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ANALYSIS OF INTERNATIONAL PASSENGERS' SATISFACTION WITH THE AUTO GATE AT INTERNATIONAL AIRPORT

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Abstract

At Kualanamu International Airport, long queues at the immigration checkpoint prompted the adoption of the Auto Gate system for biometric self-service clearance. This study assessed the satisfaction level of 153 international passengers toward the Auto Gate and examined its effect on overall service quality. A descriptive quantitative approach was used, with questionnaires developed from the five SERVQUAL dimensions — tangibles, reliability, responsiveness, assurance, and empathy. Data were analyzed through descriptive statistics and simple linear regression. Results showed that passengers were generally satisfied across all five dimensions, with empathy receiving the highest rating. Simple linear regression confirmed a significant positive effect of Auto Gate usage on passenger satisfaction (R^2 = 0.616, $p < 0.05$), indicating that 61.6% of the variation in satisfaction is explained by Auto Gate usage.

Keywords: *airport, auto gate, immigration, passenger satisfaction, SERVQUAL*

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Introduction

In the era of globalization and rapid technological advancement, airports play a strategic role in facilitating the movement of people and goods across countries (Kalakou, 2021). The efficiency and quality of airport services, especially in the immigration area, are crucial indicators of a country's image in the eyes of international travelers (Graham, 2020; Wandelt et al., 2025). Kualanamu International Airport, located in Deli Serdang, North Sumatra, serves as one of Indonesia's main gateways for international flights. As passenger numbers continue to rise each year, the airport faces growing challenges in maintaining service quality, particularly in managing immigration procedures.

Long queues and manual document verification processes often lead to passenger dissatisfaction and operational inefficiency. To address these challenges, the Directorate General of Immigration introduced the Auto Gate system as part of a digital transformation initiative to improve service speed, accuracy, and convenience (Qinthara Fatharani et al., 2021). The Auto Gate uses biometric and electronic passport verification to allow self-service immigration clearance, reducing direct human contact and processing time (Muzakkir et al., 2025). Similar technological adoptions have successfully upgraded the customer convenience (Andhini et al., 2024), and have been successfully implemented at major international airports such as Singapore Changi, Incheon, and Kuala Lumpur, which have reported positive impacts on service satisfaction and efficiency. Wongyai et al.'s (2025) results indicate that passengers' intentions to use biometric are strongly shaped by their attitudes and perceived behavioral control. Dias et al. (2024) similarly emphasized that smart airport technologies require alignment with passenger expectations. These factors suggest that airports generally adopt innovations in response to developments worldwide. Factors such as financial limitations, security concerns, and the perceptions and acceptance of passengers and employees also influence how airports introduce new technologies, helping explain why airports around the world vary significantly in their levels of technological advancement to support operations.

Previous studies have shown that the five SERVQUAL dimensions tangibles, reliability, responsiveness, assurance, and empathy—significantly influence passenger satisfaction (Setiono & Hidayat, 2022). Martadireja et al. (2024) found that the implementation of Auto Gate at Soekarno-Hatta Airport positively affected the passenger experience and reduced processing time. Nissa (2022) demonstrated that facility comfort and service quality significantly influence passenger satisfaction at Indonesian airports. However, limited empirical research has examined how the SERVQUAL dimensions relate to automated immigration systems, such as the Auto Gate, at regional airports in Indonesia. Understanding passenger perceptions of this technology is important to ensure that automation investments align with user expectations and operational objectives. These considerations indicate that airports typically adopt innovations in reaction to global developments. Financial constraints, security concerns, and the attitudes and acceptance of both passengers and staff also shape the way airports implement new technologies, helping to explain the wide differences in technological advancement among airports worldwide (Kim et al., 2023; Chaiwan, 2026; Simarmata et al., 2025). This research therefore aims to analyze the level of international passenger satisfaction toward the Auto Gate at Kualanamu International Airport and to determine how the system contributes to improving service quality and operational performance.

Recent advancements in biometric technology have accelerated the adoption of automated border control systems across Southeast Asian airports. Countries such as Singapore, Malaysia, and Thailand have reported measurable reductions in average immigration processing time following the deployment of e-gate systems, with some studies noting decreases from over three minutes per passenger to under forty seconds (Satria et al., 2025). In Indonesia, the expansion of Auto Gate facilities at airports beyond major hubs reflects a national commitment to digital transformation in public

services, as mandated by Law No. 25 of 2009. However, the effectiveness of these systems is not solely determined by technological capability — it is equally shaped by how passengers perceive and interact with the technology. Service quality dimensions, particularly responsiveness and empathy, remain critical in automated environments where direct human assistance is reduced (Setiono & Hidayat, 2022). Empirical evaluation of passenger satisfaction at specific airports therefore remains essential to guide targeted improvements (Andhini et al., 2024).

Methods

This research applied a descriptive quantitative method using a structured questionnaire based on the SERVQUAL framework (Setiono & Hidayat, 2022). The study was conducted at the immigration area of Kualanamu International Airport, Deli Serdang.

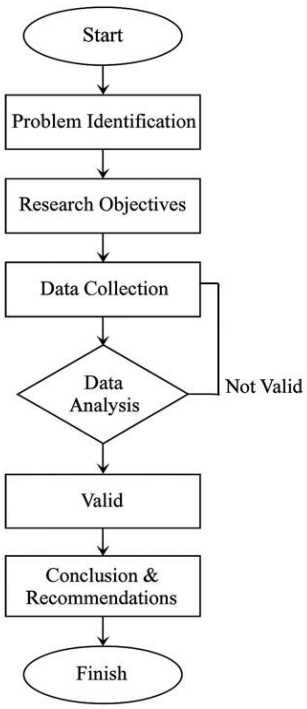

Figure 1. Research Flowchart

The population comprised all international passengers who used the Auto Gate at Kualanamu International Airport. Since the total population was unknown, the Lemeshow formula was applied at a 95% confidence level and a 10% margin of error, yielding a minimum sample size of 96 respondents. The researcher increased the sample size to 153 respondents to enhance reliability. Data were collected via a Google Forms questionnaire utilizing a five-point Likert scale (1 = Very Dissatisfied to 5 = Very Satisfied) (Adeniran & Fakunle, 2025). The instrument was designed based on the nine public service standard elements of Law No. 25 of 2009 and the SERVQUAL dimensions. Observation and documentation were used as complementary data collection methods.

Instrument validity was assessed using Pearson correlation (r-count > r-table at df = 151, r-table = 0.158) (Anggraini et al., 2023). Reliability was assessed using Cronbach's Alpha ($\alpha > 0.60$) (Izah et al., 2023). Prior to regression analysis, normality was verified using the Kolmogorov–Smirnov test and linearity using ANOVA (Kwak & Park, 2019; Luiz, 2021). Simple linear regression analysis was employed to examine the effect of Auto Gate usage (X) on passenger satisfaction (Y).

The satisfaction level for each SERVQUAL dimension was calculated using the Kaplan and Norton model with the average score formula: RK = JSK / JK, where RK is the average satisfaction score, JSK is the total questionnaire score, and JK is the number of questionnaires. Statistical analyses were performed using SPSS software. The satisfaction scale uses the Kaplan and Norton theory, as stated in (Ayad & Aliane, 2022).

Table 1. Kaplan and Norton Operator Satisfaction Scale

Average Score	Category	Interpretation
4.21 – 5.00	Very Satisfied	Excellent performance
3.41 – 4.20	Satisfied	Good performance
2.61 – 3.40	Neutral	Adequate performance
1.81 – 2.60	Dissatisfied	Below expectations
1.00 – 1.80	Very Dissatisfied	Requires urgent improvement

For the research instrument such as the indicators, we arranged instrument grid based on Law No. 25 of 2009, the instruments are stated on Table 2.

Table 2. Research Instrument Grid

Variable	Dimension	Indicators	Scale
Auto Gate Usage (X)	Tangibles	Physical appearance of equipment,	Likert 1–5

		modernity of technology	
	Reliability	Consistency and accuracy of service delivery	Likert 1–5
	Responsiveness	Speed and willingness to assist users	Likert 1–5
	Assurance	Staff knowledge, courtesy, and user confidence	Likert 1–5
	Empathy	Individual attention and ease of access	Likert 1–5
Passenger Satisfaction (Y)	Completion Timeframe	Speed of immigration clearance process	Likert 1–5

Results And Discussions

Respondent Characteristics

The study involved 153 international passengers. Table 2 presents a summary of respondent characteristics by gender, age, and nationality.

Table 3. Respondent Characteristics

Cat.	Classification	Freq. (n)	Per. (%)
Gender	Male	80	52.3
	Female	73	47.7
Age	Under 20	11	7.2
	20–29	52	34.0
	30–39	44	28.8
	40–49	31	20.3
	Over 50	15	9.8
Nationality	Indonesian (WNI)	114	74.5
	Foreign (WNA)	39	25.5
Total		153	100.0

Source: Primary data (2024)

Male respondents slightly outnumbered female respondents (52.3% vs. 47.7%), indicating relatively balanced usage of the Auto Gate across genders. The productive age group (20–39 years) comprised 62.8% of respondents, consistent with higher digital literacy and international travel frequency in this demographic. Indonesian citizens (WNI) accounted for 74.5% of Auto Gate users, reflecting the system's broad use by domestic and international travelers, including foreign nationals.

Instrument Validity and Reliability

All nine items of the Auto Gate usage variable (X1–X9) yielded r-count values ranging from 0.771 to 0.830, each exceeding the r-table value of 0.158 (df = 151, α = 0.05), confirming that all items are valid. Similarly, all five items of the passenger satisfaction variable (Y1–Y5) produced r-count values between 0.665 and 0.747, all exceeding the r-table threshold of 0.312, confirming validity. Reliability analysis using Cronbach's Alpha yielded α = 0.934 for variable X and α = 0.837 for variable Y, both substantially exceeding the minimum threshold of 0.60 (Sopiah et al., 2022; Utami, 2023).

Table 4. Validity Test Results – Auto Gate Usage Variable (X)

Item	r-count	r-table (df=151)	Sig. (2-tailed)	Result
X1	0.771	0.158	0.000	Valid
X2	0.800	0.158	0.000	Valid
X3	0.810	0.158	0.000	Valid
X4	0.817	0.158	0.000	Valid
X5	0.808	0.158	0.000	Valid
X6	0.812	0.158	0.000	Valid
X7	0.821	0.158	0.000	Valid
X8	0.814	0.158	0.000	Valid
X9	0.830	0.158	0.000	Valid

Source: Primary data analysis

Table 4 shows that all the X variables are valid based on the test.

Table 5. Validity Test Results – Passenger Satisfaction Variable (Y)

Item	r-count	r-table (df=151)	Sig. (2-tailed)	Result
Y1	0.665	0.312	0.000	Valid
Y2	0.693	0.312	0.000	Valid
Y3	0.730	0.312	0.000	Valid
Y4	0.747	0.312	0.000	Valid
Y5	0.710	0.312	0.000	Valid

Source: Primary data analysis

Based on Table 5, all items for the Y variable are valid, and Table 6 shows a reliability of "reliable," indicating the instruments are reliable and ready to use for the test.

Table 6. Reliability Test Results

Variable	Cronbach's Alpha	Result
Auto Gate Usage (X)	0.934	Reliable
Passenger Satisfaction (Y)	0.837	Reliable

Source: Primary data analysis

Classical Assumption Tests

The Kolmogorov–Smirnov normality test yielded a p-value of 0.200 (> 0.05), indicating that the data are normally distributed (Sayili & Gunver, 2025).

Table 7. Normality and Linearity Test Results

Test	Statistic	Sig.	Result
Kolmogorov–Smirnov (Normality)	0.054	0.200	Normal
ANOVA Linearity Test	—	< 0.05	Linear

Source: Primary data analysis

Simple Linear Regression and Hypothesis Testing

Simple linear regression analysis yielded the equation Y = 7.951 + 0.353X. This indicates that each one-unit increase in Auto Gate usage is associated with a 0.353-unit increase in passenger satisfaction, holding other variables constant. The T-test produced a calculated t-value of 15.577 with a significance value of 0.000 (< 0.05), confirming that Auto Gate usage has a significant positive effect on passenger satisfaction. The Alternative Hypothesis (H_1) is therefore accepted. The coefficient of determination (R^2) value of 0.616 indicates that 61.6% of the variation in passenger satisfaction is explained by Auto Gate usage, reflecting a strong explanatory relationship. These results are consistent with previous studies on automated airport service systems.

Table 8. Simple Linear Regression Coefficients

Regression equation: Y = 7.951 + 0.353X

	B	Std. Error	t	Sig.
Constant	7.951	0.522	15.230	0.000
Auto Gate Usage (X)	0.353	0.023	15.577	0.000

Source: SPSS output, primary data analysis

The regression coefficient of 0.353 indicates that every one-unit increase in Auto Gate Usage (X) increases the dependent variable (Y) by 0.353 units. The positive coefficient shows a positive relationship between the two variables. The t-value of 15.577 and p-value of 0.000 (< 0.05) indicate that Auto Gate Usage has a significant positive effect on the dependent variable. Therefore, the hypothesis that Auto Gate Usage influences the dependent variable is supported.

Table 9. Model Summary – Coefficient of Determination (R^2)

R	R Square	Adjusted R Square	Std. Error of the Estimate
0.785	0.616	0.613	1.471

Source: SPSS output, primary data analysis

The Model Summary in Table 9 presents the coefficient of determination (R^2), which indicates how much of the variance in the dependent variable can be explained by the independent variable(s). Table 9 shows an R value of 0.785, indicating a strong positive relationship between the independent and dependent variables. The R Square (R^2) value of 0.616 means that 61.6% of the variation in the dependent variable is explained by the model, while the remaining 38.4% is influenced by other factors not included in the model. The Adjusted R Square value of 0.613 is very close to the R^2 value, suggesting that the model has good explanatory power and that the included predictors contribute meaningfully to explaining the dependent variable. Additionally, the Standard Error of the Estimate (1.471) indicates the average deviation of the observed values from the regression line, with lower values reflecting a better model fit. Overall, the results suggest that the regression model has a moderately strong explanatory capability, explaining approximately 61.6% of the variance in the dependent variable.

SERVQUAL Satisfaction Analysis

The average satisfaction scores for each SERVQUAL dimension were calculated using the Kaplan and Norton satisfaction scale. Results across all five dimensions are summarized in Table 10.

Table 10. SERVQUAL Satisfaction Scores by Dimension

Dimension	Average Score (RK)	Category
Tangibles	4.07	Satisfied
Reliability	4.08	Satisfied
Responsiveness	4.02	Satisfied
Assurance	4.02	Satisfied
Empathy	4.09	Satisfied
Completion Timeframe (Variable Y)	4.11	Satisfied

Source: Primary data analysis

All five SERVQUAL dimensions received average scores between 4.02 and 4.11, placing them uniformly in the "Satisfied" category on the Kaplan and Norton scale. The Empathy dimension received the highest score (4.09), indicating that passengers perceived adequate individual attention and accessibility, while Responsiveness and Assurance received the lowest scores (4.02), suggesting that speed of assistance and confidence-building remain areas for potential improvement. The Tangibles dimension (4.07) reflects positive perceptions of the Auto Gate system's physical facilities and modern technology.

The overall pattern confirms that the Auto Gate system delivers a consistently satisfactory service experience across all measured dimensions. The Completion Timeframe indicator for variable Y scored 4.11, the highest among all indicators, confirming that the Auto Gate effectively reduces immigration processing time and meets passenger expectations for efficiency. The findings of this study carry practical implications for airport management and immigration authorities. The relatively low scores in the Responsiveness (4.02) and Assurance (4.02) dimensions suggest that passengers, while generally satisfied, perceive limitations in the availability of personnel assistance and the clarity of guidance during the Auto Gate process. This is particularly significant for first-time users and elderly passengers, who may require additional support when navigating biometric verification procedures. Airport operators are encouraged to address these gaps by placing dedicated assistance officers near Auto Gate lanes, providing multilingual instructional signage, and conducting periodic staff training focused on proactive passenger engagement. Furthermore, the strong coefficient of determination ($R^2 = 0.616$) indicates that Auto Gate usage accounts for 61.6% of satisfaction variation, implying that the remaining 38.4% is influenced by other factors — such as overall terminal ambiance, queue management, and inter-agency coordination between immigration and airline ground handling — which warrant further investigation in future studies (Simarmata et al., 2025).

Conclusion

This study investigated the satisfaction levels of 153 international passengers with the Auto Gate system in the immigration area at Kualanamu International Airport, Deli Serdang, using the SERVQUAL framework. Results confirm that passengers expressed satisfaction across all five service dimensions—tangibles, reliability, responsiveness, assurance, and empathy—with average scores ranging from 4.02 to 4.11 on a five-point scale, placing all dimensions uniformly in the "Satisfied" category according to the Kaplan and Norton scale. The Empathy dimension received the highest score (4.09), reflecting adequate personal attention and accessibility, while Responsiveness and Assurance (4.02) represent areas where further improvement is most needed. Simple linear regression confirmed a significant positive effect of Auto Gate usage on passenger satisfaction ($R^2 = 0.616$, $p < 0.05$), indicating that 61.6% of the variation in satisfaction is attributable to the system's usage quality. These findings demonstrate that the Auto Gate system effectively enhances immigration efficiency and passenger comfort and affirm the relevance of the SERVQUAL dimensions as a reliable framework for evaluating automated public service technologies in the aviation context. Airport authorities and immigration offices are encouraged to sustain continuous improvement efforts — particularly in responsiveness and assurance — through staff deployment strategies, clearer user guidance, and regular system maintenance. Future research may

expand the scope to include multiple airports and incorporate additional variables, such as passenger digital literacy, nationality-based behavioral differences, and long-term satisfaction trends, to yield a more comprehensive understanding of the quality of automated immigration services in Indonesia.

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