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Performance Analysis Of Urban Transport Network In Denpasar City

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ABSTRACT

Denpasar City has experienced many changes in the use of public transportation. In the previous year 18 active routes operating, while currently there are only 5 active routes. Therefore, an analysis of the performance of transportation, route network plans, and operational systems of the transportation is needed. Primary data was obtained from headway surveys, interview surveys, and on-board surveys. Vehicle Operating Cost (VOC) calculations, route network planning, and operational systems used the Department of Transportation method. The results of the analysis showed that almost all routes did not meet the standards of both operational performance and service quality. In this study, 6 routes were planned centered on the east parking lot of Renon field. The results of the new route planning are: Renon-Penatih with a route length of 18.7 km, a circulation time of 61.5 minutes and a total of 13 vehicles; Renon-Ubung with a route length of 22 km, a circulation time of 69.8 minutes and a total of 46 vehicles; Renon-Sanur with a route length of 14.3 km, a circulation time of 45.6 minutes and a total of 3 vehicles.

1. Introduction

Since the 1990s until now, there have been many changes in the use of public transportation in Denpasar City [1]. These changes can be seen from the decreasing number of routes that are actively operating. Several years ago, there were 18 routes that were actively operating, while currently there are only 5 routes that are still active [2].

The problem that is currently occurring is the decreasing number of passengers using public transportation [3]. According to data from the Denpasar City Transportation Agency in 2023, the number of routes that are still active for the current condition is 5 routes [4]. The factors that cause the number of passengers to continue to decline are the rise of online-based



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transportation and the ease of having private vehicles [5]. In addition, the route network is not based on careful planning, so it does not reach all points in Denpasar City [6].

The purpose of this study is to analyze transportation performance, plan route networks and operational systems to re-empower public transportation in Denpasar City [7].

2. Research Method

The research method explains the work steps carried out in this research from start to finish [8]. The work steps in this study can be seen in Figure 1 showing the stages of this research starting with conducting a literature study and preliminary study, then identifying problems and setting research objectives [9].

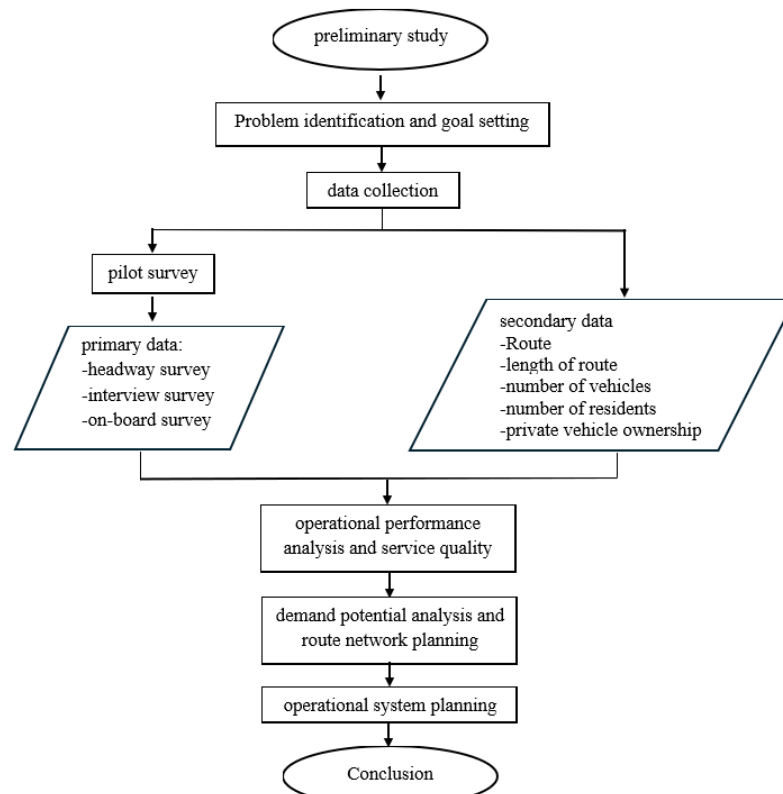


Figure 1. Research Flow Diagram
Result of This Research (2025)

3. Description and Technical

1. Research Location

The research location is Denpasar City [10].

2. Data Collection Methods

Primary data in the form of a headway survey: This survey was conducted at three points, where the first point was at the Ubung Terminal for the UK route (Ubung-Kreneng, the US route (Ubung-Sanglah) and the UT route (Ubung-Tegal). While for the second point, namely at the Kreneng Terminal, a headway survey was conducted for the KS route (Kreneng-Sanglah) and the third point was at the Suci Roundabout for the S4 route (Suci-Pesanggaran-Benoa) [11]. Secondary data was obtained from the Department of Transportation, BPS, and others. After all the data had been collected, the analysis of city transportation performance was continued [12].

3. Data Analysis

After all the data is collected, the analysis of city transportation performance is continued in terms of operational performance and service quality [13]. Transportation performance and BOK use the Department of Transportation method [14]. After that, an

analysis of potential demand is carried out in new route planning, where the planning uses territorial configuration theory [15]. Furthermore, an operational system is planned for new route planning [16].

4. Results and Discussions

4.1 City Transportation Performance Analysis

The total area of Denpasar City is 127.78 km² with a population of 914,300 people. There are 5 active routes in Denpasar City, including Suci-Pesanggaran-Benoa, Ubung-Kreneng, Ubung-Sanglah, Kreneng-Sanglah, Ubung-Tegal. The type of transportation in this study is intercity transportation. The analysis of city transportation performance consists of two indicators, namely operational performance and service quality. Before analyzing transportation performance, it should be noted that there are 5 active routes. The active routes and the number of vehicles for each route are shown in Table 1.

This section contains (concise form) data analysis and interpretation of results. Interpretation of results using theories from articles as used. The descriptions given include theoretical, implicative, and managerial, or practical [17].

Table 1. Number of Denpasar City Transportation Vehicles

Number	Route Code	Route Name	Number of vehicles (vehicles)
1	S4	Suci-Pesanggaran-Benoa	28
2	UK	Ubung-Kreneng	66
3	US	Ubung-Sanglah	88
4	KS	Kreneng-Sanglah	51
5	UT	Ubung-Tegal	32

Source: Result of This Research (2025)

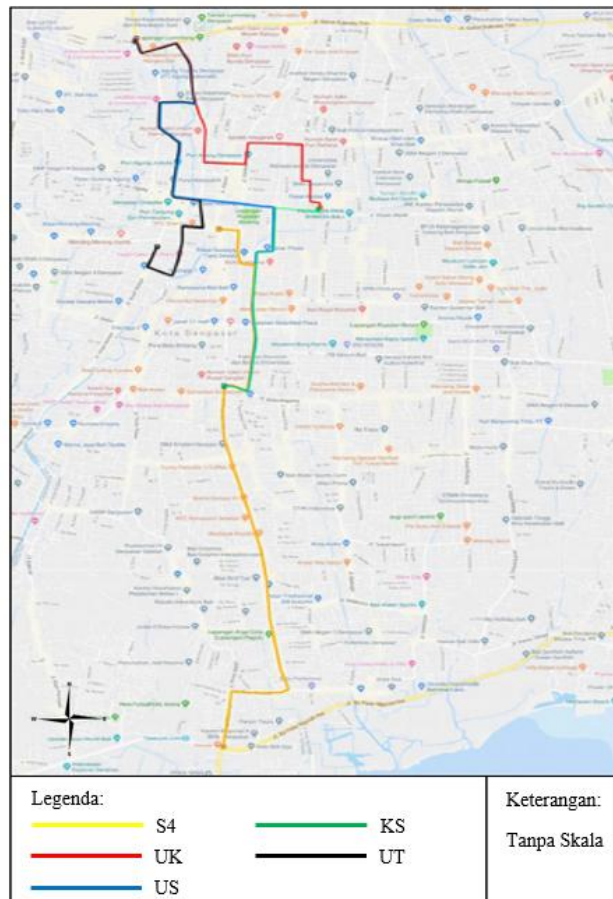


Figure 2. Denpasar City Route Network Map
Source: Result of This Research (2025)

Based on the presentation of Table 1, it can be seen that the total number of vehicles currently operating or having permits based on data from the Denpasar City Transportation Agency is 265 vehicles. The results of direct observations in the field of the number of vehicles operating do not match the data provided by the Denpasar City Transportation Agency [18]. The results of the analysis of transportation performance on each route can be seen in Table 2.

Table 2. Results of City Transportation Performance Analysis

No	Operational Performance	Standard	Route Code				
			S4	UK	US	KS	UT
1	Number of passengers	250-300 (people/day)	27	29.4	40.6	57.6	30
2	Travel distance	250 (kilometer/day)	75	59.57	100.45	94.96	49.8
3	Fuel consumption level	7.5-9 (kilometer/day)	13.16	12.95	13.76	13.96	13.11
4	<i>Load Factor per Segment</i>	70%	33.8	26.3	36.3	45	31.3
No	Kualitas Pelayanan	Standar	Kode Trayek				
			S4	UK	US	KS	UT
1	<i>Headway</i>	5-10 (minute)	24.33	15.09	12.82	14.56	18.93
2	Waiting time	5-10 (minute)	12.17	7.54	6.41	7.28	9.47
3	Travel time	1-1.5 (hour)	0.954	0.586	0.966	0.692	0.534
4	Speed	20 (kilometer/hour)	15.87	14.77	14.92	17.2	15.59

Source: Result of This Research (2025)

Based on Table 2, it can be seen that the performance of city transportation at the study location is poor. This can be seen from the operational performance of all indicators reviewed, namely all transportation routes do not meet the standards. The quality of transportation services from all indicators reviewed, on the S4 route waiting time indicator (Suci-Pesanggaran-Benoa) does not meet the standards, while other routes have met the standards [19]. On the headway indicator, travel time and transportation speed, none of the routes meet the standards.

4.2 Calculation of Vehicle Operating Costs

Vehicle operating costs are defined as costs obtained from operating a vehicle [20]. Vehicle operating costs are calculated based on the Department of Transportation method. The results of the BOK calculation analysis for each route can be seen in Table 3.

Table 3. Results of Vehicle Operational Cost Calculations

Number	Route Code	Roundtrip Length	Average Rites per Day	Total Travel Distance per Year	Vehicle Operating Costs per Year	Vehicle Operating Costs per kilometer
		(kilometer)	(ritage/day)	(kilometer)	(Rupiah/vehicle/year)	(Rupiah/vehicle/kolometer)
1	S4	15	5	27,375	62,897,764	2,298
2	UK	8.5	7	21,743	58,833,963	2,706
3	US	14.4	7	36,654	69,195,910	1.887
4	KS	11.9	8	34,66	67,594,620	1.95
5	UT	8.3	6	18,177	57,026,028	3.137

Source: Result of This Research (2025)

Based on Table 3 shows the Vehicle Operating Cost per year and km on each route. The highest BOK calculation per year is on the US route, which is IDR 69,195,910 per year, while the lowest is the UT route, which is IDR 57,026,028 per year. The difference in roundtrip and roundtrip distance that affects the vehicle's mileage which will later affect the costs incurred to travel a certain distance causes different BOK per year on each route. Meanwhile, for the calculation of vehicle operating costs per kilometer, the highest is the UT route, which is IDR 3,137 per km, while the lowest is the US route with IDR 1,887 per km.

4.3 New Route Planning

New route planning aims to re-empower transportation. Route planning is determined based on the territorial configuration theory. Territorial configuration divides the service area into several areas. In this system, all routes are connected to one point that is used as a transfer center. The transfer center is usually an area that has a large travel attraction. The planning of this new route is centered in the Renon area or more precisely in the east parking lot of Renon field towards 6 points. The planning of the 6 routes is Renon-Penatih, Renon-Ubung, Renon-Sanur, Renon-Lapangan Kompyang Sujana, Renon-Suwung, and Renon-Pedungan. The new route planning for city transportation in Denpasar City can be seen in Table 4.

Table 4. New Route Planning

Number	New Route Planning Name	Route taken
1	Renon-Penatih Route (RP)	Jl.Cok Agung Tresna, Jl. Merdeka, Jl. Hayam wuruk, Jl. Nusa Indah, Jl. W.R Supratman, Jl. Padma, Jl. Kaswari

2	Renon- Ubung Route (RU)	Jl. Moh. Yamin, Jl. Raya Puputan, Jl. Dewi Sartika, Jl. Diponegoro, Jl. Hasanuddin, Jl. Gn. Batur, Jl. Gn. Merapi, Jl. Gn. Agung, Jl. Buluh Indah, Jl. Cargo Permai Jl. Cok Agung Tresna, Jl. Merdeka,
3	Renon-Sanur Route (RS)	Jl. Hayam Wuruk, Jl. Hang Tuah, Jl. Danau Beratan, By. Pass Ngurah Rai, Pantai Matahari Terbit Jl. Moh. Yamin, Jl. Raya Puputan, Jl. Tukad Musi, Jl. Tukad Barito, Jl. Tukad Pakerisan, Jl. Waturenggong, Jl. Diponegoro, Jl. Hasanuddin, Jl. Gn. Batur, Jl. Gn. Merapi, Jl. Gn. Agung, Jl. Mahendradatta
4	Renon- Sanglah- Lapangan Kompyang Sujana Route (RSB)	Jl. Moh. Yamin, Jl. Raya Puputan, Jl. P.B sudirman, Jl. Waturenggong, Jl. Raya Sasetan, Jl. Suwung Batan Kandal Jl. Moh. Yamin, Jl. Raya Puputan, Jl. Dewi Sartika, Jl. T. Umar, Jl. Pulau Kawe, Jl. Pulau Saelus, Jl. Pulau Singkep, Jl. Pulau Moyo
5	Renon- Sesetan- Suwung Route (RSS)	Jl. Moh. Yamin, Jl. Raya Puputan, Jl. P.B sudirman, Jl. Waturenggong, Jl. Raya Sasetan, Jl. Suwung Batan Kandal Jl. Moh. Yamin, Jl. Raya Puputan, Jl. Dewi Sartika, Jl. T. Umar, Jl. Pulau Kawe, Jl. Pulau Saelus, Jl. Pulau Singkep, Jl. Pulau Moyo
6	Renon-T. Umar- Pedungan Route (RTP)	Jl. Moh. Yamin, Jl. Raya Puputan, Jl. Dewi Sartika, Jl. T. Umar, Jl. Pulau Kawe, Jl. Pulau Saelus, Jl. Pulau Singkep, Jl. Pulau Moyo

Source: Result of This Research (2025)

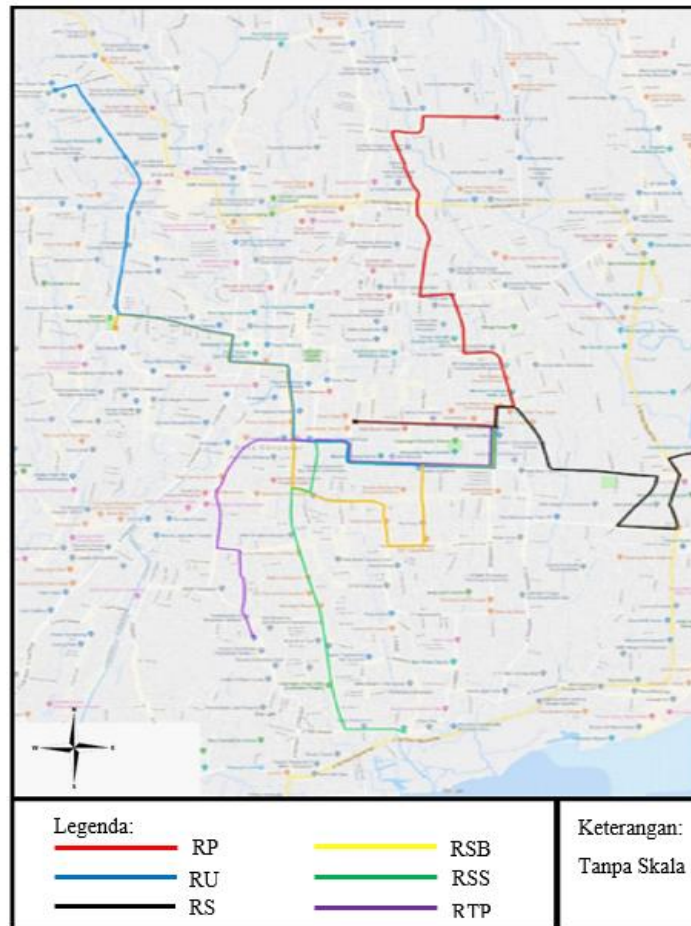


Figure 3. Network Map New Route Planning
Source: Result of This Research (2025)

Table 4 shows the route names and routes of city transportation route planning at the study location. In the planning of the new route, the number of residents, the number of potential residents who move and private vehicle ownership will be analyzed on each route passed by city transportation.

4.4 Analysis of Potential Demand on Route Plan

Analysis of potential demand on route plan based on population density, population, and private vehicle ownership. All of these data are obtained from. After calculations are made on route planning, the number of prospective passengers will be obtained. The number of prospective passengers on the new route planning can be seen in Table 5.

Table 5. Priority Number of Prospective Passengers

Number	Route's name	Number of Prospective Passengers (people/day)
1	Renon-Penatih Route (RP)	15,786
2	Renon-Ubung Route (RU)	26,998
3	Renon-Sanur Route (RS)	2,334
4	Renon-Sanglah-Lapangan Kompyang Sujana Route (RSB)	21,313
5	Renon-Sesetan-Suwung Route (RSS)	19,69
6	Renon-T. Umar-Pedungan Route (RTP)	31,098

Source: Result of This Research (2025)

Table 5 shows the priority of routes based on the number of prospective passengers. The Renon-T. Umar-Pedungan route is the priority because it has the largest number of prospective passengers, namely 31,098 people/day, while the Renon-Sanur route is the last priority because it has the lowest number of prospective passengers, namely 2,334 people/day.

4.5 Planning of City Transportation Operational System

The planning of the city transportation operational system in Denpasar City based on the number of prospective passengers can be seen in Table 6.

Table 6. Planning of Operational System

Number	Route Code	Number of Prospective Passengers (people/day)	Vehicle Requirements (vehicles)	Circulation Time (minute)	Route Length (kilometer)
1	RP	15.786	13	63.7	19.2
2	RU	26.998	46	69.8	22
3	RS	2.334	3	45.6	14.3
4	RSB	21.313	31	57.9	18
5	RSS	19.69	29	56.3	17.4
6	RTP	31.098	39	47.9	15.1

Source: Result of This Research (2025)

Based on Table 6, it can be seen that the Renon-Ubung (RU) route requires the largest number of fleets, namely 46 vehicles with a circulation time of 69.8 minutes. Meanwhile, the route that requires the fewest vehicles is the Renon-Sanur (RS) route, with as many as 3 vehicles with a circulation time of 45.6 minutes.

5. Conclusion

5.1 Conclusion

From the research results, it can be concluded as follows: 1. Condition of operational performance and quality of city transportation services at the study location. a. Operational performance of all routes reviewed, indicators of operational performance of city transportation including number of passengers, fuel consumption level, travel distance, and load factor all do not meet the established standards. b. Quality of Service of all routes reviewed, on the S4 route waiting time indicator (Suci-Pesanggaran-Benoa) does not meet the standard, while other routes have met the standard. On the headway indicator, travel time and speed of transportation, none of the routes meet the standards of (Department of Transportation, 2002). 2. Planning of new city transportation routes in Denpasar City based on territorial configuration, where there is one meeting point location for mode transfer, namely in the Renon area. Based on potential demand, 6 new routes are planned, namely the Renon-Penatih, Renon-Ubung, Renon-Sanur, Renon-Sanglah-Lapangan Kompyang Sujana, Renon-Sesetan-Suwung, and Renon-T.Umar-Pedungan routes. The operational system of city transportation at the study location that can be applied based on the route plan is: With the Mikrolet fleet: a. For the Renon-Penatih (RP) route, the route is 19.2 km long with a circulation time of 63.74 minutes. The vehicle requirement is 13 units. B. For the Renon-Ubung (RU) route, the route is 22 km long with a circulation time of 69.78 minutes. The vehicle requirement is 46 units. C. For the Renon-Sanur (RS) route, the route is 14.3 km long with a circulation time of 45.55 minutes. The vehicle requirement is 3 units. D. For the Renon-Sanglah-Lapangan Kompyang Sujana (RSB) route, the route is 18 km long with a circulation time of 57.9 minutes. The vehicle requirement is 31 units. e. For the Renon-Sesetan-Suwung (RSS) route, the route is 17.4 km long with a circulation time of 56.3 minutes. The vehicle requirement is 29 units. For the Renon-T.Umar-Pedungan (RTP) route, the route length is 15.1 km with a circulation time of 47.9 minutes. The vehicle requirement is 39 units.

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