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Determinant Factors of Port Concession Performance with the Mediating Role of Port Performance

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Abstract: This study investigates the factors determining concession performance in port concession schemes by examining the mediating role of port performance. Using an explanatory research design, data were collected through structured questionnaires administered to 15 private port TERMINALS. The proposed model incorporates Investment, Tariff, Throughput, and Human Resources as exogenous variables, Port Performance as a mediating variable, and Concession Performance as the endogenous variable. Structural Equation Modeling (SEM) was employed to analyze the relationships among constructs. The results indicate that tariffs have no significant direct or indirect effect on concession performance. Investment and human resources exhibit significant positive effects on both port performance and concession performance, while port performance itself strongly influences concession performance. Throughput shows a significant negative direct effect on concession performance but does not significantly affect port performance. These findings suggest that concession success is primarily driven by effective investment utilization and workforce capability rather than pricing mechanisms or cargo volume alone. This study contributes to port governance and concession literature by emphasizing the importance of performance-based operational transformation in achieving sustainable concession outcomes.

Keywords: Investment, Tariff, Throughput, Human resources, Port performance, Concession performance.

INTRODUCTION

Seaports are critical nodes in global and national logistics systems, enabling the efficient movement of goods and supporting economic growth and regional integration. For archipelagic countries such as Indonesia, port performance is particularly crucial, as ports function not only as international gateways but also as connectors of inter-island trade and national distribution

networks. Efficient port services contribute to lower logistics costs, improved supply chain reliability, and enhanced national competitiveness (T. Notteboom & Rodrigue, 2005).

Port services cover cargo handling, vessel operations, storage, and terminal management, all of which are shaped by several key determinants, including tariff structures, levels of investment, cargo throughput, and the quality of human resources. Previous studies demonstrate that adequate investment and modern infrastructure improve port productivity and service quality, while competitive tariffs influence cargo attraction and financial sustainability (Wilmsmeier et al., 2024) . In addition, throughput reflects the intensity of port utilization and is closely associated with operational efficiency and economies of scale (Merk & Dang, 2012). Human resources also play a strategic role in ensuring safe and reliable terminal operations (Moros-daza & Jubiz-diaz, 2024)

To enhance efficiency and mobilize private capital, many countries have adopted port concession schemes and public–private partnerships. These arrangements are expected to introduce managerial efficiency, technology transfer, and additional investment (Platias et al., 2025). However, empirical evidence indicates that concession outcomes vary widely and depend heavily on port performance and the effectiveness of governance and monitoring mechanisms (Parola et al., 2013).

In Indonesia, the expansion of port concessions has not always been accompanied by consistent performance improvements. Challenges related to digital integration, uneven human resource capabilities, and weak monitoring remain evident. Moreover, limited empirical research has simultaneously examined how tariffs, investment, throughput, and human resources influence concession performance through the mediating role of port performance, particularly in developing-country contexts.

Therefore, this study proposes and tests a structural model in which port performance mediates the relationships between key operational determinants and concession performance, focusing on special terminals and terminals transitioning into public and commercial operations in Indonesia. The findings are expected to contribute to port governance and concession literature while providing practical insights for policymakers and port stakeholders in designing more effective, performance-oriented concession frameworks.

METHOD

This study adopts an explanatory research design aimed at examining causal relationships among the investigated constructs. The development of the research model and the specification of variables are grounded in prior empirical studies and established theoretical frameworks, which serve as the basis for model justification. The study investigates six main variables, namely Investment (X1), Tariff (X2), Throughput (X3), and Human Resources (X4), Port Performance (Z) as a mediating variable, and Concession Performance (Y) as the endogenous outcome variable. Data are collected through a structured questionnaire consisting of structured questionnaire items administered to 15 private port terminals. The questionnaire is designed to capture respondents' perceptions regarding each research indicator. Responses are measured using a closed-ended ratio scale ranging from 1 to 10, enabling greater sensitivity in capturing variations in perceptions. The collected data are analyzed using the Structural Equation Modeling (SEM) approach, which allows simultaneous assessment of the measurement model and the structural model. SEM is employed to evaluate the validity and reliability of the constructs as well as to test the proposed hypotheses and the overall feasibility of the research model.

RESULTS AND DISCUSSION

Validity Testing

Table 1. Validity Testing

Variable	Indicator	*Loading Factor*	Description
Tariff (X1)	X1.1	0.828	VALID
	X1.2	0.834	VALID
	X1.3	0.832	VALID
	X1.4	0.884	VALID
Investment (X2)	X2.1	0.742	VALID
	X2.2	0.860	VALID
	X2.3	0.897	VALID
	X2.4	0.828	VALID
	X2.5	0.840	VALID
Throughput (X3)	X3.1	0.887	VALID
	X3.2	0.889	VALID
	X3.3	0.871	VALID
	X3.4	0.909	VALID
Human Resources (X4)	X4.1	0.889	VALID
	X4.2	0.840	VALID
	X4.3	0.835	VALID
	X4.4	0.875	VALID
Concession Performance (Y)	Y1	0.846	VALID
	Y2	0.813	VALID
	Y3	0.868	VALID
	Y4	0.844	VALID
Port Performance (Z)	Z1	0.738	VALID
	Z2	0.844	VALID
	Z3	0.813	VALID
	Z4	0.835	VALID
	Z5	0.739	VALID

Source: Research data

The validity test results indicate that all indicators have loading factor values above 0.70, demonstrating that each indicator makes a strong contribution to representing the overall variable construct. Accordingly, all indicators for each variable are declared valid and can therefore be utilized in subsequent measurement model and structural model analyses.

Heterotrait-Monotrait Ratio (HTMT)

Table 2. HTMT Testing

	TRIF	INVS	THPT	HR	CONC	PORT
TRIF						
INVS	0.700					
THPT	0.498	0.532				
HR	0.476	0.567	0.544			
CONC	0.571	0.747	0.242	0.683		
PORT	0.537	0.681	0.561	0.679	0.803	

Source: Research data

The table above shows that the Heterotrait–Monotrait Ratio of Correlation (HTMT) values are below 0.90, indicating that the variables exhibit good discriminant validity and are therefore considered valid.

Reliability Testing

Table 3. Reliability Testing

	Cronbach's alpha	Composite reliability (rho_c)
TRIF	0.866	0.909
INVS	0.890	0.920
THPT	0.912	0.938
HR	0.882	0.919
CONC	0.864	0.908
PORT	0.855	0.896

Source: Research data

Based on the reliability test results presented in Table 3, the Cronbach's Alpha values obtained for all constructs in this study are ≥ 0.70. Therefore, it can be concluded that the research instruments used in this study are reliable.

Coefficient of Determination

Table 4. Coefficient of Determination Testing

	R-square	R-square adjusted
CONC (Y)	0.696	0.686
PORT (Z)	0.503	0.489

Source: Research data

The R-square value for Concession Performance is 0.696, indicating that 69.6% of its variance is explained by the model and classified as moderate. Port Performance shows an R-square value of 0.503, also in the moderate category. The The adjusted R-square value for Concession Performance is 0.686 for Concession Performance and 0.503 for Port Performance confirm the model's moderate to strong explanatory power and good predictive accuracy.

F-Square Test

Table 5. F-Square Testing

Variable	F-Square
Tariff -> Concession Performance	0.024
Investment -> Concession Performance	0.184
Throughput -> Concession Performance	0.270
Human Resources -> Concession Performance	0.140
Port Performance -> Concession Performance	0.348
Tariff -> Port Performance	0.005
Investment -> Port Performance	0.114
Throughput -> Port Performance	0.023
Human Resources -> Port Performance	0.161

Source: Research data

The analysis results show varying levels of influence among the variables. Most of the f-square values indicate small to moderate effect sizes, ranging from 0.005 to 0.348. The most notable effect is Port Performance on Concession Performance, with an f-square value of 0.348, indicating a strong impact. In addition, Throughput (0.270) and Investment (0.184) demonstrate moderate effects on Concession Performance, while Human Resources shows a moderate effect on Port Performance (0.161). Meanwhile, Tariff exhibits only a minimal effect on both Port Performance (0.005) and Concession Performance (0.024), suggesting that pricing factors contribute relatively little compared to operational and managerial factors.

GOF

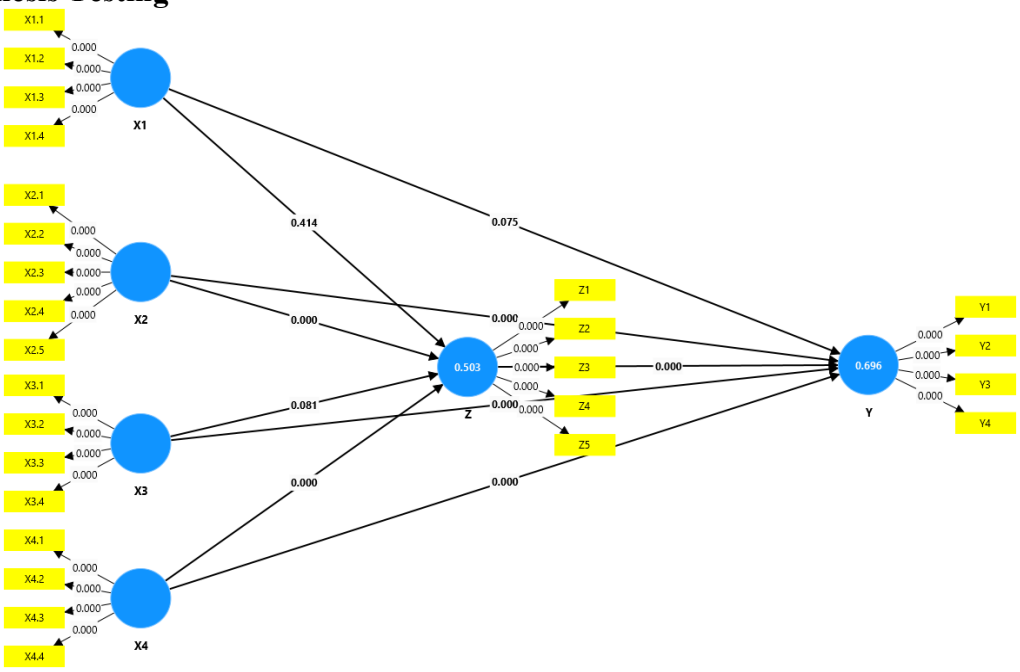
Table 6. GoF Testing

	AVE	R-square adjusted
TRIF	0.713	
INVS	0.697	
THPT	0.791	
HR	0.739	
CONC	0.711	0.686
PORT	0.632	0.489
Avarage	0.714	0.588

Source: Research data

Based on the calculation results, the Goodness of Fit (GoF) value is 0.65, indicating that the combined performance of the outer and inner models in this study can be classified as strong.

Hypothesis Testing



Source: Research Results

Figure 1. Bootstrapping

Based on the results of data processing using SmartPLS software, as illustrated in the bootstrapping output presented in Figure 1, as well as in Table 7 which reports the results of direct and indirect effect testing, the findings are further explained in detail as follows:

Table 7. Hypothesis Testing

	Original Sample	Standart Deviation	T Statistics	Pvalues (1 Tail)	Description
The Effect of Tariff on Concession Performance	0.112	0.063	1,778	0.075	H1: Rejected
The Effect of Tariff on Port Performance	0.064	0.079	0.818	0.414	H2: Rejected

The Effect of Investment on Concession Performance	0.342	0.069	4,977	0.000	H3: Accepted
The Effect of Investment on Port Performance	0.327	0.088	3,716	0.000	H4: Accepted
The Effect of Throughput on Concession Performance	-0.355	0.063	5,602	0.000	H5 : Accepted
The Effect of Throughput on Port Performance	0.132	0.075	1,746	0.081	H6 : Rejected
The Effect of Human Resources on Concession Performance	0.274	0.053	5,157	0.000	H7 : Accepted
The Effect of Human Resources on Port Performance	0.349	0.079	4,405	0.000	H8: Accepted
The Effect of Port Performance on Concession Performance	0.461	0.069	6,693	0.000	H9: Accepted
The Effect of Tariff on Concession Performance through Port Performance	0.030	0.037	0.794	0.427	H10: Rejected
The Effect of Investment on Concession Performance through Port Performance	0.151	0.049	3,054	0.002	H11: Accepted
The Effect of Throughput on Concession Performance through Port Performance	0.061	0.036	1,704	0.088	H12: Rejected
The Effect of Human Resources on Concession Performance through Port Performance	0.161	0.040	3,971	0.000	H13: Accepted

Discussions

Hypothesis 1

Based on the test results, the path coefficient of Tariff on Concession Performance is 0.112, with a T-statistic of 1.778 and a P-value of 0.075. Since the P-value is above the 0.05 significance level, H1 is statistically rejected. This indicates that tariff levels do not directly determine concession performance. This finding aligns with T. Notteboom et al. (2021), who state that port concession performance is more strongly influenced by operational efficiency and investment quality than by tariff structures alone. Thus, concession performance tends to depend more on value creation through service quality rather than pricing instruments.

Hypothesis 2

The path coefficient of Tariff on Port Performance is 0.064, with a T-statistic of 0.818 and a P-value of 0.414, indicating that H2 is rejected. This result suggests that tariff policies alone are insufficient to improve port performance. Consistent with Christodoulou & Cullinane (2024) , port performance is primarily driven by infrastructure capacity, digitalization, and hinterland connectivity rather than tariff competitiveness. Therefore, tariff adjustments without operational improvements are unlikely to produce meaningful performance gains.

Hypothesis 3

The path coefficient of Investment on Concession Performance is 0.342, with a T-statistic of 4.977 and a P-value of 0.000. Since the P-value is below 0.05, H3 is supported. This finding is consistent with Parola et al. (2013) who emphasize that sustained capital investment in terminals significantly improves operational reliability, asset utilization, and concession outcomes. Hence, increased investment strengthens concession performance by enabling modern equipment deployment and capacity expansion.

Hypothesis 4

The path coefficient of Investment on Port Performance is 0.327, with a T-statistic of 3.716 and a P-value of 0.000, indicating that H4 is supported. This result corroborates the findings of Karlsson et al. (2023), who argue that port investment in infrastructure and digital systems enhances productivity and vessel turnaround time. Therefore, investment plays a central role in strengthening overall port performance.

Hypothesis 5

The path coefficient of Throughput on Concession Performance is -0.355, with a T-statistic of 5.602 and a P-value of 0.000. Thus, H5 is supported, although the effect is negative. This suggests that higher throughput may reduce concession performance when capacity is constrained. This finding is consistent with Zhou (2024), who report that congestion and capacity saturation can deteriorate service reliability and financial efficiency. Therefore, throughput growth must be accompanied by proportional capacity expansion.

Hypothesis 6

The path coefficient of Throughput on Port Performance is 0.132, with a T-statistic of 1.746 and a P-value of 0.081, indicating that H6 is rejected. This result suggests that throughput volume alone does not guarantee improved port performance. According to Cabrero et al. (2024) , port performance depends more on operational coordination and process efficiency than on cargo volume. Thus, high throughput without efficiency improvements may not enhance performance.

Hypothesis 7

The path coefficient of Human Resources on Concession Performance is 0.274, with a T-statistic of 5.157 and a P-value of 0.000, indicating that H7 is supported. This finding aligns with Wang et al. (2022), who emphasize that skilled and well-trained port personnel significantly improve terminal productivity and concession success. Therefore, human capital quality is a strategic determinant of concession performance.

Hypothesis 8

The path coefficient of Human Resources on Port Performance is 0.349, with a T-statistic of 4.405 and a P-value of 0.000, confirming that H8 is supported. This result is consistent with Moros-daza & Jubiz-diaz (2024) , who finds that workforce competence and training directly enhance port operational effectiveness. Consequently, human resources development is essential for achieving superior port performance.

Hypothesis 9

The path coefficient of Port Performance on Concession Performance is 0.461, with a T-statistic of 6.693 and a P-value of 0.000. Therefore, H9 is supported. This finding is consistent with T. Notteboom et al. (2021), who argue that strong port performance directly translates into higher concession profitability and sustainability. Hence, port performance acts as a key driver of concession performance.

Hypothesis 10

Based on the test results, the indirect path coefficient of Tariff on Concession Performance through Port Performance is 0.030, with a T-statistic of 0.794 and a P-value of 0.427. Since the P-value is above the 0.05 significance level, H10 is statistically rejected. This indicates that Port Performance does not mediate the relationship between Tariff and Concession Performance. This finding is consistent with Vaggelas et al. (2022), who argue that tariff mechanisms alone rarely generate performance improvements unless accompanied by

structural and operational enhancements. Therefore, tariff adjustments do not indirectly enhance concession outcomes through improvements in port performance.

Hypothesis 11

The indirect path coefficient of Investment on Concession Performance through Port Performance is 0.151, with a T-statistic of 3.054 and a P-value of 0.002. Since the P-value is below 0.05, H11 is statistically supported. This result indicates that Port Performance significantly mediates the relationship between Investment and Concession Performance. This finding aligns with Hidalgo-gallego (2025), who emphasize that infrastructure and technological investments improve terminal productivity and service efficiency, which subsequently enhance financial and concession outcomes. Thus, investment strengthens concession performance not only directly but also indirectly through improvements in port operational performance.

Hypothesis 12

The indirect path coefficient of Throughput on Concession Performance through Port Performance is 0.061, with a T-statistic of 1.704 and a P-value of 0.088. Since the P-value exceeds 0.05, H12 is rejected. This suggests that Port Performance does not significantly mediate the relationship between Throughput and Concession Performance. This finding is consistent with Cabrero et al. (2024), who state that cargo volume growth does not automatically translate into performance improvements when operational efficiency and capacity management are not optimized. Therefore, increased throughput does not indirectly improve concession performance through port performance.

Hypothesis 13

The indirect path coefficient of Human Resources on Concession Performance through Port Performance is 0.161, with a T-statistic of 3.971 and a P-value of 0.000. Since the P-value is well below 0.05, H13 is statistically supported. This result indicates that Port Performance significantly mediates the relationship between Human Resources and Concession Performance. This finding is consistent with Moros-daza & Jubiz-diaz (2024), who highlights that skilled and competent port personnel enhance operational effectiveness, which subsequently improves financial and concession outcomes. Therefore, human resource quality contributes to concession performance both directly and indirectly through enhanced port performance.

CONCLUSION

This study examines the determinants of concession performance in port concession schemes by positioning port performance as a mediating variable. The findings reveal that concession performance is not uniformly influenced by all economic and operational inputs, but rather by how these inputs are transformed into effective port service outcomes.

Tariff variables are found to have neither direct nor indirect significant effects on concession performance, indicating that pricing mechanisms alone are insufficient to improve concession outcomes. In contrast, investment demonstrates a strong positive effect on both port performance and concession performance, both directly and indirectly. This confirms that capital investment enhances concession success when it strengthens infrastructure capacity, operational efficiency, and service reliability.

Throughput shows a significant negative direct effect on concession performance, suggesting that volume growth without proportional capacity and efficiency improvements may create operational strain and reduce performance. However, its indirect effect through port performance is not significant. Meanwhile, human resources significantly influence both port

performance and concession performance, highlighting that workforce competence and capability are critical in translating operational inputs into sustainable outcomes.

Furthermore, port performance itself significantly drives concession performance, confirming its mediating role within the model. Overall, the study concludes that sustainable concession performance depends primarily on effective investment utilization and human resource quality, supported by strong operational performance, rather than on tariff adjustments or cargo volume growth alone. These findings contribute to the literature by emphasizing performance-based governance as the core foundation of successful port concession schemes.

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