obtained by distributing questionnaires to 200 respondents, each consisting of students, lecturers, and staff of UGM and UII which can be seen on the table 7 (see appendix 2). This planning is contained in the Master Development Plan which adjusted to the UGM Strategic Plan for the period 2002-2007, 2008-2012, and 2017-2022 period.

These plan aim to create a campus that is conducive to the learning process in the context of developing interdisciplinary synergies that are responsive to ecological issues. At UII itself, the policy of using motorbikes is still allowed to enter the University, but this campus has provided a parking lot to minimize traffic density on campus. The parking management itself uses a ticketing gate system.

The results of the research above are also not by the Vision of Sustainable Transportation according to The Center for Sustainable Transportation as follows : 1. Focus on access that means sustainable transportation 2. Non-motorized transportation, 3. Motorized transportation in form of public transportation due to its spatial planning and regional design to support the reduction of the use of private vehicles which will incur greater costs.

The results of this study were that the use of motorbikes was still very much in demand by all members of the academy (students, lecturers, and students) so the vision of The Center for Sustainable Transportation has not been implemented properly on both campuses. It is necessary to review the policy and its implementation.

Table 6. The Results of the Demographic Profile of Respondents

No	Variabel	UGM	%	UII	%
1.	Gender :				
	Male	50	25	51	25.5
	Female	51	25.5	52	26
2.	Age Group :				
	18-30	91	45.5	92	46
	31-45	5	2.5	9	4.5
	4660	3	1.5	2	1
	61 +	1	0.5	-	0
3.	Marital status :				
	Unmarried	90	45	93	46.5
	Married	12	6	11	5.5
4.	College Student				
	Lecture	84	42	93	46.5
	Education	10	5	5	2.5
	Staff	6	3	2	1
5.	Residence :				
	Boarding house around campus	78	39	60	30
	Homes around campus	3	1.5	4	2
	Home not around campus	36	18	25	12.5

Source : Data Processed, 2020

Validity test is used to measure whether a questionnaire result is valid or not. A questionnaire is said to be valid if the questions on the questionnaire can reveal something that will be measured by the questionnaire (Ghozali, 2002: 49). The following are the results of the calculation of the Validity Test :

Table 8. The Reliability Test Results of the Questionnaire on the Driving Factors of Sustainable Transportation at UGM and UII

Indicator	Correlattion	Rtable 5% (200)	Explana tion
Convenience	0.500	0.116	Valid
Health	0.642	0.116	Valid
Advantage	0.654	0.116	Valid
Cost	0.536	0.116	Valid
Weather	0.629	0.116	Valid
Security	0.649	0.116	Valid
Reliability	0.618	0.116	Valid
Time	0.564	0.116	Valid
Convenience	0.639	0.116	Valid

Source : Data Processed, 2020

The reliability itself is a tool for measuring a questionnaire which is an indicator of a variable or constructs. In other words, a questionnaire is said to be reliable or reliable if a person's answer to a question is consistent or stable over time (Ghazali, 2002: 45). Reliability can be measured by the Cronbach Alpha (α) statistical test with the limitation of a variable said to be realistic if the Cronbach Alpha value> r table.

The KMO and Barlett test values in table 10 showed 0.782 with a significant value of 0.000. Since the KMO number was above 0.5 and the significance number on Barlett's Test of Sphericity was below 0.05, then the existing variables could be further analyzed using factor analysis.

Table 9. The Results of the Questionnaire Validation Test on the Driving Factors of Sustainable Transportation at UGM and UII

Indicator	Correlattion	Rtabel 5% (200)	Explana tion
Convenience	0.793	0.116	Valid
Health	0.776	0.116	Valid
Advantage	0.780	0.116	Valid
Cost	0.797	0.116	Valid
Weather	0.781	0.116	Valid
Security	0.775	0.116	Valid
Reliability	0.780	0.116	Valid
Time	0.786	0.116	Valid
Convenience	0.779	0.116	Valid
Route	0.787	0.116	Valid

Source : Data Processed, 2020

Based on the table 11, all variables gained the MSA results above 0.5 in which according to the criteria must be> 0.5. It could conclude that all of the variables could be analyzed further.

Table 10. KMO dan Barlette's Test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.782
Bartlett's Test of Sphericity	Approx. Chi-Square	715.315
	Df	45
	Sig.	.000

Source : Data Processed, 2020

From Table 12 Communality, it can be seen that the ten (10) variables had communal values above 0.5, meaning that all of these variables could be tested using further factor analysis. Furthermore, based on the table above, the value of the comfort variable was 0.657, indicating that 60.5% of the variation in the amount of the comfort variable could be explained by the formed factors. In addition, the greater the value of commonalities in a variable, the closer the relationship between the variables is.

Table 11. MSA (Measure of Sampling Adequacy)

No	Variable	MSA
1.	Convenience	0.802
2.	Health	0.752
3.	Advantage	0.822
4.	Cost	0.743
5.	Weather	0.757
6.	Security	0.785
7.	Reliability	0.879
8.	Time	0.810
9.	Convenience	0.740
10.	Route	0.755

Source : Data Processed, 2020

As explained earlier, the determination of which factors are formed is seen from the eigenvalues that must be above one (1). If there is a value that is below one (1), then there is no factor formed. From the table 13 we know that there were 3 factors formed. However, for 7 factors with an eigenvalues number below 1, namely 0.668, the factoring process stopped at only 3 factors. In this process, there were only three of ten 10 variables put into specific factors.

The number of factors in this analysis was determined by the value of the cumulative proportion. If the value of the cumulative proportion ranges from 60% -70%, the component can be selected as the main component or the main factor. Based on the above provisions, 3 components obtained cumulative proportion in the range of 60% -70%. Thus, the ten main components were the best summary of information from several items analyzed. Moreover, the table above explained that the formation of ten factors after simplification of some of the original items.

Table 12. Communality Analysis

Communalities		
	Initial	Extraction
Convenience	1.000	.657
Health	1.000	.765
Advantage	1.000	.572
Cost	1.000	.717
Weather	1.000	.687
Security	1.000	.668
Reliability	1.000	.556
Time	1.000	.647
Convenience	1.000	.778
Route	1.000	.677

Source : Data Processed, 2020

The Eigenvalues Component 1 value was 3,703 or> 1, then it became a factor 1 and could explain 37,033% of the variation, the Eigenvalues Component 2 value was 1,949 or> 1, then it became a factor of 2 and could explain 19,485% of the variation, the Eigenvalues Component 3 value was 1,072 or> 1, then it became a factor of 3 and was able to explain 10.725% of the variation. The Scree Plot on figure 2 can show the number of factors formed by looking at the Component point which has an Eigenvalue > 1.

This component matrix shows the correlation value between each variable and the factors that are formed, from the table above the variable correlation value, namely : The correlation value of the comfort variable with factor 1 : 0.492, correlation with factor 2: 0.494 and correlation with factor 3 : -0.413. The correlation value of health variables with factor 1 : 0.624, correlation with factor 2 : 0.607, correlation with factor 3 : -0.080.

The correlation value of the profit variable with factor 1 : 0.615, correlation with factor 2 : 0.437, correlation with factor 3 : 0.043 The correlation value of the cost variable with factor 1 : 0.488, the correlation with factor 2 : -0.162, and the correlation with factor 3 : 0.673. Weather correlation value with factor 1 : 0.600, correlation with factor 2 : 0.073, and correlation with factor 3 : 0.567. Safety correlation value with factor 1 : 0.642, correlation with factor 2 : 0.506, and correlation with factor 3 : -0.015.

Reliability correlation value with factor 1 : 0.654, correlation with factor 2 : -0.339, and correlation with factor 3 : -0.116. Travel time correlation value with factor 1: 0.620, correlation with factor 2: -0.498, correlation with factor 3 : -0.124. Ease of correlation value with factor 1 : 0.707, correlation with factor 2: -0.471, correlation with factor 3 : -0.23 Route correlation value with factor 1: 0.609, correlation with factor 2 : -0.521, correlation with factor 3 : 0.184. Further, the followings table 15 are the results of Rotated Component Matrix

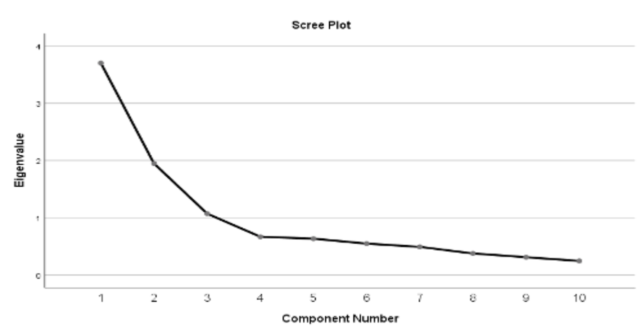

Figure 2. Scree Plot Diagram
Source : Data Processed, 2020

Table 13. Total Variance Explained Test

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.703	37.033	37.033	3.703	37.033	37.033	2.650	26.496	26.496
2	1.949	19.485	56.519	1.949	19.485	56.519	2.577	25.765	52.261
3	1.072	10.725	67.243	1.072	10.725	67.243	1.498	14.982	67.243
4	.668	6.682	73.926						
5	.635	6.346	80.271						
6	.548	5.482	85.753						
7	.491	4.913	90.666						
8	.377	3.767	94.432						
9	.311	3.111	97.544						
10	.246	2.456	100.000						

Extraction Method : Principal Component Analysis

Source : Data Processed, 2020

Factor 1 consists of: Reliability, Travel Time, Convenience, and Route. Factor 2 consists of: Comfort, Health, Benefits, and Safety. Factor 3 consists of : Weather and Cost.

Table 14. Component Matrix Analysis

	Component Matrix		
	1	2	3
Convenience	.492	.494	-.413
Health	.624	.607	-.080
Advantage	.615	.437	.043
Cost	.488	-.162	.673
Weather	.600	.073	.567
Security	.642	.506	-.015
Reliability	.654	-.339	-.116
Time	.620	-.498	-.124
Convenience	.707	-.471	-.237
Route	.609	-.521	-.184

Extraction Method : Principal Component Analysis.

a. 3 components extracted.

Source : Data Processed, 2020

The table 16 shows that the Component Transformation Matrix in which the component 1 correlation value was 0.673> 0.5, component 2 correlation value was 0.747> 0.5 and component 3 correlation value was 0.915> 0.5. Hence, the three factors formed were feasible to summarize the ten variables analyzed.

Table 15. Rotated Component Matrix

	Rotated Component Matrix		
	1	2	3
Convenience	.138	.773	-.202
Health	.044	.860	.151
Advantage	.110	.699	.267
Cost	.215	.023	.819
Weather	.169	.293	.756
Security	.102	.780	.222
Reliability	.703	.180	.172
Time	.788	.042	.158
Convenience	.866	.143	.087
Route	.816	.032	.099

Source : Data Processed, 2020

Factor 1 : factor 1 consisted of the variable reliability, travel time, convenience, and route, so factor 1 will be named the Efficiency Factor.

Factor 2 : Factor 2 consisted of the variables of safety, profit, health and comfort, so factor 2 will be named Facility Factor. Factor 3 : Factor 3 consisted of weather and cost variables, so factor 2 is named Non-Physical Factor.

Table 16. Component Transformation Matrix/ Naming Factors

Component Transformation Matrix			
	1	2	3
1	.673	.621	.401
2	-.663	.747	-.044
3	-.327	-.236	.915

Extraction Method: Principal Component Analysis
Rotation Method: Varimax with Kaiser Normalization
Source : Data Processed, 2020

Factor 1 consisted of reliability, travel time, convenience, and route. This factor was called the Efficiency Factor with a correlation number of 0.673. The main purpose of providing transportation was to provide efficiency (convenience) for each user. Transportation policy must look at the factor of mobility (ease of movement) which aimed to increase the number of vehicles at a higher speed.

The results of this study are in line with the results of research conducted by Maria (2015) which states that green transportation is very good if the variable sustainable transportation has been successful. Surely the success is realized by meeting the indicators of sustainable transportation, namely travel time, accessibility, efficiency, safety, ease of disability, maintenance of local culture, and environmental indicators related to reducing air pollution. The analysis above results showed that if UGM and UII improve their efficiency factors, the success of sustainable transportation will be achieved. The results of this study support the research conducted by Litman (2016) who found that the results of sustainable transportation indicators can be found through: the planning process, namely the quality of analysis used in planning decisions, choices and incentives, namely by selecting transportation which is efficient

In the same way, the results of this study are also in accordance with the statement of the Center for Sustainable Development (2000) where a sustainable transportation system is a system that provides access to needs for individuals or communities safely and remains consistent with human health and ecosystems or the environment, with current and future social justice.

The second factor formed covered security, benefits, health and comfort. This second factor was called the Facility Factor because of the several factors formed drove the provision of Sustainable Transportation facilities. This second factor was called the Facility Factor with a correlation number of 0.747. Transportation has a major impact on health and safety. The results of this study are in association with the research conducted by Prihanto (2014).

From his research, the internal transportation system at the University runs properly, but there are facilities and infrastructure that are still not optimal because of the lack of comfort and health of the internal transportation. Teguh Prihanto's research is in line with the results of this study, namely that the comfort and health of sustainable transportation greatly influence the driving factors for the selection of sustainable transportation.

Motorized vehicles contribute 70% of air pollution and 60% accidents. Therefore, a safer trip can be done using public transportation, on foot and using a bicycle. The results of this study are also in line with the research conducted by Amrina (2019) that structuring and infrastructure are the criteria for a sustainable campus that are mostly chosen.

Proposed improvements to improve transportation criteria that improve campus transportation facilities and infrastructure are needed, such as improving facilities in the form of improving sidewalks for walking to comfort users, increasing bus schedules and developing environmentally-friendly transportation to be good for health and surrounding environment.

The results of this study are also supported by a research conducted by Brotodewo (2010) that sustainable transportation is expected to minimize accidents and can also improve social justice and improve health, which means that sustainable transportation will support creating a healthy social environment.

The results of this study are also in line with the Sustainable Transportation Indicators which include travel safety for drivers and passengers, the effect of transportation on the surrounding environment, the convenience of using transportation modes, emissions from toxic substances and hazardous chemicals and air pollution due to transportation modes in the world of sustainable transportation that consider health aspects.

The third factor consisted of weather and cost called as non-physical factor. The correlation number on this factor was 0.915. A sustainable transport policy should be a cheap project and limit the development of expensive modes of transportation such as private cars.

By limiting private vehicles and motorized vehicles and inhibiting their growth, one can avoid building expensive road networks and parking lots. Therefore, it is necessary to promote the use of public transport, pedestrians and bicycles.

This factor was the most dominant because in student areas such as campus, economic factors need to be taken into account because if the transportation costs are cheap in terms of fuel and cheap, it will be more profitable for the academic community to use sustainable transportation, especially for students.

The results of this study are supported by research results from Brotodewo (2010) where Sustainable Transportation prioritizes economic aspects, namely ensuring transportation financing, such as creating productive transportation costs. The results of this study are also in line with the results of research conducted by Nugraha (2020). In his research, the results show that the measurement of sustainable transportation in the city of Yogyakarta uses 3 aspects from Brotodewo (2010), namely economic, social and environmental aspects. Where in this study, 7 indicators of the success of sustainable transportation were found, including from an economic aspect, the availability of sustainable transportation at low cost.

The results of the research by Andika Alam Nugraha are certainly in harmony with the results of this study where costs are a driving factor in the selection of sustainable transportation, and costs are included in non-physical factors of sustainable transportation.

CONCLUSION

Based on the results and discussion of the research, it can be concluded that according to calculations from this study using Factor Analysis, there are 3 driving factors for sustainable transportation, namely the first factor which consists of the variables of reliability, travel time, convenience, and routes. Hence, the name Efficiency Factor of the Component The Transformation Matrix was 0.673, the second factor formed consists of the variables of safety, profit, health and comfort.

It is named the Facility Factor, the Failure Factor, with the Component Transformation Matrix is 0.747. The third factor formed consists of variables Weather and cost variables named Non-Physical Factors. This Non-Physical Factor is the final result of the Component Transformation which is 0.915. Among the Efficiency Factors, Facility Factors and Non-Physical Factors, the third factor or Non-Physical Factors get the most Component Transformation results, namely 0.915, meaning that the Non-Physical Factors have the most influence on the driving factors for Sustainable Transportation at UGM and UII.

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APPENDIX

Appendix 1. Air Quality Index (AQI) of 33 Provinces in Indonesia 2014-2019

No	Province	2014	2015	2016	2017	2018	2019
		IKU	IKU	IKU	IKU	IKU	IKU
1.	West Papua	91.03	91.03	93.40	90.41	92.64	92.64
2.	East Kalimantan	83.96	96.20	80.20	88.87	83.36	90.31
3.	Papua	84.24	84.24	89.60	90.01	89.89	92.56
4.	Bengkulu	86.48	92.51	85.40	92.55	91.63	92.69
5.	Central Sulawesi	85.99	89.12	87.90	94.38	89.09	92.98
6.	Maluku	91.81	82.33	87.30	85.64	84.99	88.72
7.	North Maluku	96.94	96.94	86.20	96.00	90.77	92.38
8.	West Kalimantan	84.57	91.75	81.50	89.12	88.68	90.07
9.	South East Sulawesi	92.56	83.61	83.50	91.04	89.85	90.01
10.	Aceh	91.20	89.44	86.30	89.84	88.33	91.08
11	Central Kalimantan	92.69	89.87	83.80	92.25	87.07	88.03
12.	Bali	86.61	92.35	88.30	91.40	88.97	89.85
13.	Riau Islands	95.53	86.61	78.60	95.47	90.83	90.59
14.	Bangka Belitung	90.39	95.61	80.40	94.97	89.09	91.94
15.	Gorontalo	96.30	96.20	88.30	94.79	92.17	86.88
16.	North Sumatera	87.23	88.15	79.20	87.32	85.72	86.56
17.	South Sumatera	89.25	79.64	81.60	88.88	85.32	87.13
18.	West Sulawesi	92.23	89.21	86.40	91.45	89.26	89.97
19.	South Sulawesi	90.43	76.80	85.80	88.66	93.56	89.56
20	North Sulawesi	88.55	92.72	86.70	95.32	91.07	92.41
21	East Nusa Tenggara	77.13	77.13	82.70	91.18	86.83	88.18
22	West Jawa	59.24	74.63	78.60	77.85	72.80	74.93
23	Lampung	85.98	82.26	77.50	85.02	82.98	86.03
24.	East Jawa	73.20	89.21	83.20	85.49	81.80	83.06
25.	Jambi	91.26	82.93	88.10	64.98	88.04	87.17
26.	Central Jawa	82.64	81.32	77.30	83.91	82.97	84.81
27	West Sumatera	89.16	88.48	82.90	83.87	88.37	89.40
28.	West Nusa Tenggara	92.83	92.27	81.20	88.02	87.17	87.40
29	South Kalimantan	88.35	87.60	85.60	89.02	87.75	88.78
30.	Banten	53.15	50.65	58.80	76.36	71.63	74.98
31	Riau	60.30	60.30	71.40	90.90	89.25	84.19
32	Special Region of Yogyakarta	82.01	90.58	87.50	88.08	84.25	84.19
33	DKI Jakarta	46.28	78.78	56.40	53.50	66.57	67.97

Source : Ministry of Environment and Forestry 2019

Appendix 2. Transportation and Event Equipment Use Profiles

No	Variable	Vehicle data	UGM	%	UII	%
1.	Travel from one faculty to another	On foot	30	15	38	19
		Cycling	12	6	4	2
		Bus capable	-	0	-	0
		Motorcycle	72	36	80	40
		Pickup car	13	6.5	9	4.5
		Other	-	0	2	1
		Online motorcycle taxi	4	2	3	1.5
2.	Trip to university	On foot	15	7.5	17	8.5
		Bus capable	2	1	3	1.5
		Taxi	2	1	1	0.5
		Cycling	2	1	-	0
		Car	10	5	5	2.5
		Motorcycle	69	34.5	77	38.5
3.	Travel during free time	On foot	11	5.5	21	10.5
		Train	2	1	-	0
		Bus capable	-	0	3	1.5
		Taxi	3	1.5	2	1
		Cycling	10	5	3	1.5
		Car	4	2	5	2.5
		Motorcycle	73	36.5	65	32.5
4.	In an event	On foot	1	0.5	2	1
		Train	1	0.5	3	1.5
		Bus capable	3	1.5	2	1
		Taxi	5	2.5	3	1.5
		Car	27	13.5	30	15
		Motorcycle	69	34.5	54	27
5.	Faculty program	On foot	10	5	8	4
		Train	1	0.5	1	0.5
		Bus capable	13	6.5	9	4.5
		Taxi	1	0.5	3	1.5
		Cycling	4	2	1	0.5
		Car	6	3	15	7.5
		Motorcycle	63	31.5	67	33.5

Appendix 2. Transportation and Event Equipment Use Profiles

6.	Work	On foot	4	2	2	1
		Train	-	0	1	0.5
		Bus capable	3	1.5	5	2.5
		Taxi	1	0.5	3	1.5
		Cycling	2	1	-	0
		Car	8	4	8	4
		Motorcycle	75	37.5	73	36.5
7.	Other	On foot	4	2	7	3.5
		Train	1	0.5	3	1.5
		Bus capable	2	1	6	3
		Taxi	1	0.5	2	1
		Cycling	5	2.5	2	1
		Car	7	3.5	5	2.5
		Motorcycle	50	25	66	33

Source : Data Processeed, 2020