

## Analysis of Vehicle Parking Area Management to Support Ground Side Operational Efficiency at Sultan Aji Muhammad Sulaiman Sepinggan Airport Balikpapan

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Article Info	ABSTRACT
<p><b>Article History:</b> Submitted: July 7, 2025 Revised : July 25, 2025 Accepted : August 8, 2025</p> <hr/> <p><b>Keywords:</b> <i>Airport Parking Management, Operational Efficiency, Sultan Aji Muhammad Sulaiman Seppingan Balikpapan Airport</i></p>	<p>The increasing volume of vehicles entering Sultan Aji Muhammad Sulaiman Sepinggan Airport demands more efficient parking area management. However, several issues persist, including underutilized parking capacity, poor facility conditions, and the misuse of drop zones as long-term parking areas, leading to congestion and operational inefficiency. This study aims to analyze parking area management and its impact on ground-side operational efficiency. A mixed-method approach was employed, combining field observations, interviews, documentation, and a questionnaire distributed to 50 vehicle users and relevant airport personnel. Statistical analysis using simple linear regression shows a positive and significant relationship between parking management and operational efficiency, with a regression coefficient of 0.820 and <math>p &lt; 0.001</math>. Qualitative findings further reveal issues such as waterlogging, non-functional elevators, unclear signage, and lack of enforcement. These conditions reduce user satisfaction and hinder optimal circulation. This study recommends an integrated strategy involving parking zone reconfiguration, smart parking technologies, and regulatory enforcement aligned with Manual of Standard Land Side Operation Facility issued by PT Angkasa Pura I (Persero). Although the model is limited by a small sample and single-variable analysis, the results provide relevant insights for improving both service quality and non-aeronautical revenue at the airport.</p>

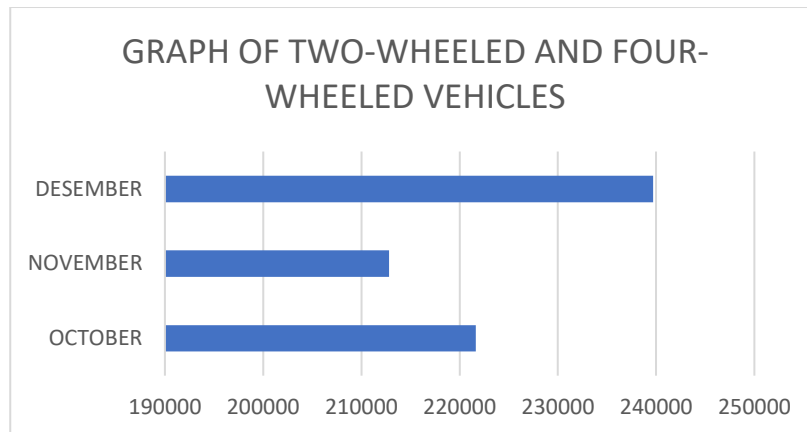
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## INTRODUCTION

Airports, as air transportation hubs, not only serve as departure and arrival points for aircraft, but also have high operational complexity, not only on the airside but also on the landside [1]. One of the key elements in landside operations is parking area management, which plays a crucial role in ensuring smooth vehicle flow, passenger comfort, and terminal service efficiency [2]. Additionally, effective parking management not only supports daily airport operations but also has the potential to become a significant source of non-aeronautical revenue [3].



**Figure 1.** Graph of the Movement of 2-wheeled and 4-wheeled Vehicles Entering the Airport Area from October to December[1]

Due to the increase in the demand for vehicle parking services, Sultan Aji Muhammad Sulaiman (SAMS) Sepinggan Balikpapan Airport needs to prepare adequate parking facilities to accommodate this demand. At SAMS Sepinggan Balikpapan Airport itself, parking areas have been constructed with large capacity and modern facilities. However, in reality, various issues are still encountered on-site, such as vehicle congestion in the drop-off zone, inadequate optimization of parking space, and irregular vehicle circulation. These issues could potentially lead to negative perceptions of airport services. On the other hand, if landside services such as parking areas and drop zones are designed and managed with a good system, they can improve operational efficiency, enhance service quality, and boost customer satisfaction [4].

Several studies have discussed parking management in public and commercial environments, but research specifically reviewing the importance of the relationship between parking area management and airport operational efficiency, particularly in eastern Indonesia such as SAMS Sepinggan Balikpapan Airport, is still limited. Therefore, a study focusing on the evaluation and analysis of parking management strategies in supporting the smooth operation of the land side is needed.

Therefore, it is necessary to conduct a comprehensive analysis of the parking area management system at SAMS Sepinggan Balikpapan Airport and evaluate the extent to which this management supports the operational efficiency of the ground side. The results of this study are expected to provide recommendations for airport managers in improving service quality and optimizing the use of parking facilities [5].

This research only focuses on the management of parking area, *drop zone*, and its impact on the operation of SAMS Sepinggan Balikpapan Airport. The data used comes from observations, interviews, documentation and questionnaires during the period of the author's *On the Job Training*. The analysis only includes four-wheeled vehicles that use the parking area and *drop zone*.

## METHODS

This research employs a mixed-method approach, combining descriptive qualitative insights from interviews and observations with quantitative data analysis as supporting data obtained through distributing questionnaires to the respondents [6]. The data from the questionnaires were statistically processed using Statistical Package for the Social Sciences (SPSS) to provide reinforcement to the

qualitative findings from observations and interviews. Thus, the quantitative approach is complementary to strengthen the results of the main qualitative analysis [7].

### Research Variables

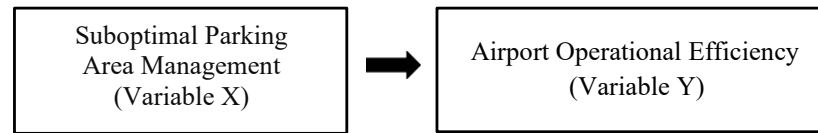


Figure 2. Research Variables

### Population

Sugiyono stated that population is a generalization area consisting of objects or subjects set by researchers to study and then draw conclusions [8]. In this study, the population used as the object of research is airport parking officers, terminal service officers, aviation security officers and SAMS Sepinggan airport passengers.

### Sample

The sampling technique used in this study is purposive sampling, a non-probability method where participants are deliberately selected based on their relevance to the research objectives [9]. This approach is appropriate given the need to obtain in-depth insights from individuals directly involved in, or affected by, the parking area operations at Sultan Aji Muhammad Sulaiman Sepinggan Airport. The selected sample consisted of key stakeholders and service users within the airport's landside area. Specifically, it included one aviation security officer, one parking attendant, the team leader of the Terminal Service Officer unit, the Airport Operation Landside and Terminal Manager, and 50 four-wheeled vehicle users who utilized the parking and drop-off facilities at the airport. Although the sample size is relatively small, the regression analysis applied in this study serves an exploratory purpose, not for population, wide generalization but to identify preliminary patterns and relationships between variables in a real operational setting [10].

These individuals were chosen because of their firsthand experience and operational knowledge, which are critical in understanding the challenges and dynamics of parking area management. This sampling aims to obtain accurate information about parking area management and how it affects user experience at Sultan Aji Muhammad Sulaiman Sepinggan Balikpapan International Airport.

The sampling was designed to gather accurate insights from both the managerial and user perspectives regarding the management of the parking area and its influence on service experience. By involving key personnel and service users directly, this study aims to generate practical findings that can inform improvements in landside operational efficiency.

### Data Collection Technique






Data collection techniques in this study were divided into four techniques, namely observation, interview, documentation, and questionnaire. The observation conducted is the observation required for the object of research regarding the analysis of vehicle parking area management to support the efficiency of land-side operations at SAMS Sepinggan Balikpapan Airport. The observation method is important because it is able to provide an opportunity for researchers to obtain more in-depth and contextual information. Then, the author conducted intensive interviews with an aviation security officer, a parking attendant, a Terminal Service Officer (TSO) team leader, and the Manager of Airport Operation Landside and Terminal in order to obtain information related to problems in the parking lot, and *drop zone*. Furthermore, to obtain data on the general description of the airport, circumstances related to the optimization of the parking building area and drop zone, as well as other records, the author used documentation data collection in collaboration with the airport. Finally, the researcher also collected questionnaire data through a questionnaire containing a series of statements related to the issue under study and addressed to service users at Sultan Aji Muhammad Sulaiman Sepinggan Balikpapan

International Airport with a total of 50 respondents. This questionnaire uses Likert scale with 20 statement items through google form platform.

## RESULT AND DISCUSSION

### Observation Results

**Table 1.** Findings on Parking Building and Drop Zone  
FINDINGS ON PARKING LOT AND DROP ZONE

No	Date	Area	Documentation	Description
1	January 3, 2025	Vehicle Parking Building		Puddles, especially when it rains
2	January 3, 2025	Drop Zone		A number of vehicles stopped for a long time in the drop zone area (about 21 minutes), even though the maximum time to stop in the area is only 3 minutes.
3	January 23, 2025	Vehicle Parking Building		Some lighting is not working, the placement of direction signs is less visible
4	January 23, 2025	Vehicle Parking Building		Vehicles are parked in an unorganized condition
5	January 23, 2025	Parking Lot Elevator		Three out of four elevator units are not functioning

The findings of this study indicate that the parking area management at Sultan Aji Muhammad Sulaiman Sepinggan Airport is still not optimal. One of the most critical issues is the tendency of vehicle users to avoid using the designated parking building and instead occupy the drop zone area for extended periods. This behavior contributes to congestion at the terminal frontage and reduces the efficiency of groundside circulation.

Based on observations, this practice clearly violates provisions outlined in the Manual of Standard Land Side Operation Facility issued by PT Angkasa Pura I (Persero), which explicitly prohibits the use of the drop zone as a parking area. According to the standard, the drop zone must only be used for short-term stops with a maximum duration of three minutes, intended solely for passenger drop-off and pick-up. However, in practice, this rule is frequently ignored, as many drivers park their vehicles in the drop zone for extended periods, often without active enforcement from airport personnel.

This gap between regulatory standards and on-site behavior highlights the urgency of implementing better control mechanisms, including physical separation between drop zones and parking access, improved signage, and the use of digital monitoring systems. These findings will be further explored in the discussion section, with a focus on corrective strategies that align infrastructure use with operational policies.

### **Interview Results**

Based on interviews conducted with three elements of field officers, Airport Operation Landside Terminal, Aviation Security, and parking managers, it is found that the main obstacle in the drop zone area is motorists who park carelessly and exceed the stopping time limit. The result of this undisciplined behavior often causes congestion in the drop zone area. This congestion is exacerbated by the lack of officers and the lack of visible road signs. According to Interviewee 1, congestion most often occurs during peak hours, between 11am and 1pm and between 5pm and 6pm.

The result of this irregular utilization of the drop zone access is ineffective use of the parking building. Interviewee 3 complained that the parking lot was quiet even though the drop zone area was full of vehicles parked there. In the end, in order to enforce the parking lot, the officers put a paper with the words "no parking" on the windshields of the cars that were parked in the drop zone area. Interviewee 1 hopes that the idea of premium parking can be implemented with the cooperation of TNI / Polri personnel so that the conditions in the drop zone area are more conducive and the parking lot can be effectively used by airport visitors.

## Questionnaire Results

### 1. Validity Test

The results of the validity test using SPSS for the research variables with a significance level of 5% on 50 respondents are shown below:

**Table 2.** (a) X Variable Validity Test Results (b) Y Variable Validity Test Results

Statement	r Count	r Table	Description	Statement	r Count	r Table	Description
P1	0,591	0,2787	VALID	P1	0,458	0,2787	VALID
P2	0,465	0,2787	VALID	P2	0,500	0,2787	VALID
P3	0,583	0,2787	VALID	P3	0,402	0,2787	VALID
P4	0,369	0,2787	VALID	P4	0,541	0,2787	VALID
P5	0,384	0,2787	VALID	P5	0,529	0,2787	VALID
P6	0,507	0,2787	VALID	P6	0,463	0,2787	VALID
P7	0,405	0,2787	VALID	P7	0,351	0,2787	VALID
P8	0,484	0,2787	VALID	P8	0,635	0,2787	VALID
P9	0,528	0,2787	VALID	P9	0,500	0,2787	VALID
P10	0,619	0,2787	VALID	P10	0,551	0,2787	VALID

(a)

(b)

The calculated r value for each statement tested produces a positive value and is greater than the r table value so that it can be concluded that all statements on the operational efficiency variable are valid and can be used in the analysis.

### 2. Reliability Test

**Table 3.** (a) X Variable Reliability Test Results (b) Y Variable Reliability Test Results

Reliability Statistics		Reliability Statistics	
Cronbach's Alpha	N of Items	Cronbach's Alpha	N of Items
,657	10	,656	10

(a)

(b)

From the table above using SPSS, it is known that the variable service quality of flight security personnel has a Cronbach's Alpha value of 0.657. And the operational efficiency variable has a Cronbach's Alpha value of 0.656. Therefore, it can be concluded that variables X and Y have reliable answer constructs, so that research can be continued.

### 3. Normality Test

**Table 4.** Kolmogorov-Smirnov Normality Test Results  
**One-Sample Kolmogorov-Smirnov Test**

		Unstandardized Residual	
N		50	
Normal Parameters <sup>a,b</sup>	Mean	,0000000	
	Std. Deviation	2,40794075	
Most Extreme Differences	Absolute	,071	
	Positive	,053	
	Negative	-,071	
Test Statistic		,071	
Asymp. Sig. (2-tailed) <sup>c</sup>		,200 <sup>d</sup>	
Monte Carlo Sig. (2-tailed) <sup>e</sup>	Sig.	,757	
	99% Confidence Interval	Lower Bound	,746
		Upper Bound	,768

a. Test distribution is Normal.

b. Calculated from data.

c. Lilliefors Significance Correction.

d. This is a lower bound of the true significance.

e. Lilliefors' method based on 10000 Monte Carlo samples with starting seed 2000000.

From the table above using SPSS, it is known that the variables of parking area management and operational efficiency have been confirmed through the Kolmogorov Smirnov (KS) test with a two-tailed value of 0.2 exceeding the established criteria of 0.05. Therefore, it can be concluded that the parking area management and operational efficiency variables have normal answer constructs, so the research can be continued.

### 4. Simple Linear Regression Test

**Table 5.** The Result of Simple Linear Regression Test

<b>Coefficients<sup>a</sup></b>						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	7,402	3,104		2,384	,021
	XTOT	,820	,077	,840	10,721	<,001

a. Dependent Variable: YTOT

Based on the table above using SPSS, the results of the simple linear regression equation are:

$$Y = a + bX \quad (1)$$

$$Y = 7,402 + 0,820X \quad (2)$$

Y = dependent variable

X = independent variable

So it can be interpreted, with a constant value of 7.402 indicating that if there is no influence from parking area management ( $X = 0$ ), then operational efficiency is at 7.402 units. Then with the regression coefficient of 0.820, it states that every 1 unit increase in the parking area management variable will increase operational efficiency by 0.820 units. In addition, the significance value (Sig.) for

variable X is  $<0.001$ . This value is smaller than the critical limit of 0.05, so it can be concluded that the effect of variable X on Y is statistically significant.

The t-count value of 10.721, which is much larger than the t-table (at  $n = 50$ ), also reinforces that variable X has a real effect on Y. Thus, it can be concluded that parking area management has a significant and positive influence on operational efficiency in the drop zone area of SAMS Sepinggan Balikpapan Airport.

From a practical standpoint, this result highlights that even relatively small improvements in how the parking area is managed, such as better signage, increased space availability, or stricter enforcement of drop zone usage, can lead to measurable gains in traffic flow and overall landside efficiency. This aligns with findings by Setiani, who noted that well-managed parking systems significantly reduce congestion and improve passenger throughput at terminal curbside areas [11]. In contrast, in line with research by Fadzril, Irianto, and Mabui, if airport parking system management is not managed properly, it can have an impact on irregularities in vehicle circulation in the airport area, thereby reducing airport operational efficiency [12].

However, it should be noted that this analysis is based on a single-variable model, and thus does not account for other factors that may also influence operational efficiency, such as weather, flight volume, or external transportation infrastructure. Furthermore, the measurement of efficiency was derived from subjective indicators, which may be influenced by respondent perception. Future studies are recommended to expand the model using multivariate regression with a larger sample and additional independent variables to validate and enrich these findings.

## Discussion

When the results of this study are compared with those of Hafizah and Firdausi, they show similarities in terms of the causes of congestion, namely the dominance of private vehicles and the lack of discipline among users in utilizing drop-off zones. Additionally, there is an idea proposed through research by Saputra and Mildawati regarding the planning of a premium parking system. This idea could serve as one solution to encourage more optimal utilization of parking areas and reduce the burden on drop zones, particularly when applied to SAMS Sepinggan Balikpapan Airport [13].

Based on this discussion, it can be concluded that improving physical facilities, stricter supervision, and utilizing supporting technology such as digital information boards and surveillance cameras are important steps to improve parking area management. This strategy is expected to reduce congestion in the drop zone, and support the smooth operation of the land side as a whole.

In addition to having an impact on the smooth flow of vehicles, the management of parking areas that have not been maximized also has the potential to reduce non-aeronautical airport revenues. Parking areas that are not optimally used will result in low occupancy rates, even though this sector can be an important source of income for the airport. As explained by Saputra and Mildawati, a professionally and efficiently managed parking system is able to increase the contribution to non-aeronautical revenue.

To improve the current parking management system and address the inefficiencies found in this study, an integrated action plan can be proposed with three primary components: facility zoning, digitalization through smart-parking technology, and regulatory alignment.

First, the airport can designate differentiated parking zones such as premium, standard, and short-stay drop zones, with clear signage and pricing tiers. This approach not only redistributes traffic more effectively but also introduces a potential non-aeronautical revenue stream, as premium parking can be monetized with dynamic pricing models, especially during peak hours [14]. Second, the integration of smart parking systems (SPS), including IoT-based sensors, mobile booking platforms, and real-time occupancy monitoring, can significantly enhance user experience, reduce search time for parking, and improve overall efficiency. Studies have shown that SPS implementation contributes to faster vehicle turnover, better compliance with parking time limits, and measurable improvements in traffic flow around terminal access points [15]. Third, these improvements must align with Manual of Standard Land Side Operation Facility issued by PT Angkasa Pura I (Persero), which mandates strict separation of parking and drop-off zones. A policy recommendation is to establish a maximum stop duration in drop zones (e.g., 3–5 minutes) with digital monitoring and enforcement using license plate recognition systems (LPR). Enforcement mechanisms must be clearly communicated to users and supported by signage and fines for violations.

## CONCLUSION

This study concludes that the management of the parking area at SAMS Sepinggang Balikpapan Airport is currently suboptimal and has a significant influence on the operational efficiency of landside airport operations. Field observations, interviews, and questionnaire data revealed several persistent issues such as puddles, non-functional elevators, inadequate signage, and misuse of the drop zone as long-term parking. These inefficiencies contribute to congestion, reduce user satisfaction, and diminish the effectiveness of terminal access flow.

The results of the simple linear regression analysis confirm a statistically significant and positive relationship between parking area management (X) and operational efficiency (Y), with a regression coefficient of 0.820 and a significance value of  $p < 0.001$ . This finding suggests that improvements in parking infrastructure, enforcement, and circulation systems can lead to meaningful gains in ground-side efficiency. Additionally, qualitative findings emphasize the role of user behavior, lack of enforcement, and poor facility conditions as root causes of drop zone congestion.

From a strategic perspective, the implementation of a more structured parking zoning system, supported by smart-parking technologies and regulatory enforcement aligned with Manual of Standard Land Side Operation Facility issued by PT Angkasa Pura I (Persero), presents a feasible path forward. Not only can this improve traffic flow and service quality, but it may also unlock greater non-aeronautical revenue opportunities for the airport operator.

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