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Public Transportation Analysis of West Java International Airport: Kertajati

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Abstract

This research identifies the needs and initial design of the development of Access Road Mode Public Transportation (Bus) West Java International Airport. To obtain recommendations for the development of public transport access (Bus) that are integrated with regional development plans / other infrastructure in order to increase airport utilization. In general, there are several main tasks to be carried out in the Bus/Shuttle Development Study at West Java International Airport, as follows Spatial Analysis, Airport Demand Analysis, Road Geometric Analysis, Public Transport Modeling, Public Transport Analysis, and Financial and Economic Analysis. From analysis, 5 priority bus routes were selected and proposed to improve airport airport utility by analyzing the route, demand, operational schedule, headway, fare, mode capacity, travel frequency, number of buses, and investment costs. Priority routes include Cipaku Terminal, DAMRI Pool Kebun Kawung, Leuwi Panjang Terminal, Curug Agung Terminal, and Harja Mukti Terminal to and from West Java International Airport.

Keywords: Public Transport, Airport Accessibility, Demand Modeling

1. Introduction

West Java International Airport (Kertajati Airport) is included in the National Strategic Program with construction starting in 2015. This airport was built as one of the efforts made by the government in strengthening connectivity in West Java to increase the development of intermodal infrastructure, one of which is the airport. In addition, the existence of Husein Sastranegara International Airport is considered unable to serve the increasing demand for movement.

West Java International Airport is a new international airport located in Majalengka Regency, West Java Province, built and managed by PT Bandar Udara Internasional Jawa Barat (BIJB). The airport has a runway with a length of 3,000 meters, so it can serve wide-body aircraft such as Boeing 777. The airport is projected to have a service capacity of 29 million passengers/year and 1.5 million tons of cargo.

West Java International Airport was inaugurated by the president of Indonesia on May 24, 2018 and began partial operation on June 8, 2018. Then on October 31, 2018, West Java International Airport began full operation by serving additional homecoming flights for Lebaran 1439 H, then serving regular services since July 1, 2018. However, after operating, the utilization of this airport was very low, and the airport was even closed during the Covid-19 pandemic. After covid-19 this airport returned to normal operations

but there were no signs of revival of flight activities, even when the Cipali Toll Road and Cisumdawu Toll Road were built and operated in July 2023 to support airport connectivity, but the utilization of this airport was still low.

In addition, poor accessibility conditions have meant that since its official operation, the airport has only served one flight route. This is due to poor land access to and from West Java International Airport. Although land access has been improved by the government with the construction of the Cileunyi-Sumedang-Dawuan (Cisumdawu) toll road, access from public transportation serving trips to and from West Java International Airport is still limited. In addition, by reviewing the changes to the master plan of West Java International Airport in 2016, public transportation access to and from the airport needs to be reviewed for development.

The purpose and objective of this research is to identify the needs and initial design of the development of Road Mode Public Transport Access to West Java International Airport in order to obtain recommendations for the development of Road Mode Public Transport access to West Java International Airport which is integrated with other regional / infrastructure development plans to increase the utilization of the airport.

2. Literature Review

A transportation system at the airport must have good access. Another thing that needs to be considered in an intermodal transportation system is that the system offered must be comfortable and fast so that travelers prefer to use intermodal instead of private vehicles, and also the problem of congestion can be resolved (Vetrovsky dan Kanafani, 1994). The airport is one of the transport hubs that plays an important role in the implementation of intermodal transport, especially between air, road and rail modes. To improve the operational performance of an airport, it must be supported by reliable and high-qualcaity public transport facilities (Firdausi, 2014).

Devianty (2019), conducted a study to analyse the potential demand and to plan the operational system of intermodal transport at H.A.S. Hanandjoedin Airport. The data collection method was carried out with the stated preference (SP) technique using questionnaires distributed at H.A.S. Hanandjoedin Airport to determine the willingness of respondents to use the mode-mix transit service as a basis for planning the mode-mix transit operating system and its facilities and infrastructure. Based on the results of a survey conducted among air passengers at H.A.S. Hanandjoedin Airport, 56% of the respondents were interested in using the combined transport service, with an increase in the aspects of service, speed and cost of combined transport.

Capah (2013), examines the estimated demand for road transportation modes to and from Ahmad Yani Airport Semarang. The analysis methods used in the research are forecasting and descriptive methods. From the results of the analysis in 2014 the potential public transport developed is the route of Ahmad Yani Airport Semarang City and Ahmad Yani Airport Ungaran Semarang Regency. While in 2020 the potential public transport developed is the route of Ahmad Yani Airport Semarang City, Ungaran Semarang Regency, Cepu Blora Regency and Sukorejo Kendal Regency.

Meanwhile, Hafizah & Hidayat (2019) conducting research to provide future demand forecasts for Yogyakarta International Airport. This research uses revealed preference analysis which is an approach used by conveying real choice statements to be given an assessment by respondents. The results of the questionnaire were then processed using statistical analysis to determine the factors that influence the choice of transport mode to and from the airport. The factors examined in this study were travel costs,

travel time, travel distance and general costs. The results show that prospective air travellers are more dominant in the choice of the travel cost attribute compared to other attributes.

Another study conducted by Prayitno (2017) which aims to analyze the willingness of airplane passengers to use the Trans Jogja bus from private vehicle users such as cars, motorbikes and taxis using stated preference techniques. This analysis of the willingness of airplane passengers to use the trans Jogja bus uses the logit model. The result is through a model application that is carried out to apply scenarios of changes in cost and travel time in stages to the Trans Jogja bus mode, then see changes in utility and probability values that occur in these modes. The results of the model scenario show that changes in the cost and travel time attributes of the Trans Jogja bus are more sensitive to changes in probability, meaning that cost and travel time are the most important considerations.

Based on the literature study compiled above, the objective of this activity is to provide recommendations for the development of road public transport access at West Java International Airport, which is integrated with other regional / infrastructure development plans that include the following indicators:

1. Evaluation of technical aspects;
2. Basic design;
3. Operational study;
4. Financial evaluation
5. Project investment costs.

3. Methodology

In general, there are several main tasks to be carried out in the Bus/Shuttle Development Study at West Java International Airport, as follows:

a. Spatial Analysis;
b. Airport Demand Analysis;
c. Road Geometric Analysis;
d. Public Transport Modelling;
e. Public Transport Analysis; and
f. Financial and Economic Analysis.

Based on the scope of work above, a flow chart of the methodology for implementing the Bus/Shuttle Development Study work at the West Java International Airport can be made as shown in figure 1. This section is carried out in order to understand the work process more simply and systematically. At the initial stage of the work, an understanding of the purpose and objectives of the study as well as the scope of the study is carried out, which is then continued with an understanding of previous studies, related regulations, and an introduction to the study area. This was followed by the establishment of the feasibility study methodology and data collection. After that, the search for the required data such as Masterplan, Hinterland, Demand, and Constraints of West Java International Airport was carried out in order to identify and study to analyze the selection of Road Mode Public Transport Access for West Java International Airport. The data is also needed for the process of technical, operational, demand projection, and alternative selection of Road Mode Public Transportation Access for West Java International Airport. Finally, the study finalization stage is carried out to improve and refine the previous stages.

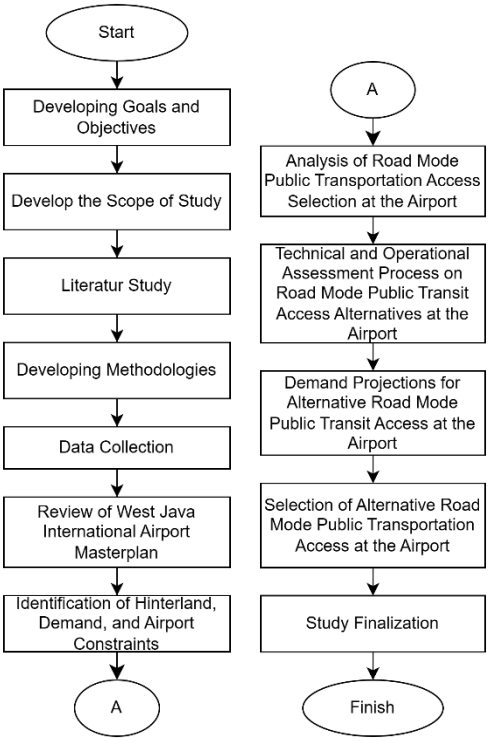

Figure 1. Methodology Framework

4. Data Analysis

4.1 Spatial

In planning public transport routes, the social and economic aspects of the hinterland area are important to analyze and consider. The area and population data of the hinterland are used to calculate the population density in the hinterland. By recapitulating data on population density, population and Gross Regional Domestic Product (GRDP), an assessment can be carried out to rank hinterland areas that potentially have high demand.

Table 1. Order of Cities/Regencies Based on Socio-Economic Data

No.	City/Regency	Population Density Per km^2	Population	GRDP
1	Bandung City	14,957	2,496,325	241,120
2	Bandung Regency	2,135	3,656,182	103,957
3	Indramayu Regency	847	1,709,970	71,407
4	Cirebon Regency	2,227	2,159,574	42,226
5	West Bandung Regency	1,302	1,665,585	40,445
6	Brebes Regency	951	1,795,638	40,311
7	Subang Regency	843	1,562,548	34,682
8	Tegal Regency	1,644	1,433,143	30,463
9	Sumedang Regency	759	1,145,622	29,890
10	Cimahi City	15,643	600,763	27,136
11	Majalengka Regency	1,001	1,193,634	25,869
12	Kuningan Regency	973	1,068,161	20,771
13	Cirebon City	8,547	313,379	19,953

14	Tegal City	6,298	248,067	13,066

Apart from social and economic aspects, transportation infrastructure in the form of bus terminals is also an important consideration to be analyzed regarding its availability and development plans. The availability and development plan of bus terminals will be reviewed in the "Realization of The Transportation Network System" in the RTRW of hinterland cities/regencies and obtained 12 cities/regencies that have bus terminals that are in accordance with the requirements, including Cimahi city, Bandung City, Cirebon City, Tegal City, Cirebon Regency, Bandung Regency, West Bandung Regency, Majalengka Regency, Kuningan Regency, Indramayu Regency, Subang Regency, and Sumedang Regency. The pattern and distribution of hinterland city/regency activities are also taken into consideration to determine the origin of public transport routes. Cities/regencies with the status of Regional Activity Centers are areas that potentially have a high demand, followed by City Service Centers, Local Activity Centers, and Urban Activity Centers.

Table 2. Subdistricts Proposed in the Hinterland

No.	City/Regency	Subdistrict Proposed
1	Cimahi City	South Cimahi
2	Bandung City	Bojongloa Kidul/Kiaracondong
3	Cirebon City	Harjamukti/Kejaksan
4	Tegal City	Margadana/Tegal Timur
5	Cirebon Regency	Ciledug/Arjawinangun
6	Bandung Regency	Soreang
7	Tegal Regency	Slawi
8	West Bandung Regency	Padalarang
9	Majalengka Regency	Kadipaten
10	Kuningan Regency	Sindangagung/Kuningan
11	Brebes Regency	Bumiayu/Tanjung/Brebes
12	Indramayu Regency	Indramayu
13	Subang Regency	Subang
14	Sumedang Regency	North Sumedang

4.2 Airport Demand

The determination of the size of the projected passenger movement in the development year is carried out using the time series method. The following is the projection of passenger movements in the 2019-2038 period.

Table 3. Kertajati Airport Passenger Movement Projections 2019 - 2038

No.	Year	Domestic Passengers (pax/ year)	International Passengers (pax/ year)
1	2019	1.416.650	265.031
2	2020	2.796.822	910.088
3	2021	4.176.993	1.555.145

4	2022	5.557.164	2.200.201
5	2023	6.937.336	2.845.258
6	2024	8.317.507	3.490.315
7	2025	9.697.678	4.135.372
8	2026	11.077.8501	4.780.429
9	2027	12.458.021	5.425.485
10	2028	13.838.192	6.070.542
11	2029	15.218.364	6.715.599
12	2030	16.598.535	7.360.656
13	2031	17.978.706	8.005.713
14	2032	19.358.878	8.650.769
15	2033	20.739.049	9.295.826
16	2034	22.119.220	9.940.883
17	2035	23.499.392	10.585.940
18	2036	24.879.563	11.230.997
19	2037	26.259.734	11.876.0534
20	2038	27.639.906	12.521.110

In terms of analyzing the mode of public transportation, the required demand must be known. For the calculation of the number of daily passengers at Kertajati International Airport using an analysis based on IATA 1989, namely by distributing the existing flight schedule with the number of aircraft capacities served by assuming a maximum passenger of 80% of the total aircraft capacity. Passenger distribution analysis aims to determine the number of passengers per hour. So that the peak hour of airport passengers can be known. At Kertajati International Airport, the peak hour time occurs at 08.00-09.00 WIB.

Table 4. Calculation of Daily Passenger Count of Kertajati Airport

No.	Time Schedule	Number of Passengers Per Hour	No.	Time Schedule	Number of Passengers Per Hour
1	00.00-01.00	640	**16**	12.00-13.00	846
2	01.00-02.00	0	**17**	13.00-14.00	695
3	02.00-03.00	0	**18**	14.00-15.00	1246
4	03.00-04.00	0	**19**	15.00-16.00	1243
5	04.00-05.00	144	**20**	16.00-17.00	1251
6	05.00-06.00	344	**21**	17.00-18.00	1596
7	06.00-07.00	830	**22**	18.00-19.00	741
8	07.00-08.00	1448	**23**	19.00-20.00	1138
9	08.00-09.00	1612	**24**	20.00-21.00	851
10	09.00-10.00	1084	**24**	21.00-22.00	464
11	10.00-11.00	1262	**24**	22.00-23.00	432
12	11.00-12.00	1483	**24**	23.00-00.00	1056

4.3 Road Geometry Analysis

The feasibility analysis of road geometry for large buses was carried out based on the Bina Marga Road Geometric Design Guidelines (2021). Based on the parameters of road function, design speed, lane width, and maximum slope, all planned road sections are suitable for large buses.

Table 5. The Feasibility of Road Geometry for Large Buses

Road Type	Road Function	Bus Passability	Design Speed (km/h)		Maximum Slope	
			Flat	Hill	Flat	Hill
Intercity	Primary Artery	V	60-100	50-90	6%	8%
	Primary Collector	V	40-80	30-70	6%	8%
Urban	Primary Artery	V	60-100		4%	5%
	Secondary Artery	V	30-60		5%	
	Secondary Collector	V	20-40		5%	

Table 6. Feasibility Analysis of Road Sections Planned to Be Used by Large Buses

No	Road Name	Road Type	Function	Road Type	Road Width (m)	Design Speed (km/h)	Slope Feasibility
1	Kebon Kawung	Urban	Collector	4/2UD	13,5	20	V
2	Pasir Kaliki	Urban	Arteri	4/2D	30	30	V
3	Suniaraja	Urban	Arteri	2/2UD	17,3	30	V
4	Otto Iskandar Dinata	Urban	Arteri	4/2UD	14,7	30	V
5	BKR	Urban	Collector	4/2D	21,1	20	V
6	Moh Toha	Urban	Arteri	4/2UD	17,6	30	V
7	Bandara BIJB	Intercity	Collector	4/2UD	13,7	20	V
8	Leuwipanjang	Urban	Collector	4/2D	15	20	V
9	Nasional III	Urban	Arteri	2/2D	11,6	30	V
10	Sriwijaya Raya	Urban	Collector	4/2UD	13,7	20	V
11	HMS Mintareja Sarjana	Urban	Arteri	4/2D	33,4	30	V
12	Brawijaya	Intercity	Arteri	2/2UD	9	30	V
13	Kertajati Kadipaten	Intercity	Arteri	2/2UD	7,6	30	V
14	Angkasa Raya	Intercity	Arteri	2/2UD	7,2	30	V

15	Raya Pantura	Inter-city	Collec-tor	4/2D	14	20	V
16	Dewi Sartika	Inter-city	Arteri	2/2UD	10,6	30	V
17	Fatahillah	Inter-city	Arteri	2/2UD	11	30	V
18	Otto Iskandar	Inter-city	Collec-tor	4/2D	21,6	20	V
19	Lkr Cilimus	Inter-city	Collec-tor	4/2D	9,5	20	V
20	Raya Cilimus	Inter-city	Arteri	2/2UD	7,6	30	V
21	Gatot Subroto	Inter-city	Collec-tor	4/2D	20	20	V
22	Raya Jatibarang-In-dramayu	Inter-city	Collec-tor	4/2D	12,5	20	V
23	Mayor Dasuki	Inter-city	Collec-tor	2/2UD	6,6	20	V
24	Jatibarang-Kadipaten	Inter-city	Arteri	2/2UD	7,8	30	V
25	Prabu Gajah Agung	Inter-city	Arteri	2/2UD	11	30	V
26	Gerbang Tol Sumedang	Inter-city	Collec-tor	4/2D	17,8	20	V
27	Darmodiharjo	Inter-city	Arteri	2/2UD	8,2	30	V
28	Raya Sukamelang	Urban	Arteri	2/2UD	7,6	30	V
29	Veteran	Inter-city	Arteri	2/2UD	11	30	V
30	Raya Cikopo	Inter-city	Arteri	2/2UD	15,2	30	V
31	Pramuka	Inter-city	Arteri	2/2UD	8,2	30	V
32	Dr. Cipto Mangunkusumo	Inter-city	Arteri	4/2D	16,5	30	V
33	Margasari-Jatibarang	Inter-city	Arteri	4/2D	24	30	V
34	Banjaranyar-Tegal	Inter-city	Collec-tor	4/2UD	12	20	V
35	Nanggeleng-Cirahayu	Urban	Arteri	6/2D	25	30	V

4.4 Public Transport Modelling

The initial step is to conduct a Stated-Preference survey in 14 Regencies/Cities which serve as hinterland. These areas are divided into 30 zones (27 internal zones and 3 external zones) with the following details:

Table 7. Detailed List of Hinterland Zones

No.	Internal/External Zone	Zone	No.	Internal/External Zone	Zone
1	Internal Zone	Bandung City 1	**16**	Internal Zone	Cimahi City 2
2	Internal Zone	Bandung City 2	**17**	Internal Zone	Cimahi City 3
3	Internal Zone	Bandung City 3	**18**	Internal Zone	Tegal City
4	Internal Zone	Bandung City 4	**19**	Internal Zone	Tegal Regency
5	Internal Zone	Bandung City 5	**20**	Internal Zone	Brebes Regency
6	Internal Zone	Bandung City 6	**21**	Internal Zone	Indramayu Regency 1
7	Internal Zone	Cirebon City 1	**22**	Internal Zone	Indramayu Regency 2
8	Internal Zone	Cirebon City 1	**23**	Internal Zone	Bandung Regency
9	Internal Zone	Cirebon City 1	**24**	Internal Zone	Kuningan Regency
10	Internal Zone	Sumedang Regency	**25**	Internal Zone	Subang Regency
11	Internal Zone	Bandung Barat Regency 1	**26**	Internal Zone	Purwakarta Regency
12	Internal Zone	Bandung Barat Regency 2	**27**	Internal Zone	Garut Regency
13	Internal Zone	Bandung Barat Regency 3	**28**	External Zone	Karawang Regency
14	Internal Zone	Majalengka Regency	**29**	External Zone	Tasikmalaya Regency
15	Internal Zone	Cimahi City 1	**30**	External Zone	Pemalang Regency

This survey aims to determine the probability of passenger shifting from Soekarno Hatta International Airport and Husein Sastranegara International Airport to Kertajati International Airport. The review of these two airports is based on the background of Kertajati International Airport's development, which aims to reduce the demand at Soekarno Hatta International Airport and redirect passengers from Husein Sastranegara International Airport to Kertajati International Airport, as the latter is intended solely for military activities.

Based on survey results with 200 respondents, the probabilities of passengers shifting from Soekarno Hatta International Airport and Husein Sastranegara International Airport to Kertajati International Airport are 67.3% and 55.1% respectively. Variables that inaccurately affect this include differences in travel time and fare between existing and planned routes.

The next step, equations for trip generation and attraction are sought to project demand, which will be used to form an Origin-Destination Matrix input into PTV Visum. Trip generation and attraction equations obtained using Stepwise 1 are as follows.

Trip Generation Equation $Y_1 = -159863.29 + 0.011X_1 + 41.93X_2 + 2169.69X_3 + 0.0012X_4$
Trip Attraction Equation $Y_2 = -170355.76 + 0.013X_1 + 50.93X_2 + 2299.35X_3 + 0.0014X_4$
Explanation:
Y_1 = Generation (passengers/year)
Y_2 = Attraction (passengers/year)
X_1 = Population
X_2 = Gross Regional Domestic Product (GRDP) at current prices
X_3 = Human Development Index (HDI)
X_4 = Number of tourists

Below are trip generation and attraction figures for each zone, measured in passengers/day for the base year 2023.

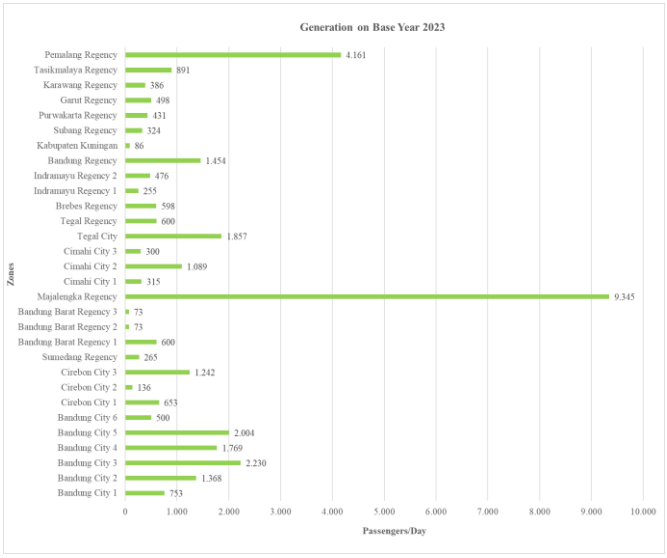

Figure 2. Generation on Base Year 2023

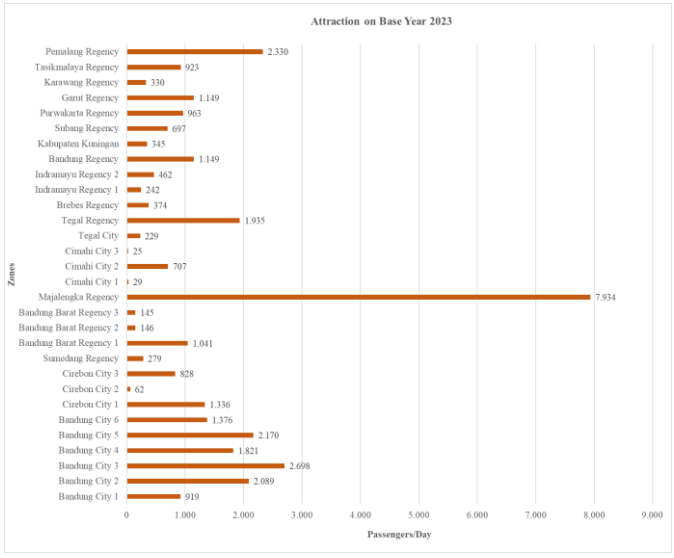

Figure 3. Attraction on Base Year 2023

After obtaining the Origin-Destination Matrix, trip assignments are conducted for a 20-year review period at intervals of 5 years (2028, 2033, 2038, and 2043). Public transport passenger travel is using a timetable-based concept. Output of this process is demand of bus passengers per route.

Figure 4. Trip Assignment on PTV Visum

Below are the demand figures for bus passengers per route (passengers/day) for the review year, which will be used as input for public transport analysts for multi-criteria analysis and quantity surveyors to calculate revenue.

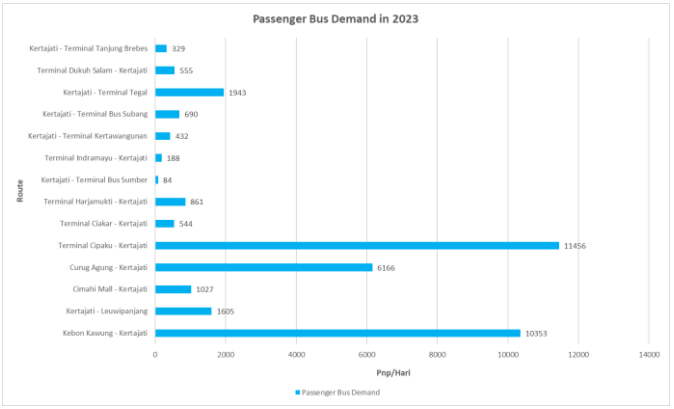

Figure 5. Passenger Bus Demand in 2023

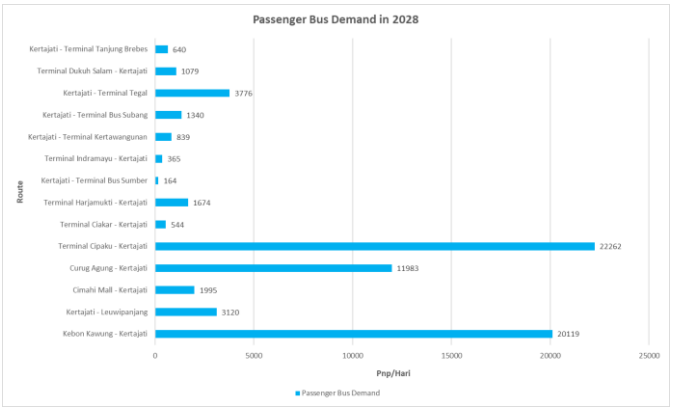

Figure 6. Passenger Bus Demand in 2028

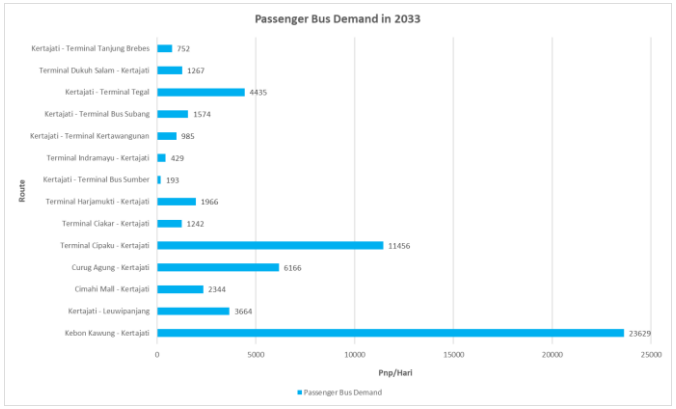

Figure 7. Passenger Bus Demand in 2033

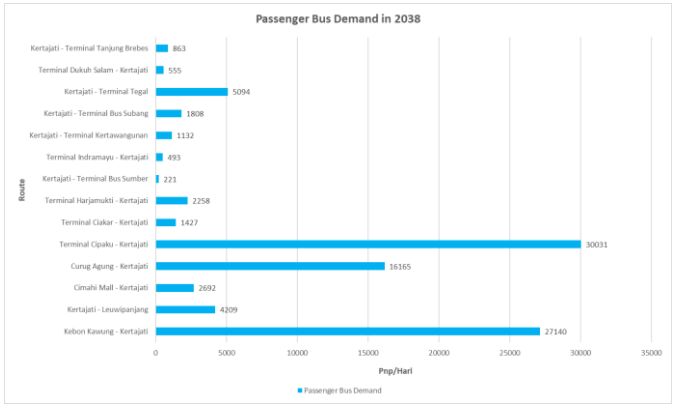

Figure 8. Passenger Bus Demand in 2038

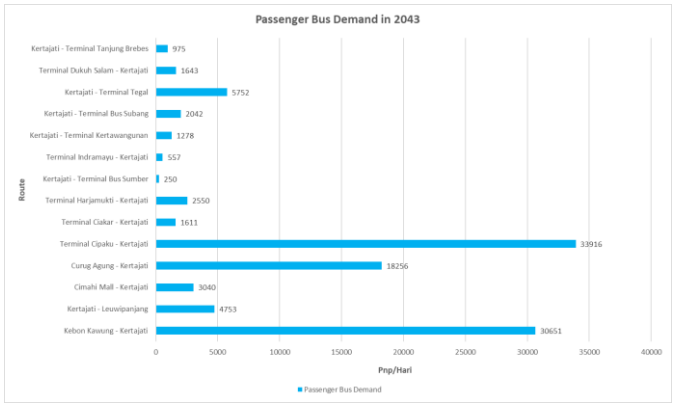

Figure 9. Passenger Bus Demand in 2043

4.5 Public Transport Analysis

The proposed plan includes a total of 14 routes for 14 cities and regencies. However, not all routes will be further developed, necessitating the identification of priority routes. These 14 routes will be categorized into several development priorities for public transportation. In this plan, the top 5 priority routes will be selected for development. The selection of priority route alternatives will use a multi-criteria analysis method.

Multi-criteria analysis is conducted to make decisions based on various criteria. This analysis will concider various perspectives in the selection and evaluation process. The multi-criteria analysis will review operational, spatial planning, economic and financial, also traffic aspects. The assessment will employ a scoring method to evaluate the relative importance of each criterion and determine their respective scores (priorities) in the analysis. Each variable will be evaluated using a Likert scale rangking from 0 to 10.The following are the criteria and their respective weights for each aspect in the multi-criteria analysis.

Table 8. Likert Scale Rangking

Criteria	Variable	Weight
Operational	Demand projection (pass/day) (1)	20%
	Time travel (min) (2)	10%
Land Use	Infrastructure accessibility (3)	8.67%
	Potential of region development (4)	11.67%
	Socio-economic (5)	9.67%
Economic and Financial	Vehicle operational cost (IDR) (6)	15%
	Value of time (IDR) (7)	10%
Traffic	Road reparation (IDR) (8)	8.25%
	Road elevation (%) (9)	6.75%

The results of the weighting from the multi-criteria analysis are presented in Table 9. Based on this weighting, five primary public transportation routes will be selected for development. The routes to be developed are Bandung City/Regency, Majalengka Regency, West Bandung Regency, and Cirebon City.

Table 9. Route Rank of Public Transportation

City/Regency	Traject	Opera-tional	Land Use			Economy and Fi-nancial		Traffic		Rank
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	
Bandung City/Regency	Traject 1	10	6	10	10	10	4	5	8	3	1
	Traject 2	9	7	8	10	9	4	6	9	10	2
West Bandung Regency	Traject 3	10	6	8	10	7	2	9	3	2	4
Cimahi City	Traject 4	8	7	5	10	4	3	7	4	10	6
Majalengka Regency	Traject 5	10	10	3	10	3	10	1	5	5	3
Cirebon City/Regency	Traject 6	5	8	10	10	1	7	3	6	5	5
	Traject 7	1	8	8	10	8	9	2	1	3	9
Kuningan Regency	Traject 8	2	6	3	3	2	6	4	1	1	14

Indramayu Regency	Traject 9	2	8	3	7	9	9	1	2	10	8
Sumedang Regency	Traject 10	3	9	3	3	4	8	10	10	10	10
Subang Regency	Traject 11	4	8	3	3	6	6	4	10	10	11
Tegal City/Regency	Traject 12	9	5	10	7	1	1	6	7	10	7
	Traject 13	4	2	5	7	5	1	9	10	10	12
Brebes Regency	Traject 14	2	5	5	3	6	5	8	1	10	13

The initial operational analysis involved establishing the travel time for each route and forecasting the hourly passenger volume. At this preliminary stage of analysis, the operational system is assumed to determine the track capacity utilization. Passenger potential and lane capacity can be a clue to find out how many fleets are needed and operate.

Table 10. Potential Selected Routes

City/Regency	Traject	Travel Time (min)	Headway (min)	Capacity (pass)	Number of Mode (veh)	Freq per vehicle
Bandung City/ Regency	Pool Leuwipanjang Terminal	± 88	60	23	13	5
	Pool Kebon Kawung	± 93	30	23	65	5
Majalengka Regency	Pool Cipaku Terminal	± 34	30	23	27	14
West Bandung Regency	Pool Curug Agung Terminal	± 98	60	23	40	5
Cirebon City	Pool Harjamukti Terminal	± 62	60	23	6	7

4.6 Financial and Economic Analysis

Economic analysis is a flow of returns on invested capital, not in the form of a flow of financial returns but direct benefits felt by the community, such as: savings in vehicle operating costs, time savings, reduced accident rates, regional development and environmental improvements. Economic analysis is based on vehicle operational costs and value of time.

1. Vehicle Operational Costs based on the calculation results, they are ranked sequentially from 1-14, namely Tegal Regency, Tegal City, West Bandung Regency, Cimahi City, Bandung City, Bandung

Regency, Brebes Regency, Kuningan Regency, Subang Regency, City Cirebon, Sumedang Regency, Cirebon Regency, Indramayu Regency and finally Majalengka Regency.

2. Value of Time, based on the calculation results, the ranking is carried out sequentially from 1-14, namely Indramayu Regency, Majalengka Regency, Kuningan Regency, Cirebon City, Subang Regency, Cirebon Regency, Tegal City, Brebes Regency, Bandung City, Kota Cimahi, Bandung Regency, Tegal Regency, West Bandung Regency, and finally Sumedang Regency.

Financial Analysis is the time needed to return profits. Financial feasibility analysis uses several indicators such as:

1. Net Present Value (NPV) is the difference between the value of cash inflows and the value of cash outflows in a certain time period which is adjusted to current conditions. NPV is a function of expenses, income, interest rates, and the time the income/expenses occur. The NPV value can be determined using the following equation:

$$NPV = \sum \frac{R_t}{(1+i)^t}$$

When:

Rt = The difference between income and expenses at time t

i = Interest rate

t = The difference in review time from the start

2. Benefit Cost Ratio (BCR) is a calculation method of comparing production costs with the benefits of a business project. The BCR value can be determined using the following equation:

$$BCR = \frac{\sum PV\ Benefit}{\sum PV\ Cost}$$

3. Payback Period is the period or number of years required to return the investment value that has been spent by investors. The payback period value can be determined using the following equation:

Payback Period = PV Benefit – PV Cost

Apart from reviewing the NPV and BCR values, it is also necessary to look at the time needed to cover back investment expenses (Payback Period). The following is a table of analysis results financial feasibility :

Table 11. Analysis Result Financial Feasibility

City / Regency	Discount Rate	∑ NPV	(NPV >0)	∑ PV Benefit	∑ PV Cost	BCR	(BCR >1)	Payback Periode
Bandung City	10 %	IDR 54.464.866.291.409,10	TRUE	IDR 101.291.835.240.556,00	IDR 46.786.515.762.897,40	2,16	TRUE	at the 11th year
	15 %	IDR 40.813.550.591.823,70	TRUE	IDR 79.734.499.069.547,70	IDR 38.880.495.291.474,00	2,05	TRUE	at the 11th year

	20%	IDR 31.990.197.802.851,20	TRUE	IDR 65.165.867.024.235,70	IDR 33.135.216.035.134,50	1,97	TRUE	at the 11th year
Bandung Regency	10%	IDR 4.795.261.621.786,00	TRUE	IDR 15.706.966.231.347,90	IDR 10.903.626.871.061,90	1,44	TRUE	at the 11th year
	15%	IDR 3.303.228.800.731,01	TRUE	IDR 12.364.146.644.360,50	IDR 9.052.840.105.129,47	1,37	TRUE	at the 11th year
	20%	IDR 2.386.984.970.222,89	TRUE	IDR 10.105.040.554.243,60	IDR 7.709.977.845.520,73	1,31	TRUE	at the 11th year
Cirebon City	10%	IDR 1.174.669.518.931,54	TRUE	IDR 6.319.759.555.885,19	IDR 5.140.918.132.953,65	1,23	TRUE	at the 11th year
	15%	IDR 699.946.404.123,01	TRUE	IDR 4.974.762.717.179,41	IDR 4.270.644.409.056,40	1,16	TRUE	at the 11th year
	20%	IDR 422.994.809.136,84	TRUE	IDR 4.065.802.386.690,99	IDR 3.638.635.673.554,15	1,12	TRUE	at the 11th year
Majalengka Regency	10%	IDR 15.528.210.262.569,70	TRUE	IDR 19.676.166.042.210,00	IDR 4.123.356.400.913,19	4,77	TRUE	at the 11th year
	15%	IDR 11.893.729.293.709,80	TRUE	IDR 15.459.346.493.484,30	IDR 3.541.017.821.047,35	4,37	TRUE	at the 11th year
	20%	IDR 9.504.596.954.870,35	TRUE	IDR 12.618.291.312.214,20	IDR 3.089.094.978.616,67	4,08	TRUE	at the 11th year
West Bandung Regency	10%	IDR 16.815.988.616.334,10	TRUE	IDR 52.955.888.389.098,60	IDR 36.105.510.828.212,50	1,47	TRUE	at the 11th year
	15%	IDR 11.546.128.850.947,30	TRUE	IDR 41.606.857.949.778,90	IDR 30.026.340.154.279,60	1,39	TRUE	at the 11th year
	20%	IDR 8.322.601.966.096,11	TRUE	IDR 33.960.521.142.174,40	IDR 25.603.530.231.526,30	1,33	TRUE	at the 11th year

Based on the results of the analysis carried out on the 5 (five) selected alternatives, namely Bandung City, Bandung Regency, West Bandung Regency, Cirebon City and Majalengka Regency, it was concluded that the five alternatives were financially "feasible".

5. Conclusion

Based on the studies and analyses conducted, the following conclusions were drawn:

- The route scenarios selected from the 14 proposed routes to increase the usefulness of Kertajati airport based on road mode are bus with route, demand, operating schedule, headway, fare, mode capacity, frequency, number of buses and investment cost, can be seen in the table below.

Table 12. Recapitulation of Selected Routes

City/Regency	Traject	Number of Passengers/day	
		From Airport	To Airport
Majalengka Regency	Pool Cipaku Terminal - Kertajati Airport	10661	11601
Bandung City	Pool Kebon Kawung - Kertajati Airport	9953	10166
Bandung Regency	Pool Leuwipanjang Terminal - Kertajati Airport	1277	1843
West Bandung Regency	Pool Curug Agung Terminal - Kertajati Airport	5951	6032
Kab/Kota Cirebon	Pool Harjamukti Terminal - Kertajati Airport	1211	462

Table 13. Characteristics Recapitulation of Selected Routes

City/Regency	Operational Schedule (hour)	Headway (minutes)	Fare (IDR/Km)	Vehicle Capacity	Trip Frequency	Number of Vehicle (Bus)
Majalengka Regency	21 (03:00 - 23:59)	30	IDR 31.000	23	9 bus/30 minutes	27
Bandung City		30	IDR 80.500		8 bus/30 minutes	65
Bandung Regency		60	IDR 80.500		3 bus/hour	13
West Bandung Regency		60	IDR 83.000		10 bus/hour	40
Kab/Kota Cirebon		60	IDR 70.000		2 bus/hour	6

Table 14. Recapitulation of Investment Costs of Selected Routes

City/Regency	Bus investments	Depot investments	Traffic Investments	Total
Majalengka Regency	IDR 33.275.070.000	IDR 6.235.075.375	IDR 3.453.536.705	IDR 42.963.682.080
Bandung City	IDR 80.106.650.000	-	IDR 399.861.250	IDR 80.506.511.250
Bandung Regency	IDR 16.021.330.000	-	IDR 134.147.000	IDR 16.155.477.000
West Bandung Regency	IDR 49.296.400.000	-	IDR 49.296.400.000	IDR 98.592.800.000
Kab/Kota Cirebon	IDR 7.394.460.000	-	IDR 19.481.489.104	IDR 26.875.949.104

- Proposed Scheme of financing and operation of the selected scenario from 50% PT Damri and 50% Bank Loan.
- Assumption development starts in 2023 as the base year with prioritisation of 5 selected routes.

References

1. D. Vetrovsky and A. Kanafani, “The Potential Role of Airports as Intermodal Terminals : Lessons from International and Domestic Experiences,” Uctc, no. 406, 1994.
2. Eko Prayitno, “Analisis Kemauan Penumpang Pesawat Udara Untuk Menggunakan Bus Trans Jogja”, JRFTSP, vol. 7, no. 1, pp. 43-58, Nov. 2019.
3. Elkhasnet, Muhammad Fathurrahman Al Rasyid, “Analisis Biaya Operasional Kendaraan (BOK) Angkutan Kota Trayek Cimahi–Leuwipanjang Bandung”, Jurnal Teknik Sipil ITENAS, vol. 6, no. 1, pp. 33-41, 2020.
4. J. Capah, “Potensi Pengembangan Angkutan Lanjutan Dengan Moda Transportasi Jalan Di Bandara Ahmad Yani Semaran g,” J. Penelitian Transportasi Darat, vol. 15, no. 1, pp. 19–30, 2013.
5. Mutiara Firdaus., “Analisis Pengembangan Penggunaan Moda Akses Bandara Internasional Adisutjipto Yogyakarta”, Institut Teknologi Sepuluh Nopember, 2015.
6. Mei Ling TAM, Mei Lam TAM, William H.K. LAM., “Analysis of Airport Access Mode Choice : A Case Study in Hong Kong”, Journal of the Eastern Asia Society for Transportation Studies, Vol. 6, 2005, 708-723.
7. N. El Hafizah and E. Hidayat, “Analisis Karakteristik Penggunaan Moda Akses Bandara Internasional Yogyakarta,” Borneo Eng. J. Tek. Sipil, vol. 3, no. 1, p. 40, 2019.
8. N. Mirzaei Varzeghani, M. Saffarzadeh, A. Naderan, A. Taheri., “Transportation Mode Choice Analysis for Accessibility of the Mehrabad International Airport by Statistical Models”, International Journal of Transport and Vehicle Engineering Vol:17, No:2, 2023.
9. S. Devianty, “Perencanaan Angkutan Pemadu Moda Bandara H.A.S. Hanandjoedin,” Semesta Tek., vol. 22, no. 1, pp. 11–20, 2019.
10. Thobie Rahardian Priyandono, Wahju Herijanto, Anak Agung Gde Kartika, “Analisis Kelayakan Dari Segi Ekonomi dan Finansial Teman Bus dengan Program Buy the Service Rute Terminal Purabaya-Kenjeran", Jurnal Teknik ITS, vol. 10, no. 2, pp. E273-E280, 2021.

11. Vukan R, Vuchic., “Urban Public Transportation System”, University of Pennsylvania Philadelphia, PA, USA, 1981.
12. Yoko Harianto, Santi Novano., “Service Performance Improvement of Airport Public Transportation (Case Study of Airport Bus in Terminal 3 Soekarno Hatta International Airport)”, 1st International Multidisciplinary Conference on Education, Technology, and Engineering (IMCETE 2019).