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Cargo Services Equipment Utilization And Operational Efficiency In Improving Port Concession Revenue

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Abstract: Ports play a vital role in supporting global logistics and trade activities, where operational efficiency becomes a key determinant of port competitiveness and financial performance. This study aims to examine the influence of cargo services and equipment and facility utilization on operational performance and port concession revenue. The research employs a mixed-method approach with an explanatory sequential design. Quantitative analysis was conducted using secondary operational data based on the Operational Service Performance Standards at Tanjung Priok Port and processed using SPSS and EViews through classical assumption tests, path analysis, and hypothesis testing. The qualitative stage involved structured in-depth interviews with regulators, port operators, and service users to explore the roles of regulations, policies, and digital technologies such as the Internet of Things (IoT). The results indicate that equipment and facility utilization significantly improves operational performance and port revenue, while cargo services positively influence revenue but may reduce operational efficiency when operational coordination is inadequate. Operational performance also plays a significant mediating role. Overall, improving operational efficiency, infrastructure utilization, and digital integration is essential to enhance port concession revenue.

Keywords: Port Operational Performance, Cargo Services, Equipment Utilization, Port Concession Revenue, Port Regulations, Internet of Things (IoT), Port Management, Terminal Efficiency.

INTRODUCTION

Ports play a critical role in the global logistics and transportation system as they function as key nodes connecting maritime transport, trade flows, and supply chain activities. Approximately 80–90% of global trade is transported by sea, making port efficiency an essential factor in supporting economic growth and international competitiveness (Rodrigue et al., 2020). In this context, the operational performance of ports is strongly influenced by the effectiveness of infrastructure management, operational facilities, and service systems that support cargo and vessel activities.

Port operational performance is generally reflected in the efficiency of vessel and cargo services, such as vessel waiting time, berthing time, and the overall duration of cargo handling activities. Efficient cargo services, including receiving, delivering, and the use of cargo handling equipment, play a significant role in accelerating logistics flows and improving terminal productivity. Conversely, inefficient services may lead to vessel congestion, longer waiting times, and increased logistics costs, ultimately reducing the competitiveness of ports within the global logistics network (T. Notteboom et al., 2021).

In addition to operational services, the utilization of port facilities is another important indicator in evaluating terminal efficiency. The level of port facility utilization is commonly measured using indicators such as Berth Occupancy Ratio (BOR), Yard Occupancy Ratio (YOR), and Shed Occupancy Ratio (SOR), which reflect the extent to which berths, storage yards, and cargo storage facilities are used. Optimal utilization of these facilities can significantly improve terminal productivity and enhance the overall efficiency of port operations (T. E. Notteboom & Rodrigue, 2005).

Furthermore, the development of digital technologies has increasingly influenced the transformation of port operations. The implementation of Internet of Things (IoT), real-time monitoring systems, and integrated logistics platforms enables port operators to improve operational transparency, optimize equipment utilization, and enhance decision-making processes. These technologies support the development of smart ports, where operational activities can be monitored and managed more efficiently through digital integration (Heilig et al., 2017). However, the adoption of such technologies in many ports, particularly in developing countries, still faces challenges related to system integration, technological readiness, and regulatory support (Yu et al., 2025).

In modern port management systems, the implementation of port concession schemes has become an important mechanism for improving port efficiency and financial performance. A port concession refers to a long-term agreement between port authorities and private operators, where private entities are granted the right to manage and operate port facilities in exchange for generating revenue from port-related commercial activities (Brooks, 2012). Port concession revenues generally derive from various operational services, including vessel berthing services, cargo handling operations, terminal facility leasing, and other logistics services provided within the port area.

Nevertheless, the level of port concession revenue is not solely determined by operational activities. It is also influenced by the efficiency of facility utilization, the effectiveness of operational performance, and the supporting regulatory and policy framework governing port operations. Therefore, a comprehensive analysis is required to understand how cargo services, port facility utilization, operational performance, and suprastructural factors such as regulations and digital technology implementation influence port concession revenues.

Based on this background, this study aims to analyze the influence of cargo services and port facility utilization on port operational performance and their impact on port concession revenue. In addition, this study also explores the perspectives of key port stakeholders including regulators, port operators, and port service users to examine the role of regulations, policies, and digital technology implementation (IoT) in supporting operational efficiency and enhancing port revenue generation.

METHOD

This study employs a mixed-method approach with an explanatory sequential design, where quantitative analysis is conducted in the first phase and followed by qualitative analysis to provide deeper interpretation of the findings. The quantitative stage utilizes secondary data obtained from company operational records related to port concession performance and operational service standards, referring to the Operational Service Performance Standards at Tanjung Priok Port as stipulated in the Head Office Regulations No: HK.206/03/18/OP.TPK-

20, No: HK.206/3/14/OP/TPK-21, No: HK.206/3/8/OP/TPK-22, and No: UM.007/1/1/KSOP.TPK/2024. The variables analyzed include cargo services, equipment and facility utilization, operational performance, and port concession revenue. The quantitative data are processed using SPSS and EViews software, applying classical assumption tests, path analysis, and hypothesis testing to examine the causal relationships among variables. Subsequently, the qualitative phase is conducted to enrich and validate the quantitative results by capturing the perspectives of key stakeholders in the port ecosystem. This stage involves structured and in-depth interviews with regulators, port operators, and port service users to explore the role of suprastructural factors such as regulations, policies, and the implementation of digital technologies (e.g., IoT) in influencing operational efficiency and port concession revenue. Through this explanatory sequential mixed-method design, the study aims to provide a more comprehensive understanding of the operational and institutional factors affecting port concession performance.

RESULTS AND DISCUSSION

Normality Testing

Table 1. Kolmogorov-Smirnov Test Normality Results

One-Sample Kolmogorov-Smirnov Test

			Substruktur 1	Substruktur 2
N			40	40
Normal Parameters[a,b]	Mean		.0000000	.0000000
	Std. Deviation		9.49790922	15.51351346
Most Extreme Differences	Absolute		.074	.099
	Positive		.054	.087
	Negative		-.074	-.099
Test Statistic			.074	.099
Asymp. Sig. (2-tailed)[c]			.200[d]	.200[d]
Monte Carlo Sig. (2-tailed)[e]	Sig.		.835	.404
	99% Confidence Interval	Lower Bound	.825	.391
		Upper Bound	.844	.416

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 1502173562.

Based on Table 1, the significance values of the normality test for Substructure 1 is 0.844 and Substructure 2 is 0.416, respectively. Since both values exceed the threshold of 0.05, the results indicate that the data are normally distributed.

Multicollinearity Testing

Table 2. Multicollinearity Test Results for Substructure 1

Coefficients[a]

Model		Collinearity Statistics Tolerance	VIF
1	X1 (Pelayanan Barang)	.677	1.477
	X2 (Unit alat dan Barang)	.677	1.477

a. Dependent Variable: Z (Kinerja Operasional)

The data presented in Table 2 indicate that all independent and moderating variables in Substructure 1, with port concession revenue as the dependent variable, do not exhibit multicollinearity. This is evidenced by tolerance values greater than 0.10 and Variance Inflation Factor (VIF) values below 10.

Table 3. Multicollinearity Test Results for Substructure 2

Coefficients[a]

Model		Collinearity Statistics Tolerance	VIF
1	X1 (Pelayanan Barang)	.571	1.753
	X2 (Unit alat dan Barang)	.447	2.238
	Z (Kinerja Operasional)	.660	1.516

a. Dependent Variable: Y (Pendapatan Konsesi Pelabuhan)

The data presented in Table 3 show that all independent variables in Substructure 2, with operational performance as the dependent variable, do not exhibit multicollinearity. This is indicated by tolerance values greater than 0.10 and Variance Inflation Factor (VIF) values below 10.

Autocorrelation Testing

Table 4. Substructure Autocorrelation Test Results 1

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.583[a]	.340	.305	9.75123	1.854

a. Predictors: (Constant), X2 (Unit alat dan Barang), X1 (Pelayanan Barang)

b. Dependent Variable: Z (Kinerja Operasional)

The autocorrelation test for Substructure 1 was conducted using the Durbin–Watson (D–W) statistic. The results presented in Table 4 show that the Durbin–Watson value obtained is 1.854. This value was compared with the Durbin–Watson critical values at a 5% significance level ($\alpha = 0.05$) with a sample size of 40 ($n = 40$) and two independent variables ($k = 2$). Based on the Durbin–Watson table, the upper critical value (dU) is 1.600, while the value of 4 − dU is 2.400. Since the Durbin–Watson statistic satisfies the condition dU < D–W < 4 − dU (1.600 < 1.854 < 2.400), it can be concluded that the regression model does not indicate the presence of autocorrelation. This result implies that the residuals are independent across observations, meaning that the regression model in Substructure 1 fulfills the classical assumption of no autocorrelation and is appropriate for further regression and path analysis.

Table 5. Substructure Autocorrelation Test Results 2

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.823[a]	.678	.651	16.14698	2.386

a. Predictors: (Constant), Z (Kinerja Operasional), X1 (Pelayanan Barang), X2 (Unit alat dan Barang)

b. Dependent Variable: Y (Pendapatan Konsesi Pelabuhan)

The autocorrelation test for Substructure 2 was conducted using the Durbin–Watson (D–W) statistic. The results presented in Table 5 show that the Durbin–Watson value obtained is 2.368. This value was compared with the Durbin–Watson critical values at a 5% significance level ($\alpha = 0.05$) with a sample size of 40 ($n = 40$) and two independent variables ($k = 2$). Based on the Durbin–Watson table, the upper critical value (dU) is 1.600, while the value of 4 − dU is 2.400. Since the Durbin–Watson statistic satisfies the condition dU < D–W < 4 − dU (1.600 < 2.368 < 2.400), it can be concluded that the regression model does not indicate the presence of autocorrelation. This result implies that the residuals are independent across observations, meaning that the regression model in Substructure 2 also fulfills the classical assumption of no autocorrelation and is appropriate for further regression and path analysis.

Heteroscedasticity Testing

Table 6. Results of Heteroscedasticity Test of Substructure 1

Correlations

			X1 (Pelayanan Barang)	X2 (Unit alat dan Barang)	Substruktur 1
Spearman's rho	X1 (Pelayanan Barang)	Correlation Coefficient	1.000	.524**	-.005
		Sig. (2-tailed)	.	<,001	.978
		N	40	40	40
	X2 (Unit alat dan Barang)	Correlation Coefficient	.524**	1.000	-.024
		Sig. (2-tailed)	<,001	.	.883
		N	40	40	40
	Substruktur 1	Correlation Coefficient	-.005	-.024	1.000
		Sig. (2-tailed)	.978	.883	.
		N	40	40	40

**. Correlation is significant at the 0.01 level (2-tailed).

The data presented in the table 6 above show that the correlation values of all three variables are greater than 0.05, indicating that there is no heteroscedasticity problem in the model.

Table 7. Results of Heteroscedasticity Test of Substructure 2

Correlations

			X1 (Pelayanan Barang)	X2 (Unit alat dan Barang)	Z (Kinerja Operasional)	Unstandardized Residual
Spearman's rho	X1 (Pelayanan Barang)	Correlation Coefficient	1.000	.524**	-.029	-.004
		Sig. (2-tailed)	.	<,001	.860	.979
		N	40	40	40	40
	X2 (Unit alat dan Barang)	Correlation Coefficient	.524**	1.000	.423**	-.008
		Sig. (2-tailed)	<,001	.	.007	.962
		N	40	40	40	40
	Z (Kinerja Operasional)	Correlation Coefficient	-.029	.423**	1.000	.019
		Sig. (2-tailed)	.860	.007	.	.909
		N	40	40	40	40
	Substruktur 2	Correlation Coefficient	-.004	-.008	.019	1.000
		Sig. (2-tailed)	.979	.962	.909	.
		N	40	40	40	40

**. Correlation is significant at the 0.01 level (2-tailed).

The data presented in the table 7 above show that the correlation values of all four variables are greater than the 0.05 significance level, indicating that there is no heteroscedasticity problem in the regression model.

Path Analysis

Table 8. Substructure Regression Test Results 1

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	92.550	6.120		15.123	<,001
	X1 (Pelayanan Barang)	-.226	.086	-.426	-2.627	.012
	X2 (Unit alat dan Barang)	.421	.096	.708	4.365	<,001

a. Dependent Variable: Z (Kinerja Operasional)

The residual coefficient (ε_1) is calculated using the formula $\varepsilon_1 = \sqrt{(1 - R^2)}$. Based on Table 10, the R^2 value is 0.340; therefore, the residual coefficient is $\varepsilon 1 = \sqrt{1 - 0{,}340} = 0{,}812$. This residual coefficient value indicates that there is a relatively large influence from variables outside the research model, amounting to 81.2%, which also affects the dependent variable.

Table 9. Substructure Regression Test Results 2

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	-111.568	27.156		-4.108	<,001
	X1 (Pelayanan Barang)	.437	.155	.353	2.819	.008
	X2 (Unit alat dan Barang)	.537	.196	.387	2.734	.010
	Z (Kinerja Operasional)	.829	.272	.355	3.046	.004

a. Dependent Variable: Y (Pendapatan Konsesi Pelabuhan)

The residual coefficient (ε_1) is calculated using the formula $\varepsilon_1 = \sqrt{(1 - R^2)}$. Based on Table 11, the R^2 value is 0.678; therefore, the residual coefficient is $\varepsilon 1 = \sqrt{1 - 0{,}678} = 0{,}567$. This residual coefficient suggests that 56.7% of the variation in the dependent variable is explained by factors not included in the research model.

Coefficient of Determination (Adjusted R² Test)

Table 10. Results of the Determination Coefficient Test of Substructure 1

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.583[a]	.340	.305	9.75123	1.854

a. Predictors: (Constant), X2 (Unit alat dan Barang), X1 (Pelayanan Barang)

b. Dependent Variable: Z (Kinerja Operasional)

Based on the table 10 above, the coefficient of determination is 0.305, indicating that goods services, and equipment and goods units collectively explain 30.5% of the variance in port concession revenue. The remaining 69.5% is explained by other variables outside the scope of this study.

Table 11. Results of the Determination Coefficient Test of Substructure 2

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.823[a]	.678	.651	16.14698	2.386

a. Predictors: (Constant), Z (Kinerja Operasional), X1 (Pelayanan Barang), X2 (Unit alat dan Barang)

b. Dependent Variable: Y (Pendapatan Konsesi Pelabuhan)

Based on the table 11 above, the coefficient of determination is 0.651, indicating that goods services, equipment and goods units, and operational performance collectively explain 65.1% of the variance in operational performance. The remaining 34.9% is explained by other variables outside the scope of this study.

T Testing / Sobel Testing

Table 12. Substructure T-Test Results 1

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	92.550	6.120		15.123	<,001
	X1 (Pelayanan Barang)	-.226	.086	-.426	-2.627	.012
	X2 (Unit alat dan Barang)	.421	.096	.708	4.365	<,001

a. Dependent Variable: Z (Kinerja Operasional)

The t-test results indicate that goods services (X1) have a significance value of 0.012 (< 0.05) with a beta coefficient of −0.426, indicating a negative and statistically significant effect on operational performance therefore, the first hypothesis is accepted. Meanwhile, equipment and goods units (X2) show a significance value of < 0.001 (< 0.05) with a beta coefficient of

0.708, indicating a positive and statistically significant effect on operational performance. Thus, the second hypothesis is accepted. These findings suggest that improvements in equipment and goods units significantly enhance operational performance, while goods services exhibit a significant but negative relationship with operational performance in the regression model.

Table 13. Substructure T-Test Results 2

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-111.568	27.156		-4.108	<,001
	X1 (Pelayanan Barang)	.437	.155	.353	2.819	.008
	X2 (Unit alat dan Barang)	.537	.196	.387	2.734	.010
	Z (Kinerja Operasional)	.829	.272	.355	3.046	.004

a. Dependent Variable: Y (Pendapatan Konsesi Pelabuhan)

The t-test results indicate that goods services (X1) have a significance value of 0.008 (< 0.05) with a beta coefficient of 0.353, indicating a positive and statistically significant effect on port concession revenue; therefore, the third hypothesis is accepted. Meanwhile, equipment and goods units (X2) show a significance value of 0.010 (< 0.05) with a beta coefficient of 0.387, indicating a positive and statistically significant effect on port concession revenue; thus, the fourth hypothesis is accepted. Furthermore, operational performance (Z) exhibits a significance value of 0.004 (< 0.05) with a beta coefficient of 0.355, indicating a positive and statistically significant effect on port concession revenue; hence, the fifth hypothesis is accepted. These findings suggest that improvements in goods services, equipment and goods units, and operational performance significantly contribute to increasing port concession revenue.

Mediation Effect Testing

Table 14. Substructure T-Test Results 2

Goods Services		Statistic Test	P-Value
a	-0.226	**-1.990**	**0.046**
B	0.829		
Sa	0.086		
Sb	0.272		
Tools and Goods Unit			
a	0.421	**2.502**	**0.012**
B	0.829		
Sa	0.096		
Sb	0.272		

a. Independent variable
b. Mediating variable
Sa. Standart error independent variable
Sb. Standar error mediating variable

The mediation test results indicate that operational performance mediating the relationship between cargo services and port concession revenue yields a test statistic of −1.990 with a p-value of 0.046 (< 0.05), indicating a statistically significant mediation effect; therefore, the sixth hypothesis is accepted. Meanwhile, operational performance mediating the relationship between equipment and goods units and port concession revenue produces a test statistic of 2.502 with a p-value of 0.012 (< 0.05), indicating a statistically significant effect; thus, the seventh hypothesis is accepted. These findings demonstrate that operational performance plays an important mediating role in strengthening the influence of goods services as well as equipment and goods units on port concession revenue.

The Role of Port Regulations, Policies, and Internet of Things (IoT) in Port Operations on Operational Performance and Port Concession Revenue

From the perspectives of regulators and operators, Indonesian port regulations have provided legal certainty regarding port concession mechanisms, particularly the obligation of Port Business Entities (BUP) to contribute 2.5% of gross terminal revenue to the Central Government through the Port Authority (OP). This regulation is considered effective in ensuring state revenue and maintaining port asset management stability. However, it is perceived to emphasize administrative compliance rather than operational performance as a strategic instrument, and it has not fully adapted to the dynamics of modern port operations and technological developments.

In policy terms, both regulators and operators view the current concession scheme as uniform and flat, without adequately considering differences in performance, business scale, asset utilization, and terminal contributions. There is therefore an opportunity to reposition concessions as a strategic policy tool that not only secures revenue but also encourages efficiency, productivity, and optimal asset utilization.

Both parties also recognize that IoT and digitalization have strong potential to improve transparency, accountability, and objective performance evaluation through real-time operational data on vessel services, cargo flows, and equipment utilization. Nevertheless, differences in digital systems across terminals and the lack of integrated operational data still limit the optimal implementation of performance-based concession policies

Discussions

1. Hypothesis 1

The statistical results show that Delivery Time has a positive and significant effect on the Decision to Use freight forwarding services ($\beta = 0.271$; $T = 4.289$; $p < 0.001$), indicating that H1 is accepted. This finding suggests that timeliness in logistics operations plays a crucial role in influencing customers' decisions to select a freight forwarder. Indicators such as on-time cargo delivery, punctual container loading, timely vessel departure, and clear timeliness information significantly shape customer confidence in logistics service providers. In the context of LCL shipping, exporters and SMEs tend to prioritize service providers that demonstrate reliability in schedule management because delays can disrupt supply chains, production planning, and international trade commitments. This result aligns with the findings of Vinh & Minh (2023) who reported that delivery reliability and timeliness significantly influence customer decision-making in logistics service selection. Their study concluded that logistics service quality dimensions, particularly delivery performance, strongly determine customer choice in freight forwarding services.

2. Hypothesis 2

The hypothesis testing results show that Delivery Time significantly influences Intention to Use ($\beta = 0.280$; $T = 4.214$; $p < 0.001$), indicating that H2 is accepted. This finding implies that customers' perceptions of timeliness in logistics operations encourage their intention to utilize freight forwarding services. Indicators such as punctual cargo handling, accurate vessel schedules, and transparent timeliness information contribute to customers' interest in exploring freight forwarding services, requesting quotations, and comparing services with competitors. In the logistics industry, timeliness is considered one of the most critical service attributes because customers seek predictability and reliability in international shipping operations. These results are supported by Hui et al. (2025), who found that delivery reliability and timeliness significantly influence customers' behavioral intentions in logistics service usage. The study highlights that timely logistics performance increases customer trust and stimulates future service utilization intentions.

3. Hypothesis 3

The results indicate that Price has a positive and significant influence on the Decision to Use freight forwarding services (β = 0.166; T = 2.609; p = 0.009), confirming that H3 is accepted. This finding demonstrates that competitive and reasonable pricing strategies significantly influence customers' final decisions when selecting freight forwarding services. Indicators such as competitive prices, affordable rates, price-service compatibility, and flexible pricing schemes contribute to customers' perception of value. In logistics services, especially for SMEs and exporters using LCL systems, cost considerations are a key factor in choosing a service provider. Customers often compare freight rates among multiple logistics companies before making a decision. This result is consistent with the findings of Fai et al. (2019) who found that price competitiveness significantly affects customers' service selection decisions in logistics services.

4. Hypothesis 4

The hypothesis testing shows that Price significantly influences Intention to Use (β = 0.229; T = 3.584; p < 0.001), confirming that H4 is accepted. This result indicates that customers' perceptions of reasonable and competitive pricing encourage their intention to use freight forwarding services. Indicators such as affordable pricing, pricing aligned with service benefits, and the availability of special pricing schemes stimulate customers' curiosity and willingness to explore logistics services. In the freight forwarding industry, pricing transparency and competitiveness are essential because customers often evaluate service providers based on cost efficiency. This finding is supported by Chotisarn & Phuthong (2025) who found that perceived price fairness significantly influences customer behavioral intentions in logistics services, including intention to use and repurchase intentions.

5. Hypothesis 5

The statistical results show that Brand Image significantly influences the Decision to Use freight forwarding services (β = 0.233; T = 4.362; p < 0.001), indicating that H5 is accepted. This finding suggests that the reputation and credibility of freight forwarding companies strongly affect customers' service selection decisions. Indicators such as a strong reputation, professional image, customer trust, and brand recognition influence customers' perception of reliability and service quality. In logistics services, brand image serves as a signal of operational capability and service consistency, particularly for exporters who depend on reliable freight forwarding partners. This finding aligns with Kustiani et al. (2022) who found that brand image significantly influences customer decision-making and service selection behavior in logistics and transportation services.

6. Hypothesis 6

The results indicate that Brand Image has the strongest influence on Intention to Use among the independent variables (β = 0.427; T = 5.863; p < 0.001), confirming that H6 is accepted. This result implies that customers are highly influenced by the reputation and professional image of freight forwarders when developing an intention to use their services. Indicators such as company credibility, professionalism, positive customer perception, and strong brand recognition increase customers' interest in seeking information, requesting quotations, and comparing logistics services. A strong brand image reduces perceived risk in international shipping transactions, which encourages potential users to consider the service provider. This finding is consistent with Rather & Camilleri (2019) who found that brand image significantly influences customer behavioral intentions in service industries, particularly intention to use and recommendation behavior.

7. Hypothesis 7

The results show that Intention to Use significantly influences the Decision to Use freight forwarding services (β = 0.289; T = 4.078; $p < 0.001$), indicating that H7 is accepted. This finding confirms that customers' behavioral intentions serve as a strong predictor of their actual service selection decisions. Indicators such as interest in gathering information, requesting price quotations, comparing services, and evaluating payment flexibility reflect customers' readiness to proceed toward actual service usage. When customers develop strong intentions toward a service provider, they are more likely to finalize their decision and establish a logistics partnership. This finding is supported by Ajzen's Theory of Planned Behavior and reinforced by Sürücü et al. (2020) who found that behavioral intention significantly influences purchase decisions in service industries.

8. Hypothesis 8

The mediation test shows that Intention to Use significantly mediates the relationship between Delivery Time and Decision to Use (β = 0.081; T = 2.939; p = 0.003), confirming that H8 is accepted. This result indicates that customers' perceptions of delivery timeliness not only directly influence their service decisions but also indirectly affect their decisions through the development of behavioral intentions. Reliable logistics operations, such as timely container loading, accurate shipping schedules, and clear information regarding delivery timelines, first stimulate customers' intention to use the freight forwarding service. This intention subsequently leads to the final decision to utilize the service. These findings are consistent with Lin et al. (2023) who demonstrated that service performance attributes influence behavioral intention, which subsequently affects customer decision-making in logistics services.

9. Hypothesis 9

The mediation analysis indicates that Intention to Use significantly mediates the relationship between Price and Decision to Use (β = 0.066; T = 2.740; p = 0.006), confirming that H9 is accepted. This finding suggests that competitive pricing strategies first influence customers' intention to utilize freight forwarding services before ultimately affecting their final service decision. Customers who perceive prices as reasonable and aligned with service benefits tend to develop stronger interest in exploring the service, requesting price quotations, and comparing service providers. This intention subsequently leads to the final decision to select the freight forwarder. This finding is supported by Cahyanto et al. (2022) who found that perceived price value significantly influences behavioral intentions, which subsequently affect customer purchase decisions in logistics service markets.

10. Hypothesis 10

The med iation results indicate that Intention to Use significantly mediates the relationship between Brand Image and Decision to Use (β = 0.123; T = 3.140; p = 0.002), confirming that H10 is accepted. This finding demonstrates that the influence of brand image on customers' final service decisions occurs both directly and indirectly through behavioral intentions. A strong reputation, professional image, and customer trust toward freight forwarding companies stimulate customers' interest in exploring and evaluating logistics services. This interest subsequently evolves into a firm decision to use the service provider. The results are consistent with Rather et al. (2021) who reported that brand image significantly influences customer behavioral intentions, which ultimately drive purchasing and service usage decisions.

CONCLUSION

This study concludes that cargo services and equipment utilization significantly influence operational performance and port concession revenue. Cargo services show a negative effect on operational performance, indicating potential inefficiencies when operational coordination is inadequate. In contrast, equipment utilization positively improves both operational performance and revenue. Operational performance also plays a significant mediating role, confirming that efficiency is a key mechanism linking operational activities to financial outcomes. Additionally, the study highlights the importance of regulatory support and digital integration, particularly the implementation of IoT, in enhancing transparency and performance evaluation. Overall, improving infrastructure utilization, operational efficiency, and digital integration is essential for increasing port concession revenue. However, limitations include the use of secondary data and a limited sample size. Future research should incorporate broader datasets and advanced modeling approaches.

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