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Optimization Of Mass Public Transportation System Based On Demand And Supply

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Abstract

This research is motivated by the occurrence of inefficiency of the transportation system in the urban area of Sarbagita (Denpasar, Badung, Gianyar, Tabanan) caused by the use of private motorized vehicles. As a limited number of public goods, the efficiency of road space is measured not by the number of vehicles but by the number of people who use the road space. Therefore, the operation of a Mass Public Transportation System (SAUM) which has a large transport capacity optimally is the key to the efficiency of the transportation system in urban areas.This study aims to analyze the variables that affect the optimization of the Mass Public Transport System (SAUM) based on demand and service supply. This research was conducted using quantitative methods. The research location is in the urban area of Sarbagita, an agglomeration area in Bali. The research was conducted in October 2021, during the Covid-19 pandemic. The total population in this study was 14,140 with a sample of 397 passengers on 4 (four) Trans Metro Dewata service routes. Sampling using proportional stratified random sampling. The data used is in the form of a scale of differences in the meaning of attitudes towards an object which is sorted from the number (1) not important; (2) less important; (3) quite important; (4) important; (5) is very important. This research uses multivariate analysis technique with partial least square (PLS) method. The variables used in this research are Service Demand and Service Supply as exogenous variables, Service Certainty and Service Integration variables as intermediate variables and Service Optimization variables as endogenous variables.The results show that the service demand variable has no significant effect on the optimization of SAUM, while the supply, certainty and service integration variables have a positive and significant effect on the optimization of SAUM. The request has no significant effect on the integration of SAUM services. On the other hand, service supply and certainty have a positive and significant impact on the integration of SAUM services. This study also finds that the optimization of SAUM services is most influenced by service integration with a coefficient of 0.403, followed by service offerings with a coefficient of 0.374. Indirectly, the supply and demand variables have a positive and significant effect both on the variable between service integration through service certainty and on the endogenous variable of SAUM optimization through service assurance and service integration variables. The novelty of this research is that the service demand variable which has been used as a direct variable in the provision of transportation services does not have a significant effect on the optimization of SAUM. This research answers the phenomenon of the low loading rate of Trans Metro Dewata services, even though the service is free.This study suggests to the government as an institution providing public services that in an effort to realize the efficiency of the transportation system in urban areas, it is necessary to optimize SAUM services. The

SAUM optimization efforts are not only based on demand and service supply but also involve variables between service certainty which include indicators of accessibility, service level and service availability and service integration variables which include indicators of physical integration, network integration and tariff integration. The results of this study are expected to enrich the theoretical repertoire in the field of transportation economics and transportation management science which is currently developing.

Keywords: Public Transport, demand, service supply

Introduction

Transportation is an important part of economic activity that has a big role in the development and welfare of the community. In urban areas, mobility is one of the fundamental parts and is the main characteristic of economic activity. Urban transportation according to Dikun (2003) is an integral part of the city's economic life, so it cannot escape the conflicts that occur within the city itself. The important role of the transportation sector for urban economic activities requires the existence of an effective and efficient urban transportation system.

As a system that arises from the derived demand for various socio-economic activities of the community (Morlok, 1991), the transportation system is required to be able to accommodate any travel requests that occur. In essence, urban transportation problems occur because of the concentration of people, vehicles and other economic activities in relatively narrow road spaces at the same time. Problems arise when existing transportation facilities are faced with capacity constraints and the city is faced with limited land in the construction of new transportation facilities/infrastructure. The resultant of all of this is that the city becomes a place where the movement of vehicles, people and goods becomes increasingly difficult and expensive which in turn leads to energy wastage and environmental degradation. Social cost will be the dominant part of urban travel disutility. The powerlessness in providing a reliable and efficient transportation system can make transportation in urban areas no longer an "economic asset" but will instead develop into an "economic liability" (Munawar, 2007).

Awareness in the important role of mass public transport has prompted the government to develop a Mass Public Transport System (SAUM) in urban areas in Indonesia, both road-based and rail-based. The current development of the Mass Public Transportation System is even the government's obligation as mandated in Article 158 paragraph (1) of Law No. 22 of 2009 concerning Road Traffic and Transportation (LLAJ):

“The government guarantees the availability of road-based mass transportation to meet the transportation needs of people using public motorized vehicles in urban areas”.

Furthermore, to ensure the optimal implementation of mass public transportation services, the government through the Regulation of the Minister of Transportation Number PM. 10 of 2012 concerning Minimum Service Standards for Road-Based Mass Transportation and Regulation of the Minister of Transportation of the Republic of Indonesia number PM. 27 of 2015 concerning Changes to Minimum Service Standards for Mass Transportation, Regulation of the Minister of Transportation of the Republic of Indonesia number PM. 10 of 2012 concerning Minimum Service Standards for Road- Based Mass Transportation which include aspects of affordability and regularity of mass transportation services.

The purpose and benefit of the application of SAUM is to reduce the use of private vehicles by diverting the movement of people to use mass public transportation by providing comfort, security, safety and convenience for the public using public transportation.

In Bali Province, the development of SAUM, especially in the urban areas of Denpasar, Badung, Gianyar and Tabanan or better known as the acronym Sarbagita, has been stated in the Decree of the Governor of Bali Number 1186/03-F/HK/2010 dated November 11, 2010 concerning the Establishment of a Transport Route Network. General Trans Sarbagita. However, since it was first introduced in 2011, there is still a gap between the realization and the planned service delivery. From the service demand aspect, the load factor indicator shows that the average new passenger reaches 25.93 percent of the bus capacity, which consists of the load factor of Trans Sarbagita 29.76 percent and Trans Metro Dewata 22.1 percent. From the aspect of service offerings, the realization of the new corridor reached 13 percent of the plan (6 corridors of 17 corridors) and the realization of operating buses only reached 23 percent of the plan (120 buses out of 196 buses). The existence of this gap indicates that the Mass Public Transport System (SAUM) in the urban area of Sarbagita is currently not being implemented optimally.

From the description above, it is indicated that: first, the Mass Public Transportation System (SAUM) service in the Sarbagita area is currently not being implemented optimally; second, it is necessary to understand the aspects of demand and supply of services in the implementation of Mass Public Transportation System services; third, it is necessary to mediate service certainty and service integration to make mass public transportation system services can be implemented optimally; and fourth, Mass Public Transportation System services that have not been implemented optimally have resulted in the economic inefficiency of urban transportation in the Sarbagita area. The four indications are generated from a theoretical review of the direct and mediating variables that affect the optimization of mass public transport services in urban areas and are compared with empirical studies on the performance of urban mass public transport services in the Sarbagita area which are currently operating.

Theory Overview

Transport Links and Urban Economy

Transportation is an important part of the economy that has an influence on the development and welfare of society. In general, the economic impacts of transportation are categorized into direct and indirect impacts. Direct Impact relates to changes in accessibility where transportation enables markets to occur and saves time and costs. Indirect impact is related to the decrease in commodity or service prices and/or its variations in the form of an increase in the multiplier effect. The multiplier effect is intended as the emergence of new jobs caused by the existence of a new market that occurs due to the new accessibility of transportation (Susantono, 2007).

Transportation System Optimization

The use of several theories related to the optimization of the transportation system in this study is to emphasize the optimization of mass public transportation system services as the main solution to solving the main problems that cause inefficiency in urban transportation, namely traffic congestion and not the construction of new roads. These theories include:

The Downs-Thomson paradox (Downs, 1962; Thomson, 1977; Boni et al., 2021; Abolghasemi et al., 2018)) which states that the equilibrium speed of car traffic on the road is determined by the average speed of the same trip using public transport. According to this theory, increasing road capacity will exacerbate traffic congestion. This occurs when the switch from public transport results in disinvestment from that mode of transportation to the point that the operator reduces the frequency of service or increases the tariff to cover operational costs. This incident made public transportation passengers switch to cars. In the end, the public transport system will be phased out and congestion on the widened roads will be worse than before. The general conclusion is that expanding the road system as a solution to congestion is not only ineffective, but also counterproductive. A similar paradox was proposed by Smeed and Wardrup (Barter, 2000), where the number of cars needed to move a number of people is much greater than the number of buses needed to carry the same number of people. So a replacement from a bus car will allow traffic to move faster. It was also found that if everyone traveled by the “slow” method of transportation, namely the bus, then they could actually travel faster than if they all used the “fast” method of car.

Therefore, Farkas (2007) emphasizes the importance of providing affordable public transportation rather than building new roads in order to increase mobility for low-income people, reduce congestion on roads and improve air quality. This is also in line with the statement of Murray (2001) and Gwilliam (2008) which state that public transportation is an important component in the overall process of managing the urban transportation system which is even considered as an instrument of spatial development policy that can improve and enhance the shape of the city.

Variables Affecting SAUM Service Optimization

Warpani (2002) states that there are two groups of consumers of transportation services, namely captive riders who do not have access to private vehicles and choice riders who are able to have their own vehicle or choose the mode to be used. Theoretically, the demand for transportation services is derived from the need for a person to walk from one location to another to carry out an activity (Morlok, 1991; Sukanti et al., 2021). From the literature review, it is known that there are four variables that influence the choice of transportation mode, namely the characteristics of travelers, the characteristics of the movement, the characteristics of the transportation system and the characteristics of cities and zones (Bruton, 1985; Tamin, 2000). The World Bank as quoted from Abubakar (1993) also includes the service quality variable as one of the variables that influence the choice of public transport users in urban areas.

The supply side of transportation relates to the provision of transportation facilities and infrastructure to meet community needs (demand side). The offer of transportation services can be seen in terms of the equipment used, the available capacity, the technical condition of the transportation equipment used, the production of services that can be provided by the transportation company and the financing system in the operation of the transportation equipment (Morlok, 1991). The factor that affects the optimization level of mass transit services in an area is the availability of services that include the number of buses and the number of corridors, as the conclusion of research by Basuki (2014).

In addition to the service supply and demand variables, there are also other factors that are thought to be mediating variables in optimizing mass public transport services in urban areas. These factors are service certainty and service integration. The service certainty factor refers to the results of the identification of mass public transport service problems that are generally faced by urban areas in Indonesia, namely low accessibility, low service levels and service availability (Directorate General of Land Transportation, 2014). Network integration is also the key to the success of the public transportation service system in a region or city (Neumann and Nagel, 2011). This is because with an integrated public transportation network, the best network route can be determined which is not only based on the demand for community travel needs but also the optimal service coverage mechanism (Murray, 2001; Fernandez et al, 2008; Hadas and Ceder, 2010; Cortes et al. , 2011).

Research Method

This research was conducted using quantitative methods. Data collection was carried out using field survey techniques through direct interviews with users of the Trans Metro Dewata public transportation. Data were collected by cross section using a list of questions which were then analyzed quantitatively. The research location is in the urban area of Sarbagita. The population in this study is the average daily passenger of Trans Metro Dewata users, both those who have private motorized vehicles (choice riders) and those who do not have private vehicles (captive riders). The population in this study is 14,140 passengers, which is the average daily passenger on 4 (four) Trans Metro Dewata mass public transportation routes, calculated from January 2021 to March 2021. The determination of the number of research samples from the population is calculated using the formulation Slovin which produces a total sample of 388 passengers. Furthermore, considering the characteristics of the population associated with this study, the sampling in this study was carried out using proportional stratified random sampling (Proportionate stratified random sampling).

The variables of this study consist of demand and supply variables, optimization of the Road-based Mass Public Transportation System (SAUM) in urban areas (agglomeration) Sarbagita, service certainty and service integration variables. This research uses multivariate analysis technique with partial least square (PLS) method.

Result and Discussion

Inferential analysis of research data was carried out using Structural Equation Modeling (SEM) based on Variance with smartPLS ver 3.0 software for windows. The evaluation of the PLS model is a non-parametric predictive model. Path analysis carried out includes: 1) measurement model (outer model), 2) structural model (inner model), and 3) hypothesis testing. Overall, the full model of service demand, supply, service certainty, and service integration towards the optimization of the Mass Public Transportation System in the Sarbagita Region is presented in Figure 1.

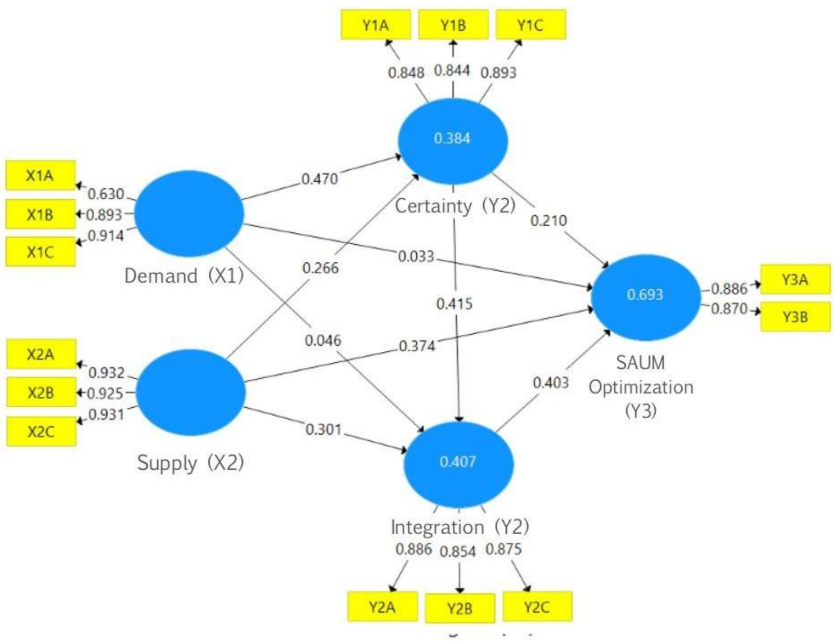

Figure 1

To know the validity of a construct can also be seen from the discriminant validity. Discriminant validity on reflective indicators is by looking at the cross loading indicator of the construct or its latent. Discriminant validity is good when the indicator has a cross loading on the construct that is greater than the other constructs or greater than 0.70. The results of cross loading indicators for each construct are greater than the other constructs. The results of cross loading indicators on the constructs of demand, supply, certainty, service integration, and optimization of the mass public transportation system are presented in Table 1.

Table 1 Cross Loading Indicators Against Each Construct

	Demand (X1)	Supply (X2)	Certainty (Y1)	Integration (Y2)	SAUM Optimalisation (Y3)
X1A	**0,630**	0,216	0,358	0,215	0,173
X1B	**0,893**	0,345	0,525	0,436	0,455
X1C	**0,914**	0,335	0,500	0,283	0,418
X2A	0,355	**0,932**	0,418	0,477	0,670
X2B	0,322	**0,915**	0,404	0,417	0,597
X2C	0,357	**0,931**	0,406	0,499	0,627
Y1A	0,412	0,297	**0,848**	0,419	0,452
Y1B	0,470	0,381	**0,844**	0,513	0,570
Y1C	0,570	0,443	**0,893**	0,536	0,576
Y2A	0,289	0,464	0,519	**0,886**	0,639
Y2B	0,387	0,397	0,491	**0,854**	0,600
Y2C	0,357	0,448	0,491	**0,875**	0,654
Y3A	0,418	0,615	0,521	0,677	**0,886**
Y3B	0,370	0,579	0,577	0,592	**0,870**

Note: X1A = Characteristics of Travelers; X1B = Movement Characteristics; X1C = Quality of Service; X2A = Service Quantity; X2B = Infrastructure Characteristics; X2C = Service Price; Y1A = Accessibility; Y1B = Service Level; Y1C = Service Availability; Y2A = Physical; Y2B = Network; Y2C = Tariff; Y3A = Affordability; Y3B = Order.

The feasibility of the constructs made can also be seen from the discrimant validity through Average Variance Extracted (AVE), Composite Reliability (CR) which is generally used for reflective indicators and aims to measure the internal consistency of a construct, and Cronbach Alpha..

Table 2 Average Variance Extracted (AVE), Composite Reliability (CR), and Cronbach Alpha on each Research Variable

Construct	Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)
Demand (X1)	0,757	0,860	0,676
Supply (X2)	0,921	0,950	0,863
Certainty (Y1)	0,828	0,897	0,743
Integration (Y2)	0,842	0,905	0,760
SAUM optimization (Y3)	0,702	0,870	0,770

Based on Table 2, it can be seen that the constructs of service demand, supply, service certainty, service integration, and optimization of the mass public transportation system (KM) are very good, because they have discrimant validity which is much greater than 0.5. Discrimant validity of all research variables is reflected in the Average Variance Extracted (AVE) value of each variable with an AVE above 0.70 for Composite Reliability and Cronbach's Alpha which exceeds 0.60. Thus, all measurements used in this study are reliable.

The evaluation of the inner model includes two main things, namely the evaluation of the goodness of fit and the evaluation of the effect of exogenous variables on endogenous variables through hypothesis testing. The structural model of PLS processing results needs to be evaluated using R-square for each dependent variable, and R-square Adjusted predictive relevant. To see the effect of exogenous latent constructs on the endogenous variables. For purposes of evaluation, the Goodness of structural is shown in Table 3 which contains the R-square coefficient for each endogenous variable.

Table 3 R-square value

Variable	R Square	Information
Certainty (Y1)	0,384	Moderate
Integration (Y2)	0,407	Moderate
SAUM optimization (Y3)	0,693	Strong

Source: data processed, 2021

Validation of the research model can be done by two methods, namely the Stone-Geisser predict relevance approach (Stone, 1974; Geisser, 1971; Geisser, 1974), namely by using Q2, the calculation results are as follows.

$Q^2 = 1 – [(1 – R_1^2) (1 – R_2^2) ... (1- R_p^2)]$ ....(5.1)

$Q^2 = 1 – [(1 – R_1^2) (1 – R_2^2) (1- R_3^2)]$

$Q^2 = 1 – [(1 – 0{,}384) (1 – 0{,}407) (1- 0{,}693)]$

$Q^2 = 0{,}888$

Based on the calculation results, the Q2 value of 0.888 means that 88.8 percent of the variation of the Mass Public Transportation System optimization variable is expressed by variations in the service demand, supply, service certainty, and service integration variables, while the remaining 11.2 percent of the variation in value changes. on the optimization variable of the Mass Public Transportation System cannot be explained by the exogenous latent variable, and is determined by other factors that are not included in this research model.

1) Direct effect test

The direct influence between research variables (latent variables) based on the results of data processing using SmartPLS can be seen from the results of the path coefficients analysis shown in Table 4. Table 4 shows that there is a direct influence of exogenous variables on endogenous variables that have a positive but not significant effect, namely demand. positive effect on the optimization of SAUM, but not significant. This relationship is evidenced by the P-value of the variable greater than 0.05, which is 0.675 for two-sided testing. In addition, an insignificant relationship is also shown in the relationship between demand and integration with a significance value of 0.699 each.

Table 4 Path Coefficients (Direct Influence Between Research Variables)

Path	Coefficient	Standard Deviation	T Statistics	P-values	Information
X1 -> Y1	0,470	0,100	4,715	0,000	Significant
X2 -> Y1	0,266	0,108	2,470	0,014	Significant
X1 -> Y2	0,046	0,119	0,387	0,699	Non Significant
X2 -> Y2	0,301	0,115	2,618	0,009	Significant
Y1 -> Y2	0,415	0,132	3,141	0,002	Significant
X1 -> Y3	0,033	0,078	0,420	0,675	Non Significant
X2 -> Y3	0,374	0,091	4,126	0,000	Significant
Y1 -> Y3	0,210	0,104	2,017	0,044	Significant
Y2 -> Y3	0,403	0,088	4,579	0,000	Significant

Description : X1 = Demand; X2 = Supply ; Y1 = Certainty;

Y2 = Integration; Y3 = SAUM Optimization (Y3)

The relationship between research variables can also be seen in the research variable row diagram as presented in Figure 2.

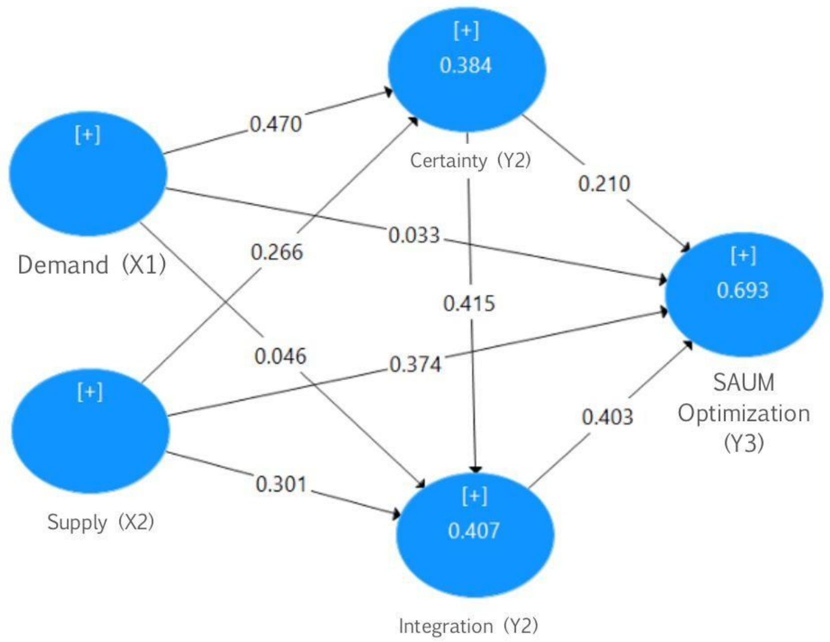

Figure 2
Path Coefficient of Relationship Between Research Variables
Determinants of Optimizing Mass Public Transport System
in the Sarbagita area

Based on Figure 2, it can be explained that the optimization of SAUM services is most influenced by service integration with a coefficient of 0.403, followed by service offerings with a coefficient of 0.374..

2) Indirect Effect Test

Indirect influence analysis, can explain the relationship between research variables (latent variables). Indirect influence occurs through the role of one or more intermediate variables. To determine the indirect effect between latent variables, it can be seen from the results of the analysis of the total indirect effect value shown in Table 5.

Table 5 Total Indirect Effects Value (Indirect Effect of Research Variables)

Path	Coefficient	Standard Deviation	T Statistics	P-values	Information
X1 ->Y1 ->Y2	0,195	0,081	2,390	0,017	Significant
X2 ->Y1 ->Y2	0,110	0,055	2,004	0,047	Significant
X1 ->Y1 ->Y2 ->Y3	0,196	0,068	2,878	0,004	Significant
X2 ->Y1 ->Y2 ->Y3	0,222	0,067	3,327	0,001	Significant
Y1 -> Y2 ->Y3	0,167	0,062	2,684	0,008	Significant

Description : X1 = Demand; X2 = Supply; Y1 = Certainty;
Y2 = Integration; Y3 = SAUM Optimization (Y3)

Based on Table 5, it is known that the mediation relationship in this test has a significant effect as evidenced by P-values 0.05. Based on these statistical results, the indirect effects of each relationship are all positive and significant.

3) Total Effects Evaluation

The direct effect between latent variables can be seen through the total effect. The results of the five (5) latent variables analyzed showed that there were nine (9) total effects that appeared. Taking into account the coefficient of the total effect of the research variables in Table 5.30, all relationships are significant at a significance level of less than 5 percent or P-values 0.05. The total effect between these latent variables was analyzed using bootstrapping management, and the results of the analysis of the total effect between the significant variables are presented in Table 6.

Based on Table 6, it can be explained that (1) the effect of demand on the optimization of SAUM in total has an effect of 0.228 with P-values of 0.011, (2) the effect of supply on the optimization of SAUM in total has an effect on the path coefficient of 0.5967 with a P-value of 0.000, (3) the effect of certainty on the optimization of SAUM in total has an effect on the path coefficient of 0.377 with a P- value of 0.0001, as well as (4) the effect of integration on the optimization of SAUM in total has an effect on the path coefficient of 0.403 with a P-value of 0.000. Likewise, the total effect of other latent variables in this study has a significant total effect.

Table 6 Coefficient Value of Total Effect of Research Variables

Path	Coefficient	Standard Deviation	T Statistics	P-values	Information
X1 -> Y1	0,470	0,100	4,715	0,000	Significant
X2 -> Y1	0,266	0,108	1,470	0,014	Significant
X1 -> Y2	0,241	0,104	2,318	0,021	Significant
X2 -> Y2	0,412	0,113	3,635	0,000	Significant

Y1 -> Y2	0,415	0,132	3,141	0,002	Significant
X1 -> Y3	0,288	0,090	2,547	0,011	Significant
X2 -> Y3	0,596	0,095	6,244	0,000	Significant
Y1 -> Y3	0,377	0,188	0,319	0,001	Significant
Y2 -> Y3	0,403	0,088	4,579	0,000	Significant

Source: data processed, 2021

Description : X1 = Demand; X2 = Supply; Y1 = Certainty;
Y2 = Integration; Y3 = SAUM Optimization (Y3)

Research Findings

There are several things stated as the main findings in this study, namely as follows.

1) So far, efforts to optimize the transportation system are usually carried out with the aim of balancing the supply and demand for transportation through an analytical approach to the direct relationship between supply and demand variables. The results of this study found that efforts to improve SAUM services, which are only based on demand and service supply, will not bring optimal results. This research answers the phenomenon of the low loading rate of Trans Metro Dewata services, even though the service is free.

2) This research was conducted through a social/economics approach, where research on the relationship between variables was carried out in a single system involving intermediate variables and their indirect influence using SEM (Structural Equation Modeling) analysis. The novelty of this research is that the service demand variable which has been functioning as a direct variable in the provision of transportation services has no significant effect on the optimization of SAUM. Service demand has a significant effect on the optimization of SAUM if it is through the variables between service certainty and service integration.

3) This research produces variables, indicators and attributes in a structured manner that can be used as a theory or approach in planning and developing SAUM services so that they can run optimally. The results of this study are expected to enrich the theoretical repertoire in the field of transportation economics which is currently developing.

Research Contribution

1) Theoretically, this research is able to answer research problems regarding the optimization of road-based Mass Public Transportation System (SAUM) services in the Sarbagita area.

2) Based on the findings obtained as a result of the research, it is hoped that this research can make an important contribution in enriching the theoretical repertoire in the field of transportation economics and transportation management which is currently developing.
3) Practically, this research can be a contribution of thought for the government as a public service provider institution in making strategic policies in an effort to optimize road-based Mass Public Transportation System (SAUM) services in the Sarbagita area and develop road-based Mass Public Transportation System (SAUM) programs in various areas.

Limitation

The limitations that can be identified related to this research are as follows:

1) Data collection was carried out during the Covid-19 Pandemic. Thus, this study relatively does not describe the characteristics of users and the characteristics of the movement of Trans Metro Dewata passengers under normal conditions.
2) Limited research results related to this research considering that so far research in the field of transportation, especially related to the relationship between variables, tends to be empirical by looking for direct relationships between variables. This study uses a social/economics approach where the research on the relationship between variables is carried out in a single system involving intermediate variables and indirect effects. This research is expected to give birth to a novelty in the scientific family of transportation economics.
3) The theoretical references and the results of empirical studies used are relatively old. This may be because transportation science has tended to be included in the civil engineering family, so transportation theories tend to be carried out through an engineering (exact) approach that is static and definite. Even if there is transportation research related to this research, it is generally in the form of an empirical study and is in a cetirus paribus condition. As a result, research related to the relationship between variables in the transportation sector tends to be a direct relationship using regression analysis. The results of this study are expected to be one of the theoretical references in the field of transportation economics, especially in the realm of studying public transportation system planning.

Conclusion

Based on the results of research on the discussion that has been described previously, it can be concluded as follows:
1) Service demand and supply have a positive and significant impact on the certainty of road-based Mass Public Transport System (SAUM) services in the urban area of Sarbagita.
2) Demand has no significant effect on the integration of road-based Mass Public Transport System (SAUM) services in the Sarbagita urban area. On the other hand, service supply and certainty have a

positive and significant impact on the integration of road-based Mass Public Transport System (SAUM) services in the urban area of Sarbagita.

3) Demand has no significant effect on the optimization of the road-based Mass Public Transport System (SAUM) in the urban area of Sarbagita. On the other hand, supply, certainty and service integration have a positive and significant impact on the optimization of the road-based Mass Public Transport System (SAUM) in the urban area of Sarbagita.

4) Indirectly, service demand and supply have a positive and significant impact on service integration through service certainty on the road-based Mass Public Transport System (SAUM) in the Sarbagita urban area.

5) Indirectly, the demand and supply of services has a significant effect on the optimization of the Mass Public Transportation System (SAUM) through service certainty and service integration on the road-based Mass Public Transportation System (SAUM) in the urban area of Sarbagita.

6) Indirectly, the demand and supply of services has a positive and significant impact on the optimization of the Mass Public Transport System (SAUM) through the certainty and integration of services on the road-based Mass Public Transportation System (SAUM) in the urban area of Sarbagita.

7) Indirectly, service certainty has a positive and significant impact on the optimization of the Mass Public Transportation System (SAUM) through the integration of services on the road-based Mass Public Transportation System (SAUM) in the Sarbagita urban area.

Suggestion

Based on the conclusions above, several things can be suggested, as follows::

1) Efforts to optimize SAUM need to be carried out to realize the efficiency of the transportation system in the urban area of Sarbagita. The optimization efforts are not only based on demand and supply of services but also involve variables between service certainty which include indicators of accessibility, service level and service availability and service integration variables which include indicators of physical integration, network integration and tariff integration.
2) This research produces variables, indicators and measurement attributes in a structured manner in a unified system that can be used as an approach in planning and developing SAUM services so that they can run optimally.
3) It is necessary to disseminate the results of this study so that the resulting research can be useful for stakeholders and the wider community.
4) The need for similar studies in the field of transportation using a social/economics approach in researching the relationship between variables as a unified system in order to enrich the repertoire of transportation economics and transportation management.

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