Study of Parking Capacity, Needs, and Effectiveness in Syamsudin Noor Banjarmasin Airport Banjarbaru City Province South Kalimantan

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Abstract— Syamsudin Noor Banjarmasin Airport is a public airport that is used for public purposes managed by PT. AngkasaPura I.The increasing number of aircraft passengers at the Syamsudin Noor Banjarmasin airport makes activities at the airport increasingly high, so that the need for adequate parking facilities is needed. Based on the terms of service it is $14m^2$/passenger for domestic and $17m^2$/passenger for international. So in this condition, Syamsudin Noor Airport has experienced Overcapacity. Therefore, to meet the requirements for eligibility standards, it is necessary to develop SyamsudinNoor Airport in the near future. The research method used was calculating the performance of the car park at the old terminal.Analysis of research data WAS to present a study analysis of capacity, parking requirements, and effectiveness, by measuring the parking accumulation, parking volume, parking duration, parking index, parking capacity, parking turn over, and parking supply. The next analysis is implementing the effectiveness of parking at the new airport terminal.Parking performance at Syamsudin Noor Airport for two-wheeled and four-wheeled vehicles is not sufficient for parking needs, where the volume of vehicles is greater than the airport's parking capacity. Parking effectiveness based on development at the new Syamsudin Noor Banjarmasin Airport terminal increase based on the parking space for two-wheeled vehicles is 7.300 vehicles,making it effective up to 16 years (in 2034), which are 6.730 units of two-wheeled vehicles.While the parking space for four-wheeled vehicles is as much as 3.800 vehicle unit, so it is effective up to 14 years (in 2032) which is for3.556 four-wheeled vehicle units.

Keywords— airport parking parking capacity, parking requirements, parking effectiveness.

I. INTRODUCTION

Parking conditions and their use at the airport is a very serious problem. This is due to the high level of demand from users of parking at the airport for all vehicle modes,both for two-wheeled vehicles or four wheels. In general, airports in Indonesia have large parking lots, but the capacity decreases by the time, as a result of an increase in the population of a region, easiness to fulfil air transportation needs, improvement of the quality of roads, and the complexity of social and business activities in the society. This has an impact on the availability of parking spaces which are reduced, to be able to accommodate the entire vehicle that will use the parking area. Parking control is becoming increasingly difficult because there are no alternative modes of choice to and from the airport area, while the land used for the development of the parking area is very limited.[1]

The airport development is in response to an increase in the number of airport visitors, who not only need a place to walk, but also need a place to stop. Private vehicles are the most convenient and flexible mode in terms of travel time so that these modes become very dominant at airports throughout the world.[2] Parking per hour parking rates are a common management strategy based on the duration of use of parking facilities (dwell time).[3]

Less orderly and parking density and the difficulty of finding an empty parking lot during rush hour becomes a problem that occurs at Syamsudin Noor Banjarmasin Airport. This is indeed a very disturbing movement around the area. In fact, the existence of an activity should be as minimal as possible causing disruption to the flow of traffic around it the problems that occur, there is a need for further studies to assess the capacity, needs, and effectiveness of parking at

Syamsudin Noor Banjarmasin Airport. The objectives to be achieved in this study were to find out the needs, parking space capacity and effectiveness of vehicle parking services at Syamsudin Noor Banjarmasin Airport.[4]

The formulation of the problems raised in this study are as follows:

a. What is the analysis of the parking space capacity based on the development at the Syamsudin Noor Banjarmasin Airport?

b. What is the level of parking needs based on the development at Syamsudin Noor Banjarmasin Airport?

c. What is the level of parking effectiveness based on the development at Syamsudin Noor Banjarmasin Airport?

Based on the formulation of the problems raised, the purpose of this study was to:

a. Know and analyze the parking space capacity based on development at Syamsudin Noor Banjarmasin Airport.

b. Know and measure the level of parking needs based on development at Syamsudin Noor Banjarmasin Airport.

c. Know and measure the parking effectiveness based on development at Syamsudin Noor Banjarmasin Airport.

It is expected that this research can provide input on meeting parking needs based on the capacity and efficiency of parking use after the development of Syamsudin Noor Banjarmasin Airport.

In this study the writer proposeda discussion with the following limitations:

a. Parking capacity and needs at the Syamsudin Noor Banjarmasin Airport at the parking location before and after the parking lot was expanded.

b. Parking specifications are for two-wheeled vehicles, airport taxis, and airport transportation (cargo).

II.   LITERATURE REVIEW

Parking is an immovable state of a vehicle that is not temporary and the driver leaves the vehicle including the interest in raising and lowering people or goods. Parking facilities are an important part of the land transportation system. The need for parking for vehicles both private vehicles, public passenger transportation, motorbikes and trucks is very important. The parking needs depend on the shape and characteristics of each vehicle with the design and location of the parking lot. Parking problems basically occur when the number of parking needs is greater than the parking capacity, so that it can disrupt traffic around the parking lot.[5]

Separate parking is intended for air bandra workers.

This area must be as close as possible to office facilities. Parking requirements for rental cars must be consulted with the rental permit holder. Although it is often expected that rental car parking is as close to the terminal building as possible to minimize passengers to walk far, there is a tendency to locate small rental car parking facilities in terminal buildings to drive from the terminal and rental car parking. Departure passengers can park the rental car away from the rental parking area but still near the airport access road, the rental party will provide transportation to the terminal. This is a general arrangement at a large airport.[6]

Management of airport parking performance consists of several characteristics,is as follows:[7]

a. Parking Accumulation

Parking accumulation is the total number that is parked somewhere at a certain time and divided according to the category of purpose of the trip.

Calculation of accumulated parking can use the equation of:

Accumulation $= Km - Kk$

Where, Km is a vehicle that enters a parking location Kk is a vehicle that exits the parking location, and x is the number of vehicles that have been parked before observation.

b. Parking Volume

Parking volume is the number of vehicles included in the parking load (which is the number of vehicles per period of time).

The formula used to calculate parking volume is:

Volume $= Nin + X$ (vehicle)

Where, Nin is the number of vehicles that enter, and X are *vehicle that existed before the survey time*.

c. Parking Duration

Parking duration is the time used by a vehicle to park at a place where the average value can vary for any given period.The duration of parking is obtained by finding the difference between the time when the vehicle leaves the parking location and the time when the vehicle enters the parking lot.

Duration $= Ti - To$

Where, Ti is the time the vehicle enters (hours), and To is the time the vehicle exits (hours).

d. Parking Index

Parking index is another measure to state the use of parking lots expressed as a percentage of space occupied by parking vehicles.

$$IP = \frac{AP}{R} \; X \; 100$$

where: *IP* is a parking index, *AP* is accumulated parking, and *R* is available parking space.

e. Parking Capacity

Parking capacity is the maximum ability of a

parking space in accommodating vehicles, in this case is the volume of vehicles using existing parking facilities.The formula used to calculate parking capacity is:

$$KP = \frac{Service\ time}{D}\ X\ S$$

where, *KP*is parking capacity (vehicle / hour), *S*is the number of parking lots (plot), and*D*is the average duration of parking (hours / vehicle).

f.   Parking Turnover

Parking turnover is a number that shows the level of use of parking spaces obtained by dividing the parking volume by the number of parking spaces for each unit of time. The formula used to calculate parking turnover is:

$$TR = \frac{n}{R}$$

where, *TR*is the number of parking changes (vehicle / plot / hour),*n*is the total number of vehicles at the time of the survey, and*R*is available parking space (SRP).

g.   Parking Supply

Parking supply or the ability to provide parking is the size limit for the number of vehicles that can be accommodated for a certain period of time (during survey time). The formula used to state the parking supply is as follows:

$$Ps = \frac{S.Ts}{D}\ X\ F$$

where, *Ps* = the capacity of the vehicle that can be parked (vehicle), *S*is the number of parking lots available at the research location (plot), *Ts*is the length of the analysis period/survey time (hours), *D*is the average parking time (hour / vehicle), *F*is a reduction factor due to parking changes, the value is between 0.85 to 0.95.

III.   RESEARCH METHODS

3.1 Initial Survey
Aninitial survey was conducted by collecting data on the spatial master plan for the development of Syamsudin Noor Banjarmasin Airport. Based on the initial survey, we can see the parking location, planned parking area, and the design of road infrastructure and parking facilities.

3.2 Data Collection
The research data is an inventory survey of parking survey facilities, questionnaire, parking manager interview, and literature study.

3.3 Research Data Analysis
The results of research data collection used to conduct capacity studies, needs, and parking

effectiveness were then analyzed using the following analysis tools.

IV.   RESEARCH RESULTS AND DISCUSSION
Based on the estimated development data on the increase in the number of aircraft and the number of passengers that researchers can get from PT AngkasaPura I Banjarmasin, it shows that 2011 was the initial year of investment in the development of the Syamsudin Noor Airport terminal and forecastingin 2019 to 2026 as can be seen in Table 1 below.

Table.1: Data on Number of Aircraft and Number of Passengers Based on Development of Airport Terminal Investment

No.	Information	Year	Number of aircraft (Unit)	Total passenger (person)
1.			11.242	2.404.121
2.	Realization operational Terminal Airport	2013	13.475	3.389.001
3.		2014	14.601	3.708.516
4.		2015	14.745	4.022.904
5.		2016	14.067	4.355.381
6.		2017	14.577	4.732.812
7.		2018	14.885	5.114.811
8.		2019	15.631	5.509.761
9.	*Forecasting*Based on Airport Terminal Development	2020	15.856	5.914.522
10.		2021	16.437	6.754.465
11.		2022	16.574	7.761.867
12.		2023	16.389	8.196.271
13.		2024	18.708	8.634.165
14.		2025	20.022	9.107.980
15.		2026	22.355	9.598.071

Source: PT AngkasaPura I (2018).

4.1 Analysis of Parking Performance of Syamsudin Noor Airport

1.   Parking Accumulation
Parking accumulation is calculated based on the number of vehicles entering minus the number of vehicles exiting, and deducted by the number of vehicles that have been in the parking location before the time of the study. [8]The accumulation of parking with the maximum number of two-wheeled vehicles is happening at 07.800 – 08.100 which is 895 units, while the minimum number of two-wheeled vehicles is at 15.00-16.00, which is 351 units. The accumulation of parking with the maximum number

of four-wheeled vehicles is happening at 12.00 – 13.00 which is 502 units, while the minimum number of four-wheeled vehicles is at o'clock 06.00 – 07.00 which is 183 units.

The calculation results show the results of accumulated parking as follows:

a. Two-wheeled vehicle:

Vehicle entered = 2.106 units

Vehicle exited= 952 units

Vehicles that have been parked before the observation time = 1.829

Based on these calculations, the total accumulation of parking for two-wheeled vehicles at Syamsudin Noor Airport is as follows :

Accumulation = 2.106 – 952 – 1.829

= 2.983 units

b. Four-wheeledvehicle:

Vehicle entered = 1.695 units

Vehicle exited= 745 units

Vehicles that have been parked before the inspection time = 1.171 units

Based on these calculations, the total accumulation of parking for four-wheeled vehicles at Syamsudin Noor Airport is as follows :

Accumulation = 1.695 – 745 – 1.171

= 2.121 units

2. Parking Volume

The results obtained are the parking volume of two-wheeled and four-wheeled vehicles at Syamsudin Noor Airport. Parking volume with the maximum number of two-wheeled vehicles is happening at 07.00 – 08.00 o'clock which is 1.212 units, while the minimum number of two-wheeled vehicles is at 15.00 – 16.00 o'clock which is 457 units. Parking volume with a maximum number of four-wheeled vehicles is happening at 15.00 – 16.00 which is 753 units, while the minimum number of four-wheeled vehicles is at 06.00 – 07.00 o'clock which is 259 units.

Syamsudin Noor's total airport parking volume is calculated based on the Volume formula = *Nin + X* (vehicle), where, *Nin* is the number of vehicles entering,and*X* is *a vehicle that has been there before the survey time*. The calculation results show the results of the parking volume as follows:

a. Two-wheeled vehicle:

Vehicle entered = 3.859 units

Vehicles that have been parked before the time of observation = 5.972 units

Based on these calculations, the total parking volume of two-wheeled vehicles at Syamsudin Noor Airport is as follows.

Volume = 3.859 + 5.972

= 9.831 units

b. Four-wheeledvehicles:

Vehicle entered = 3.759 unit

Vehicles that have been parked before the time of observation = 2.763 units

Based on these calculations, the total parking volume of four-wheeled vehicles at Syamsudin Noor Airport is as follows.

Volume = 3.759 + 2.763

= 6.522 units

3. Parking duration

Parking duration is the time span used by vehicles to park at a place where the average value can vary for each period of study time.Based on the results of observations that the researchers got in the sample of 50 units of the first two-wheeled vehicle, the parking duration data was generated.

4. Parking Index

The observations show an analysis of parking index calculations at Syamsudin Noor Airport,it can be seen that the available parking spaces experience a lack of parking capacity based on the parking for two-wheeled vehicles at 07.00 - 08.00 o'clock which is equal to 119.33% (lack of 19,33%). Whereas for four-wheeled vehicles there is a lack of capacity based on the parking index at 12.00 - 13.00 o'clock which is equal to 125.50 (deficiency of 25.50%) and at 15.00 – 16.00 which is equal to 126.75% (deficiencyof 26.75%).

5. Parking Capacity

Based on the calculation of parking capacity based on research time for two-wheeled vehicles,in every time of the study one day produces an analysis of fluctuating parking capacity. The maximum parking capacity for two-wheeled vehicles is happening at 11.00 - 12.00 which is equal to 1.212 units. While the minimum parking capacity for two-wheeled vehicles is happening at 15.00-16.00, which is 1.051 units.

Based on Table 4.8 it can be seen parking capacity based on research time for four-wheeled vehicles,where in every time of the study in one day produces an analysis of fluctuating parking capacity. The maximum parking capacity for four-wheeled vehicles is happening at 11.00 - 12.00 which is equal to 664 units. While the minimum parking capacity for four-wheeled vehicles is happening at 13.00 - 14.00 which is equal to 539 units.

6. Parking Turnover

The parking turnover of two-wheeled vehicles at Syamsudin Noor Airport reaches the maximum level at 07.00 - 08.00 which is equal to 1,44or equal to 144%. While the minimum achievement is at 15.00 - 16.00

which is equal to 0,29or equal to 29%. The turnover of four-wheeled vehicles parking at Syamsudin Noor Airport reaches its maximum level at 15.00 - 16.00 which is equal to 1.78 or equal to 178%. While the minimum achievement is at 07.00 - 08.00 which is equal to 0.85 or equal to 85%.

7. Parking Supply

The results of observing the data for the calculation of the analysis of parking supply based on the parking space capacity at Syamsudin Noor Airport for two-wheeled vehicles reaches the maximum levelat 07.00 – 08.00 o'clock which is equal to 1,086 units. While the minimum achievement is at 15.00 - 16.00 which is equal to 970 units. Parking supply based on the parking space capacity at Syamsudin Noor Airport for four-wheeled vehicles reaches the maximum level at 10:00 - 11.00 which is equal to 592 units. While the minimum achievement is at 07.00 - 08.00 which is equal to 541 units.

4.2 Analysis of Parking Needs of Syamsudin Noor Airport

Parking needs at Syamsudin Noor Airport each year have increased,where this is considered based on an increase in the number of passengers and an increase in the number of flights that occur each year (Table 4.1 page 30).

The average capacity of parking spaces at the Syamsudin Noor Airport can now be said to be lacking in meeting parking needs, even though on average they have capacity that can meet the number of needs, but during the solid hours the capacity does not meet the parking needs, both two wheels and four wheels.Parking performance of two-wheeled vehicles at 07.00 - 08.00 (lack of data capacity of 115 units), 08.00 - 09.00 (lack of data capacity of 70 units). This shows that parking capacity for two-wheeled vehicles is not sufficient for parking, where the volume of two-wheeled vehicles parked is greater than the parking capacity of the airport. While at the other research times, capacity meets the parking needs of two-wheeled vehicles.

Parking performance of four-wheeled vehicles at 13.00 - 14.00 (lack of capacity of 205 units), 15.00 - 16.00 (lack of capacity of 179 units), 16.00 - 17.00 (lack of capacity of 126 units), and 17.00 - 18.00 (lack of capacity of 36 units This shows that parking capacity for four-wheeled vehicles is not sufficient for parking, where the volume of four-wheeled vehicles parked is greater than the parking capacity of the airport.

Parking space on the development of a new terminal in Banjarmasin Syamsudin Noor Airport consists of 2 parts, with the planning of two-wheeled and four-wheeled parking facilities for airport visitors are as follows.

1. Parking area for departure
   The parking area for departure visitors has an area of 22,400 m2 which is divided into 2 parts, which are:
   a. An area of 14.500 m2 is used for four-wheeled vehicles, with a parking capacity of 1800 cars.
   b. An area of 7.900 m2 is used for two-wheeled vehicles, with a parking capacity of 3500 motorcycle units.
2. Parking area for arrivals
   The parking area for arrivals visitors has an area of 22,700 m2 which is divided into 2 parts, which are:
   a. An area of 15.000 m2 is used for four-wheeled vehicles, with a parking capacity of 2000 cars.
   b. An area of 7.700 m2 is used for two-wheeled vehicles, with a parking capacity of 3800 motorcycle units.

The average volume of two-wheeled vehicles is 829 units, while the average volume of four-wheeled vehicles is 569 units. Based on the description of the new terminal parking area of Banjarmasin Syamsudin Noor Airport, the parking capacity of the parking area is 3.800 units of four-wheeled vehicles, and 7.300 units of two-wheeled vehicles. The development of the number of passengers each year has increased by an average of 13.98% (obtained from the growth in the number of passengers each year), so that the parking effectiveness of the new terminal of Banjarmasin Syamsudin Noor Airport with the volume of two-wheeled and four-wheeled vehicles for the next few years can be seen in forecasting an increase in parking service capacity.

Table.2: The Effectiveness of Parking Services at the New Terminal of Syamsudin Noor Airport Every Year (Estimated Increase of 13.98%)

Year	Two wheels (Capacity of 7.300 units)	Four wheels (Capacity of 3.800 units)
2018	829	569
2019	945	649
2020	1.077	740
2021	1.228	843
2022	1.400	961
2023	1.595	1.095
2024	1.819	1.248
2025	2.073	1.423
2026	2.363	1.622
2027	2.693	1.849
2028	3.069	2.107

2029	3.498	2.402
2030	3.987	2.737
2031	4.545	3.120
2032	5.180	**3.556**
2033	5.904	4.053
2034	**6.730**	4.620
2035	7.671	5.266
2036	8.743	6.002

Source: Data processed (2018)

The results of the parking effectiveness analysis on the development of the new terminal in Banjarmasin Syamsudin Noor Airportcan be seen that the use of parking lots as the development of airport visitor parking services can be seen that the implementation of the airport's new terminal development is dividing the parking area into two parts, which are the parking area for visitors to departures and parking areas for visitors. Based on the parking area provided later, it can be achieved the effectiveness of adequacy, capacity, and feasibility of parking services based on forecasting the development of parking volume carried out by PT. AngkasaPura I every year.

The parking space for two-wheeled vehicles is 7.300 vehicles, so that based on the development of forecasting parking needs every year, then the two-wheeled parking area can be effective up to 16 years (in 2034), which is 6.730 units of two-wheeled vehicles. While the parking space for four-wheeled vehicles is 3,800 vehicles, so that based on the development of forecasting parking needs every year, then the four-wheeled parking area can be effective up to 14 years (in 2032), which is 3,556 units of four-wheeled vehicles.

V. CLOSE

5.1 Conclusions

1. The capacity of the parking space based on development at the Syamsudin Noor Airport in Banjarmasin for two-wheeled vehicles occurs at 07.00 - 08.00, which is 1.143,29 units. Whereas the minimum parking capacity for two-wheeled vehicles occurs at 15.00-16.00 which is equal to 1.021,33 units? The maximum parking capacity for four-wheeled vehicles occurs at 10:00 - 11:00 which is equal to 622,73 units, while the minimum parking capacity for four-wheeled vehicles occurs at 07.00 - 08.00 which is equal to 569.53 units.

2. Parking for two-wheeled and four-wheeled vehicles is not sufficient for parking, where the volume of two-wheeled vehicles parked is greater than the parking capacity of the airport. The average capacity of two-wheeled vehicles is 1.033,2 units while the average parking volume is 787 units. The average capacity of four-wheeled vehicles is 552 units while the average parking volume is 593 units so there is still a lack of availability of four-wheeled vehicle parking at 41 units.

3. The effectiveness of parking based on developments at the Syamsudin Noor Airport in Banjarmasin is increasing based on the parking space for two-wheeled vehicles at 7.300 units and effective up to 17 years (in 2035). While four-wheeled vehicles are 3,800 units of vehicles and are effective up to 14 years (in 2032).

5.2 Suggestions

1. For PT. AngkasaPura I, It is expected that it can improve the performance of airport parking services, making it easier to manage and manage services to airport users. In addition, PT. AngkasaPura I is also expected to be able to implement a digital parking system so that it can be a major aspect to increase parking revenue based on an increase in the number of parking users.

2. For Airport Parking Users, it is expected to be able to utilize the parking area of Syamsudin Noor Airport in accordance with predetermined service needs. Regularity in parking use in addition to providing benefits for parking managers, should also provide benefits and convenience for parking users in the use of airport facilities.

3. For Further Research, it is expected to develop research by presenting aspects that affect the effectiveness of the use of airport parking, among others, by expressing the factors of service quality, the provision of facilities and infrastructure, the level of parking security and others.

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