The Effect of Spare Parts Management on Vessel Operational Continuity at PT Pelayaran Samudera Rizqi

Pahri Herdiansya, Ma'ruf, Melia Handayani

Department of Marine Logistics, Universitas Pendidikan Indonesia.
Email: pahriherdiansya@upi.edu

Abstract

This study aims to describe the condition of spare parts management and operational smoothness, as well as to analyze the influence of spare parts management on operational smoothness at PT Pelayaran Samudera Rizqi. The research employed a descriptive quantitative approach using a survey method. Data were collected through questionnaires distributed to 60 respondents who are active employees of the company. The descriptive analysis results show that the average score for spare parts management is 4.08 and for operational smoothness is 4.03, both of which fall into the "good" category. Simple regression analysis yielded a t-value of 8.369, which is greater than the t-table value of 1.671, with a significance level of 0.001. This indicates a significant influence of spare parts management on operational smoothness. The coefficient of determination (R Square) is 0.547, suggesting that 54.7% of the variation in operational smoothness is explained by spare parts management, while the remaining 45.3% is influenced by other factors outside the scope of this study. The resulting regression equation model is Y = 11.695 + 0.805X. These findings emphasize that effective spare parts management plays a crucial role in supporting the smooth operation of shipping company activities.

Keywords: spare parts management, shipping, operational smoothness

INTRODUCTION

As a maritime nation, Indonesia relies heavily on sea transportation to support trade, economic activities, and connectivity among its geographically dispersed regions. The shipping industry plays a strategic role in facilitating domestic and international trade by ensuring the efficient movement of goods and maintaining the continuity of maritime logistics networks [1]. The operational reliability of shipping companies depends on several interconnected factors, including vessel maintenance, technical readiness, logistics coordination, and the availability of essential spare parts [2]. Among these factors, effective spare parts management is particularly important because it directly supports maintenance activities, reduces equipment downtime, and contributes to the continuity of vessel operations [3].

Maritime operational safety remains a major concern, particularly because vessel accidents may result from interactions among technical failures, environmental conditions, and human factors. According to statistical information attributed to the Indonesian National Transportation Safety Committee (Komite Nasional Keselamatan Transportasi, KNKT) [4], 52 maritime accident cases were recorded during the 2020–2023 period. Under Indonesian Law No. 17 of 2008 concerning Shipping, maritime accidents include collisions, sinking, grounding, and fires. Technical failures associated with machinery condition, inadequate maintenance, and equipment malfunction may contribute to operational incidents. In this context, the timely availability of spare parts is an important component of preventive and corrective maintenance, as delays in obtaining essential components may prolong equipment downtime and compromise vessel operational readiness.

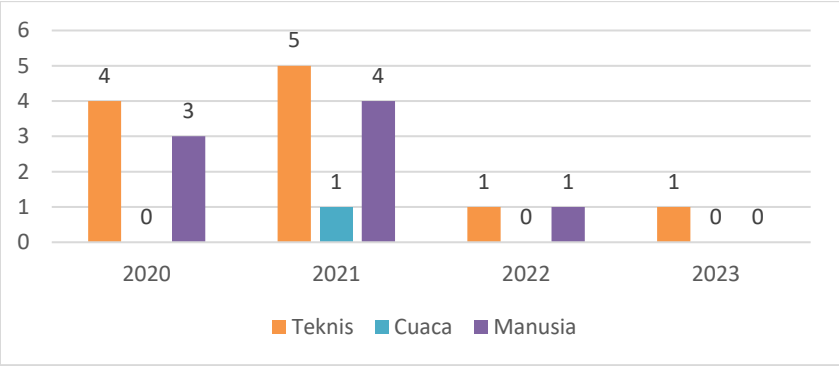


Figure 1. Distribution of the main contributing factors to maritime accidents in Indonesia.

Lisensi Creative Commons Atribusi 4.0 Internasional.

The accident classification presented in Figure 1 indicates that technical factors accounted for 55% of the reported cases, followed by human-related factors at 40% and weather-related factors at 5%. Technical factors may encompass machinery failures, equipment deterioration, inadequate maintenance, and deficiencies in technical support systems. Although these categories do not independently establish a direct causal relationship between spare parts management and maritime accidents, they highlight the importance of maintaining reliable equipment and effective technical management practices. Spare parts availability is therefore a critical consideration in vessel maintenance planning, particularly when unexpected equipment failures require immediate corrective action. Previous research by Malau et al. [5] also emphasized the importance of timely spare parts management in supporting vessel operational continuity, adherence to shipping schedules, and company performance.

PT Pelayaran Samudera Rizqi is an Indonesian shipping company engaged in maritime transportation and transshipment activities, operating a fleet of 12 tugboat–barge sets across western, central, and eastern Indonesian waters. The company implements a spare parts management system involving coordination between its operational and technical departments to support vessel maintenance and logistics requirements. However, managing spare parts across geographically dispersed operating areas presents several challenges, particularly in procurement planning, supplier coordination, inventory availability, and delivery scheduling [6]. These challenges may become more significant when vessels require urgent replacement components while operating away from established logistics facilities.

Preliminary company records indicate that spare parts deliveries experienced varying degrees of delay between September 2024 and February 2025. The recorded cases involved vessels with different procurement priority categories, including Top Urgent, Urgent, and Normal. The data provide an initial overview of the differences between estimated and actual delivery dates, as presented in Table 1.

Table 1. Spare parts delivery delays recorded by PT Pelayaran Samudera Rizqi**.**

No.	Vessel name	Number of items	Priority category	Request date	Estimated arrival	Actual arrival	Reported delay (days)
1	Trust 39	35	Top Urgent	28 Nov 2024	1 Dec 2024	7 Dec 2024	6
2	Ismail 01	16	Top Urgent	5 Dec 2024	8 Dec 2024	13 Dec 2024	5
3	Prima Power 05	80	Urgent	28 Nov 2024	5 Dec 2024	18 Dec 2024	13
4	Prima Power 01	15	Urgent	20 Jan 2025	27 Jan 2025	5 Feb 2025	8
5	Mitra Pacific 02	79	Normal	30 Oct 2024	13 Nov 2024	17 Dec 2024	33
6	Ocean Power 02	23	Normal	13 Nov 2024	27 Nov 2024	9 Dec 2024	12
7	Trans Pacific 212	27	Normal	25 Nov 2024	9 Dec 2024	20 Dec 2024	11
8	Trans Pacific 06	68	Normal	3 Dec 2024	17 Dec 2024	23 Dec 2024	6
9	Trans Pacific 211	50	Normal	16 Jan 2025	30 Jan 2025	6 Feb 2025	6
10	Trans Pacific 03	73	Delayed	5 Dec 2024	5 Jan 2025	28 Jan 2025	23

Source: Company spare parts delivery records (2024–2025). The delay values reproduce those reported in the original dataset and require reconciliation with the recorded dates.

As shown in Table 1, spare parts delivery delays occurred across different vessels and procurement priority categories. The company records reported the longest delay for Mitra Pacific 02, with 79 spare parts items classified under the Normal priority category and a reported delay of 33 days. Meanwhile, Prima Power 05 experienced a reported delay of 13 days despite its Urgent classification, while Trust 39 and Ismail 01 experienced delays of 6 and 5 days, respectively, for Top Urgent requests. These findings indicate that delivery delays were not confined to a particular procurement priority category and suggest potential limitations in the coordination between inventory planning, procurement processes, and logistics execution.

The spare parts management challenges encountered by PT Pelayaran Samudera Rizqi were associated with several operational and organizational factors, including inadequate procurement planning, complex administrative procedures, and dependence on a limited supplier network. These conditions may increase procurement lead times, reduce flexibility in responding to urgent maintenance requirements, and delay the availability of essential replacement components. When spare parts are unavailable at the required time, maintenance activities may be postponed, potentially affecting vessel readiness, departure schedules, and operational continuity. Consequently, effective spare parts management requires an integrated

Lisensi Creative Commons Atribusi 4.0 Internasional.

approach that extends beyond procurement activities to include inventory classification, demand forecasting, information management, supplier selection, and logistics coordination.

Previous studies have examined specific aspects of spare parts management within the shipping industry. Fakhrana [7] investigated the implications of delayed spare parts supply, while Aszahra [8] examined procurement and inventory management in relation to vessel operational continuity. These studies provide a foundation for understanding how procurement performance and spare parts availability influence shipping operations. However, the management of spare parts involves multiple interconnected dimensions that may collectively affect maintenance efficiency and operational reliability. An assessment focusing on individual procurement or inventory components may therefore provide only a partial understanding of the broader management system.

In the operational context of PT Pelayaran Samudera Rizqi, a more integrated examination is required to understand the relationships among spare parts classification, demand forecasting, information systems, procurement and logistics policies, and operating conditions. These dimensions represent important components of spare parts management because they influence how replacement components are identified, planned, procured, monitored, and delivered to vessels. Their interactions may become particularly relevant in tugboat and barge operations, where vessel locations, maintenance requirements, supplier availability, and transportation constraints can affect the timely delivery of spare parts.

Accordingly, the research gap addressed in this study concerns the limited integrated assessment of these five management dimensions within the operational setting of PT Pelayaran Samudera Rizqi. Rather than examining spare parts procurement or delivery delays as isolated issues, the study adopts a broader management perspective to investigate how technical, organizational, and logistical factors are associated with vessel operational continuity. This approach is intended to provide a more comprehensive understanding of the challenges affecting spare parts availability and the effectiveness of maintenance support across the company's fleet.

The principal contribution of this study is the development of an integrated analytical framework incorporating five dimensions of spare parts management: spare parts classification, demand forecasting, information systems, procurement and logistics policies, and operational conditions. The framework is intended to examine their relationships with vessel operational continuity and identify management practices that may improve procurement responsiveness, maintenance support, and operational reliability. The findings are expected to provide practical insights for strengthening spare parts management and supporting the development of more coordinated maritime logistics practices within Indonesian shipping companies.

Based on these considerations, this study aims to (1) examine the implementation of spare parts management at PT Pelayaran Samudera Rizqi, (2) assess the condition of vessel operational continuity within the company's fleet, and (3) analyze the relationship between spare parts management and operational continuity by considering the five identified management dimensions. Through this approach, the research seeks to contribute to a better understanding of the role of integrated spare parts management in supporting efficient, reliable, and sustainable shipping operations.

METHODS

This study employed a descriptive quantitative research approach using a questionnaire-based survey design to investigate spare parts management and its relationship with vessel operational continuity at PT Pelayaran Samudera Rizqi. The research was conducted from September 2024 to June 2025, with a target population of 149 individuals comprising 16 operational staff members and 133 vessel crew members. The sample size was determined using Slovin's formula with a 10% margin of error, as expressed in Equation (1):

$$\mathrm{N} = \frac{\mathrm{N}}{1 + \mathrm{Ne}^2} \tag{1}$$

where (n) represents the required sample size, (N) denotes the total population, and (e) is the specified margin of error. By substituting the population size of 149 and a margin of error of 0.10, the calculation yields:

$$N = \frac{149}{1 + 149(10\%)^2} = 59{,}83 \tag{2}$$

Accordingly, a total of 60 respondents were selected using a probability sampling technique based on simple random sampling, providing each eligible member of the study population with an equal probability of selection. The study incorporated both primary and secondary data. Primary data were obtained through questionnaires, direct observations, and interviews, while secondary data were collected from relevant company records and literature sources. The questionnaire was used to collect quantitative information concerning spare parts management practices and vessel operational continuity, whereas observations and interviews provided supporting information on operational conditions and procurement-related

Lisensi Creative Commons Atribusi 4.0 Internasional.

challenges. Data processing and statistical analysis were conducted using IBM SPSS Statistics, version 30.0.0.0 (build 178), including the assessment of the research instrument and subsequent quantitative data analysis.

RESULTS AND DISCUSSION

Descriptive Analysis of Spare Parts Management

Descriptive statistical analysis was conducted to evaluate respondents' perceptions of spare parts management practices at PT Pelayaran Samudera Rizqi. The analysis involved 60 respondents and 15 questionnaire items covering five dimensions: spare parts classification, demand forecasting accuracy, information systems, procurement and logistics policies, and operational environmental conditions.

The frequency distribution indicated that 360 responses, representing 40% of the 900 item-level responses, were assigned to scale point 4 (Agree). This finding suggests that respondents generally expressed favorable perceptions of the company's spare parts management practices. The overall grand mean was 4.08, corresponding to the Good category based on the adopted assessment criteria. The descriptive results for each dimension are presented in Table 2.

Table 2. Descriptive statistics for spare parts management.

No.	Dimension	Item numbers	Mean	Category
1	Spare parts classification	1–3	4.22	Very Good
2	Demand forecasting accuracy	4–6	3.82	Good
3	Information systems	7–8	4.21	Very Good
4	Procurement and logistics policies	9–11	4.07	Good
5	Operational environmental conditions	12–15	4.06	Good
	Grand mean		4.08	Good

Among the five dimensions, spare parts classification achieved the highest mean score (4.22), followed by information systems (4.21). These results indicate relatively favorable assessments of the company's spare parts categorization and information management practices. Procurement and logistics policies and operational environmental conditions obtained mean scores of 4.07 and 4.06, respectively.

Demand forecasting accuracy recorded the lowest mean score (3.82), suggesting that this dimension requires particular managerial attention. Difficulties in predicting spare parts requirements may contribute to inventory imbalances, including shortages of essential components and excess stocks of less frequently required items. Although respondents generally evaluated spare parts management positively, the variation across dimensions indicates opportunities to improve procurement planning and inventory control.

Descriptive Analysis of Vessel Operational Continuity

Vessel operational continuity was assessed through 15 questionnaire items encompassing four dimensions: fleet availability, operational downtime, operational time efficiency, and operational reliability. The descriptive analysis produced a grand mean of 4.03, corresponding to the Good category. This result indicates that respondents generally perceived the company's operational activities as functioning satisfactorily, although several aspects may require further improvement. The results are presented in Table 3.

Table 3. Descriptive statistics for vessel operational continuity.

No.	Dimension	Item numbers	Mean	Category
1	Fleet availability	1–4	4.19	Good
2	Operational downtime	5–7	3.82	Good
3	Operational time efficiency	8–12	4.14	Good
4	Operational reliability	13–15	3.96	Good
	Grand mean		4.03	Good

Fleet availability recorded the highest mean score (4.19), followed by operational time efficiency (4.14). These findings suggest that respondents generally perceived the company's fleet readiness and scheduling performance positively.

Lisensi Creative Commons Atribusi 4.0 Internasional.

Operational reliability achieved a mean of 3.96, while operational downtime recorded the lowest mean of 3.82. The relatively lower assessment of operational downtime suggests that interruptions to vessel operations remain an important concern. Such interruptions may be associated with equipment maintenance, spare parts availability, operational scheduling, or other internal and external conditions. Overall, the descriptive findings indicate satisfactory perceived operational continuity, while highlighting downtime management and operational reliability as areas requiring continued attention.

Normality Test

A normality test was conducted as part of the statistical assumption assessment for the regression analysis. The test produced a significance value of 0.163, exceeding the adopted significance level of 0.05. Because the reported p-value was greater than 0.05, the null hypothesis of the normality test was not rejected. Accordingly, the test did not provide sufficient evidence of a departure from normality in the assessed data.

Table 4. One-Sample Kolmogorov-Smirnov Test.

			Unstandardized Residual
N			60
Normal Parameters[a,b]	Mean		,000000
	Std. Deviation		5,90801178
Most Extreme Differences	Absolute		,105
	Positive		,105
	Negative		-,076
Test Statistic			,105
Asymp. Sig. (2-tailed)[c]			,163
Monte Carlo Sig. (2-tailed)d	Sig.		,099
	99% Confidence Interval	Lower Bound	,092
		Upper Bound	,107

The result was considered consistent with the normality assumption required for the subsequent regression analysis, subject to confirmation that the test was conducted on the regression residuals.

Linearity Test

The linearity assessment was conducted to examine whether the relationship between spare parts management and vessel operational continuity could be represented adequately by a linear model. The reported significance value for the deviation from linearity was 0.979, which exceeded the significance threshold of 0.05. This result indicated that the test did not detect statistically significant evidence of deviation from a linear relationship.

Table 5. Linearity test results.

			Sum of Squares	dF	Mean Square	F	Sig.
Operational Continuity * Spare Parts Management	Between Groups	(Combined)	2917,467	23	126,846	2,804	,003
		Linearity	2486,812	1	2486,812	54,812	<,003
		Deviation from Linearity	430,655	22	19,575	,433	,975
	Whitin Groups		1628,717	36	45,242		
	Total		4546,183	59			

The findings therefore supported the use of a linear regression specification for examining the association between spare parts management and vessel operational continuity. Nevertheless, the absence of a statistically significant deviation should not be interpreted as definitive proof of perfect linearity.

Lisensi Creative Commons Atribusi 4.0 Internasional.

Heteroscedasticity Test

A heteroscedasticity test was performed to assess whether the variability of the regression residuals changed systematically across the observations. The test produced a significance value of 0.886, which was greater than the adopted threshold of 0.05. Consequently, the test did not identify statistically significant evidence of heteroscedasticity.

Table 6. Heteroscedasticity test results.

Coefficient						
		Unstandardized		Standardized		
Model		B	Std. Error	Coefficients Beta	t	Sig.
1	(Constant)	4,964	3,897		1,274	,208
	Spare Parts Management	-,009	,063	-,019	-,144	,886

This finding was considered consistent with the homoscedasticity assumption of the regression model, although the interpretation depends on the specific diagnostic test applied.

Simple Linear Regression Analysis

Based on the regression results in Table 7, the simple regression equation is as follows:

1. If there is no spare parts management (X = 0), the value for operational smoothness is 11.695.
2. The regression coefficient indicates that every one-unit increase in spare parts management will improve operational smoothness by 0.805, assuming other factors remain constant.
3. There is a positive and significant influence of spare parts management on operational smoothness. Better spare parts management leads to improved operational smoothness for the company. The coefficient value of 0.805 indicates a substantial effect.

Table 7. Simple linear regression and coefficient significance test results.

Coefficient						
		Unstandardized		Standardized		
Model		B	Std. Error	Coefficients Beta	t	Sig.
1	(Constant)	11,695	5,916		1,977	,053
	Spare Parts Management	,805	,096	,740	9,369	,001

Hypothesis Testing

A t-test was used to assess the statistical significance of the regression coefficient associated with spare parts management.

The hypothesis test was formulated as follows:

1. H_0: Spare parts management has no statistically significant linear association with vessel operational continuity.
2. H_1: Spare parts management has a statistically significant linear association with vessel operational continuity.

The statistical analysis yielded a calculated t-value of 8.369 and a reported significance value of 0.001. The calculated t-value exceeded the stated critical value of 1.671, while the reported significance value was below the adopted threshold of 0.05.

Accordingly, the null hypothesis was rejected, indicating a statistically significant positive association between spare parts management and vessel operational continuity at PT Pelayaran Samudera Rizqi.

The result suggests that respondents reporting more favorable spare parts management practices also tended to report higher levels of operational continuity. However, because the research employed an observational questionnaire-based design, the statistical association does not independently establish a causal effect.

Spare Parts Management at PT Pelayaran Samudera Rizqi

The descriptive findings indicate that spare parts management at PT Pelayaran Samudera Rizqi was generally perceived positively, as reflected by the grand mean score of 4.08. This result falls within the Good category according to the assessment interval of 3.41–4.20. Among the five dimensions, spare parts classification and information systems achieved the highest assessments, with mean scores of 4.22 and 4.21, respectively. These results suggest that respondents perceived the company's classification practices and information management arrangements as relatively well established.

Lisensi Creative Commons Atribusi 4.0 Internasional.

Nevertheless, demand forecasting accuracy received the lowest mean score of 3.82, indicating a potential weakness in estimating spare parts requirements. Inaccurate demand forecasting can create inventory imbalances, where frequently required components are unavailable while other components remain in storage for extended periods. Such conditions may increase procurement costs, prolong maintenance activities, and reduce the responsiveness of vessel technical support. The company records of delayed spare parts deliveries provide additional operational context for these findings. Delivery delays affecting different priority categories suggest that spare parts availability may be influenced by interactions among inventory planning, procurement procedures, supplier responsiveness, and logistics coordination.

Although the information systems dimension received a favorable assessment, the operational difficulties described in the study indicate that information accuracy and availability may still require improvement. A positively perceived information system does not necessarily guarantee that inventory records, procurement status, and delivery schedules are consistently updated or effectively integrated across departments. These findings suggest that improvements in spare parts management should prioritize demand forecasting, inventory data accuracy, and coordination between technical and operational departments. Integrating historical consumption records, maintenance schedules, component criticality, and supplier lead times may provide a more reliable basis for planning future requirements.

Vessel Operational Continuity at PT Pelayaran Samudera Rizqi

Vessel operational continuity achieved a grand mean of 4.03, indicating a generally favorable assessment of the company's operational performance. Fleet availability and operational time efficiency recorded relatively high mean scores of 4.19 and 4.14, respectively. These results suggest that respondents perceived the company's ability to maintain vessel readiness and manage operational schedules positively. However, the operational downtime dimension obtained the lowest mean score of 3.82, followed by operational reliability at 3.96. These findings indicate that interruptions and reliability-related issues remain relevant operational concerns despite the favorable overall assessment.

Operational downtime can be influenced by several interconnected factors, including equipment failures, maintenance requirements, spare parts shortages, procurement delays, and scheduling constraints. External factors, such as adverse weather, cargo conditions, and documentation requirements, may also contribute to operational interruptions. Previous research by Aszahra [8] distinguished between internal factors originating within an organization and external factors arising from environmental or operational circumstances. This distinction provides a useful framework for interpreting the challenges identified in the present study. From a management perspective, reducing operational downtime requires coordination between maintenance planning, procurement activities, spare parts availability, and vessel scheduling [9]. Preventive maintenance supported by reliable spare parts supply may help reduce avoidable interruptions and improve the predictability of vessel operations. The descriptive findings therefore indicate that, although operational continuity was generally perceived as satisfactory, opportunities remain to strengthen equipment reliability, maintenance responsiveness, and operational disruption management.

Relationship Between Spare Parts Management and Vessel Operational Continuity

The regression findings provide statistical evidence of a positive association between spare parts management and vessel operational continuity at PT Pelayaran Samudera Rizqi. The reported normality test produced a significance value of 0.163, while the deviation from linearity test yielded 0.979. The heteroscedasticity test produced a significance value of 0.886. These results did not indicate significant violations of the corresponding assumptions at the 0.05 significance level, although interpretation depends on the diagnostic procedures and variables tested. The simple linear regression model produced an unstandardized coefficient of 0.805, indicating a positive relationship between the two variables. The t-test result of 8.369, with a reported significance value of 0.001, further indicated that the estimated coefficient was statistically different from zero.

These results suggest that spare parts management represents an important organizational factor associated with vessel operational continuity. Effective classification, demand forecasting, information management, procurement coordination, and consideration of operating conditions may support more timely maintenance activities and improve the availability of essential technical components. The association is particularly relevant to tugboat and barge operations because vessels may operate across geographically dispersed locations with varying access to suppliers, maintenance facilities, and logistics infrastructure. Under these conditions, spare parts shortages or delivery delays may prolong equipment downtime and complicate operational scheduling. The findings also highlight the importance of interpreting the five spare parts management dimensions as interconnected components. Classification supports the identification of critical components, forecasting estimates future requirements, information systems facilitate inventory monitoring, procurement policies influence supply responsiveness, and operating conditions affect logistical accessibility and maintenance needs.

However, the present simple linear regression analysis evaluated spare parts management as an aggregate independent variable. Therefore, the results establish an overall statistical association but do not determine the individual contribution of each management dimension or demonstrate that all five dimensions independently influence operational continuity.

Lisensi Creative Commons Atribusi 4.0 Internasional.

Furthermore, because the analysis was based on questionnaire responses collected within a single company, the findings should be interpreted as evidence of an association between reported management practices and perceived operational continuity rather than definitive proof of causality. Overall, the findings emphasize the importance of coordinated spare parts management for maintaining reliable shipping operations. Strengthening forecasting accuracy, inventory data quality, procurement responsiveness, and maintenance coordination may provide practical opportunities for improving operational continuity. Future investigations incorporating objective vessel downtime records, procurement lead times, and maintenance performance indicators could provide stronger evidence concerning the operational effects of spare parts management practices.

CONCLUSION

This study investigated the relationship between spare parts management and vessel operational continuity at PT Pelayaran Samudera Rizqi. The findings indicate that spare parts management practices were generally perceived as satisfactory, although several aspects require further improvement. In particular, inventory shortages and excessive stock levels remain important challenges, highlighting the need for more accurate spare parts demand forecasting and effective inventory control. Similarly, vessel operational continuity was positively assessed, with fleet availability receiving the highest evaluation, while operational downtime emerged as the principal area requiring improvement due to internal and external operational disruptions.

The statistical analysis revealed a significant positive relationship between spare parts management and vessel operational continuity, indicating that more effective spare parts management was associated with higher levels of perceived operational performance. The regression model explained 54.7% of the variance in operational continuity ($R^2 = 0.547$), suggesting that spare parts management is an important predictor within the investigated organizational context. Nevertheless, the remaining 45.3% of the variance may be associated with other factors not included in the model. These findings emphasize the importance of improving demand forecasting accuracy, strengthening inventory information systems, optimizing procurement and logistics coordination, and enhancing maintenance planning to support more reliable vessel operations.

The study contributes empirical evidence concerning the relationship between spare parts management and operational continuity in an Indonesian shipping company. However, its generalizability is limited by the single-company research setting, relatively small sample size, and the limited range of variables examined. Furthermore, the cross-sectional, questionnaire-based analysis does not independently establish a causal relationship. Future research should incorporate broader samples from multiple shipping companies, additional operational and organizational variables, and objective performance indicators, such as vessel downtime, spare parts delivery lead times, and maintenance completion rates. The application of qualitative or mixed-methods approaches is also recommended to provide deeper insights into managerial practices, procurement challenges, and the operational mechanisms linking spare parts availability with vessel performance.

REFERENCES

[1] A. Syamil et al., Buku Ajar Manajemen Rantai Pasok. Jambi: PT Sonpedia Publishing Indonesia, 2023.
[2] M. A. Naufal, Studi implementasi reliability centered maintenance (RCM) untuk proses perawatan dan perbaikan kapal tunda, Tugas Akhir, Institut Teknologi Sepuluh Nopember, Surabaya, 2020.
[3] Rusdi, Pengaruh manajemen suku cadang terhadap kinerja manajemen perawatan dan perbaikan pada SPB Landseadoor 16, Karya Ilmiah Terapan, Politeknik Ilmu Pelayaran Makassar, 2021.
[4] Komite Nasional Keselamatan Transportasi, Laporan Statistik Investigasi Kecelakaan Transportasi: Semester II Tahun 2023. Jakarta: KNKT, 2023.
[5] A. G. Malau, A. Hidayat, and R. W. Mada, "Keterlambatan pengiriman suku cadang kapal sehingga mengganggu kegiatan operasional kapal di PT. Global Trans Energy Internasional," Prosiding Seminar Pelayaran dan Riset Terapan, vol. 2, no. 1, pp. 115–122, 2020, doi: 10.36101/pcsa.v2i1.132.
[6] D. Nursani and A. Rachman, Modul Pelatihan Kompetensi Pengadaan Barang/Jasa Pemerintah Level 1: Pengantar Manajemen Rantai Pasok. Jakarta: LKPP, 2021.
[7] D. Fakhrana, Pengaruh keterlambatan pengadaan suku cadang terhadap kegiatan operasional kapal milik PT Sumberbumi Global Niaga, Skripsi, Sekolah Tinggi Ilmu Pelayaran, 2024.
[8] K. N. R. Aszahra, Pengaruh pengadaan dan persediaan spare part terhadap kelancaran kegiatan operasional kapal floating crane pada PT Mutiara Jawa, Skripsi, Sekolah Tinggi Ilmu Pelayaran, 2022.
[9] S. Sunyoto, F. Fauziannor, H. Hamdi, and D. E. Prihandono, Manajemen Operasi untuk Wirausahawan: Efisiensi dalam Bisnis Anda. Medan: PT Media Penerbit Indonesia, 2024.

Lisensi Creative Commons Atribusi 4.0 Internasional.