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An Analytical Study of Ship Deficiencies Identified During Port State Control: A Case Study of Kocaeli Port

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ABSTRACT

Maritime transport remains a fundamental pillar of international trade, and ship inspections are essential to ensure navigational safety and environmental protection. Port State Control (PSC) is a regulatory mechanism used to examine foreign-flagged vessels to verify their compliance with international maritime conventions. Among the various elements assessed during PSC inspections, a ship's type and age significantly influence the likelihood of identifying deficiencies. This study focuses on the PSC inspection data collected from the ports of Kocaeli, a major maritime hub in Türkiye. The objective is to analyze how vessel age and type correlate with the frequency and severity of recorded deficiencies. Using the Analysis of Variance (ANOVA) statistical method, the research compares deficiency rates across various ship categories and age brackets. Additionally, the study examines inspection frequency regarding the risk profiles of different vessels. Findings indicate that ships aged 12 years or older exhibit a higher number of deficiencies, with general cargo vessels being particularly prone to non-compliance. While the overall effectiveness of PSC inspections is evident, the study highlights the need for improved efficiency in inspection protocols. It is suggested that risk assessment models be refined to include more detailed criteria and that inspection strategies be adapted based on vessel characteristics. Furthermore, enhancing pre-inspection preparedness by ship operators may contribute to better compliance outcomes. The study aims to support safer maritime operations by offering targeted recommendations for optimizing PSC inspections at Kocaeli Port.

Keywords: International regulations, Kocaeli port, port state control, variance analysis, ship inspection.

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Liman Devleti Kontrolü Sürecinde Tespit Edilen Gemi Eksikliklerine Yönelik Analitik Bir İnceleme: Kocaeli Limanı Örneği

ÖZ

Deniz taşımacılığı, uluslararası ticaretin temel yapı taşlarından biri olmayı sürdürmekte olup, gemi denetimleri seyir güvenliği ve çevresel korumanın sağlanmasında hayati bir rol oynamaktadır. Liman Devleti Kontrolü (PSC), yabancı bayraklı gemilerin uluslararası denizcilik sözleşmelerine uygunluğunu denetlemek amacıyla uygulanan düzenleyici bir mekanizmadır. PSC denetimleri sırasında değerlendirilen çeşitli unsurlar arasında, geminin tipi ve yaşı, eksiklik tespit edilme olasılığı üzerinde önemli bir etkiye sahiptir. Bu çalışma, Türkiye'nin önemli bir denizcilik merkezi olan Kocaeli limanlarından elde edilen PSC denetim verilerine odaklanmaktadır. Araştırmanın amacı, gemi tipi ve yaşının, kaydedilen eksikliklerin sıklığı ve ciddiyetiyle nasıl bir ilişki gösterdiğini analiz etmektir. Bu kapsamda, farklı gemi kategorileri ve yaş grupları arasında eksiklik oranlarının karşılaştırılması için Varyans Analizi (ANOVA) istatistiksel yöntemi kullanılmıştır. Ayrıca, gemilerin risk profillerine göre denetim sıklığı da değerlendirilmiştir. Elde edilen bulgular, 12 yaş ve üzeri gemilerin daha fazla eksiklik barındırdığını, özellikle genel kargo gemilerinin uyumsuzluk açısından daha riskli olduğunu göstermektedir. PSC denetimlerinin genel olarak etkili olduğu görülmekle birlikte, denetim protokollerinin verimliliğinin artırılması gerektiği vurgulanmaktadır. Bu bağlamda, risk değerlendirme modellerinin daha ayrıntılı kriterlerle yeniden yapılandırılması ve denetim stratejilerinin gemi özelliklerine göre uyarlanması önerilmektedir. Ayrıca, denetim öncesi hazırlıkların iyileştirilmesi, daha yüksek uyum düzeyine katkı sağlayacaktır. Bu çalışma, Kocaeli Limanı'ndaki PSC denetimlerinin optimize edilmesine yönelik hedef odaklı öneriler sunarak daha güvenli denizcilik faaliyetlerini desteklemeyi amaçlamaktadır.

Anahtar Kelimeler: Uluslararası düzenlemeler, Kocaeli limanı, liman devleti kontrolü, varyans analizi.

1 Introduction

Maritime transport plays a crucial role in facilitating global commerce, ensuring the uninterrupted movement of goods and supporting international economic systems (Arıcan et al., 2023). Each year, vast quantities of cargo are transported via sea routes, making it essential to maintain high standards of safety, efficiency, and environmental responsibility (Arıcan et al., 2022). Regulatory compliance in the maritime sector is enforced through structured inspection systems, with Port State Control (PSC) being one of the most important instruments for overseeing foreign-flagged vessels. PSC inspections are carried out by national authorities to verify whether visiting ships meet internationally accepted maritime safety, environmental protection, and labor standards. These inspections cover critical areas such as safety procedures, pollution prevention mechanisms, crew welfare, and overall vessel condition. The International Maritime Organization (IMO) provides the legal and operational foundation for these evaluations, aiming to eliminate substandard ships and prevent accidents at sea (Unal et al., 2022). Türkiye holds a strategic geographical position, serving as a bridge between Europe and Asia. Kocaeli Port, located in the Marmara Region, is a major gateway for international shipping and experiences heavy maritime traffic. This makes the effectiveness of PSC enforcement at this port particularly significant. Data gathered from PSC inspections in Kocaeli offers valuable insights into the state of maritime safety and compliance practices in the region.

Numerous studies have examined Port State Control (PSC) inspections to identify effective targeting systems, risk indicators, and factors influencing ship detentions. Eyigün (2013) utilized survey data analyzed through SPSS to evaluate the efficiency of targeting systems for foreign-flagged vessels, concluding that the existing targeting factors adequately measure risk levels and offering improvement

suggestions. Similarly, Zhang, Gang, and Liu (2014) applied Principal Component Analysis (PCA) to identify common deficiencies leading to detentions, highlighting issues with certification validity, ship structure, and firefighting and lifesaving equipment. Further advancing statistical methods, Cariou and Wolff (2015) employed quantile regression to assess the likelihood of deficiencies causing detentions, emphasizing the need for improved vessel selection processes. Recent studies have explored the integration of artificial intelligence in enhancing the effectiveness of Port State Control inspections. Durlik et al. (2024) comprehensively reviewed AI applications in maritime safety and risk management, highlighting the potential for improved inspection protocols. Yan and Wang (2022) developed an AI model addressing data imbalance issues to predict detention probabilities, offering a novel approach to ship selection for inspections. Additionally, Sheriff et al., (202) conducted a bibliometric analysis of PSC-related research, identifying key trends and gaps in literature.

They identified that fire safety issues were prevalent among detained bulk carriers, general cargo, and reefer ships, particularly those over 30 years old. Meanwhile, Öztürk, Işık and Şanlıer (2016) compared inspection performances of Turkish ports under the Med and Black Sea MoUs using the Delphi method, determining that the lack of specialization among inspectors was a significant performance barrier. Im and Sin (2017) examined Tokyo MoU inspections over 36 months and identified poor preparedness for inspections as a major cause of detentions, particularly among bulk and general cargo vessels. Yang, Yang, and Yin (2018) proposed a Tree-Augmented Naive Bayes (TAN) model for predicting detention probabilities based on Paris MoU data, highlighting deficiencies, inspection type, ship age, and recognized organization as key factors (Ayhan, 2023). Wang, Yan, and Qu (2019) enhanced risk detection using a data-driven TAN classifier, outperforming traditional risk profiling by detecting 130% more deficiencies. Fu et al. (2020) utilized association rule mining and decision-quality-cost analysis to uncover correlations between ship types, tonnage, and specific deficiencies, providing practical insights for stakeholders (Doğanay et al., 2023). Later, Xiao et al. (2021) applied Super-SBM and Malmquist Index methods to assess global PSC regime efficiencies, ranking the Indian Ocean MoU highest. Kara (2022) evaluated flag state safety performance using TOPSIS and cluster analysis, revealing that nearly half performed below standard. Demirci and Çiçek (2023) introduced an intelligent ship inspection analytics (I-SIA) model that personalized inspections using fuzzy clustering and Apriori algorithms. Finally, Gezici (2024) used Bayesian networks and machine learning to analyze 2022 Med MoU inspection data, finding frequent deficiencies in fire detection, lifesaving equipment, and cleanliness, with general cargo vessels being the most affected.

By analyzing PSC data specific to Kocaeli Port, this research identifies key factors for improving inspection outcomes and reducing operational risks. The study serves as a resource for practitioners and scholars aiming to optimize maritime safety procedures.

This study aims to analyze the correlation between ship age and type and the number of deficiencies identified during Port State Control (PSC) inspections, using data collected from Kocaeli Port between 2020 and 2024. The scope of the research includes examining 1,834 ship inspections and applying statistical methods, specifically ANOVA, to determine whether these vessel characteristics significantly influence inspection outcomes. The primary purpose of this study is to investigate whether ship age and type have a statistically significant effect on the number of deficiencies identified during Port State Control inspections conducted at Kocaeli Port. By focusing on a major Turkish port within the Mediterranean Memorandum of Understanding (Med MoU) framework, the study offers localized insights with implications for improving risk-based inspection strategies and maritime safety protocols.

2 Methodology

Statistical analysis encompasses a comprehensive set of methods and techniques aimed at collecting, organizing, interpreting, and deriving conclusions from data. This discipline utilizes mathematical and statistical principles to interpret observed data sets, perform hypothesis testing, and reveal patterns or relationships within the data (Field, 2024). Statistical analysis plays a significant role across a wide range of fields, including social sciences, engineering, health sciences, and economics. In scientific research, the application of statistical analysis is essential for validating hypotheses, thereby enhancing the credibility and reliability of research findings (Hair et al., 2013).

Among various statistical methods, analysis of variance (ANOVA) is a widely employed technique that evaluates whether the mean values (dependent variable means) differ significantly across categories of one or more independent variables. The method investigates how the data points forming the means within each category are distributed. ANOVA is particularly suited for comparing the means of two or more groups and determines whether any statistically significant differences exist between them by accounting for both within-group and between-group variances (Field, 2024).

ANOVA is especially valuable in experimental and quantitative research designs, as it assesses the effect of an independent variable on a dependent variable. The analysis is based on two principal components:

- Within-group variability: Represents the individual variation within each group.
- Between-group variability: Indicates the variation in means between different groups.

The ANOVA procedure consists of five systematic steps:

- Checking assumptions: Verifying that the assumptions required for ANOVA are met (e.g., normality, homogeneity of variance).
- Calculating variance sources: Computing the sources of variance that form the basis for ANOVA.
- Computing the F-statistic: Calculating the F-ratio needed for hypothesis testing.
- Significance testing: Determining the significance by evaluating the p-value in relation to a predefined alpha level.

In this study, the Statistical Package for the Social Sciences (SPSS) was employed to perform the ANOVA. SPSS is a Windows-based software program used for data entry, statistical analysis, and the generation of tables and graphs. It is capable of automatically conducting all statistical equations and assumption tests required for ANOVA, which makes it a suitable tool for the present research. Moreover, SPSS enhances the interpretation of results through its ability to generate explanatory outputs, well-organized tables, and visual representations (Pallant, 2020).

The current study focuses on port state control inspections carried out within the administrative jurisdiction of Kocaeli between 2020 and 2024. A total of 1,834 ships were inspected during this period, and the number of deficiencies identified by inspectors during these inspections was analyzed in relation to ship characteristics, specifically ship age and ship type. The data were retrieved from the THETIS-Med information system, developed by the European Maritime Safety Agency (EMSA), which serves to record port state control results conducted by member states of the Mediterranean Memorandum of Understanding (Med MoU).

Although the data were extracted using the THETIS-Med system, the analysis was not conducted based on Med MoU inspection criteria. Instead, the Paris MoU inspection standards were adopted. This decision was based on the compatibility between Paris MoU and Med MoU information systems, as

well as the alignment of Med MoU inspection procedures with those of Paris MoU through recent revisions.

To classify vessels into two distinct risk groups—High-Risk Ships (HRS) and Low-Risk Ships (LRS)—the study followed a simplified approach inspired by the Paris MoU and Med MoU targeting criteria. Ship age and ship type were the primary determinants of risk classification. Vessels older than 12 years and those known to have higher deficiency or detention rates in historical inspection data (such as general cargo, bulk carriers, and oil tankers) were categorized as high-risk (HRS). In contrast, newer ships and those typically associated with better compliance records (e.g., container ships and Ro-Ro vessels) were categorized as low risk (LRS). This binary risk classification facilitated a clearer statistical comparison of deficiency trends across ship profiles.

Ships in the dataset were classified by type and age, resulting in two distinct risk categories:

- HRS (High-Risk Ships)
- LRS (Low- Risk Ships)

The ship types included in the analysis are as follows:

- General Cargo Ship
- Ro-Ro Vessel
- Container Ship
- Chemical Tanker
- Oil Tanker
- Liquefied Gas Carrier

The ship ages included in the analysis are as follows:

- 12 years or less
- Older than 12 years

The stages of the study with the above data are given in Table 1.

Table 1: *Overview of the Methodology Process*

Steps	Process Description
1. Data Collection	THETIS-Med system used to collect inspection data for 1,834 ships (2020–2024) at Kocaeli Port.
2. Data Classification	Ships classified by type (7 categories) and by age (2 categories= into risk groups (LRS / HRS).
3. Variable Definition	Dependent Variable: Number of deficiencies. Independent Variables: Ship Type, Ship Age
4. Hypothesis Setup	H_0: No significant difference in deficiencies among ship types/ages. H_1: Significant difference exists.
5. Assumption Testing	Normality and homogeneity of variances tested using SPSS.
6. ANOVA Execution	One-way ANOVA performed using SPSS to analyze group differences.
7. Significance Analysis	F-statistic and p-value calculated. $p < 0.05$ interpreted as significant.
8. Interpretation	Results interpreted to identify relationships between ship characteristics and deficiencies.

3 Results

In accordance with the methodological criteria, inspection data for 1,834 ships operating under the jurisdiction of Kocaeli between 2020 and 2024 were extracted from the THETIS-Med system and organized for ANOVA analysis. A selected portion of this dataset is displayed in Table 2.

As previously mentioned, the independent variables in this study are ship type and ship age, while the dependent variable is the number of deficiencies identified during inspections. The impact of the independent variables on the dependent variable is presented in Table 3.

The findings reported in Table 3 clearly illustrate the significant influence of both ship type and age on deficiency levels. The overall average number of deficiencies is calculated as 1.47; however, a clear upward trend is observed with increasing ship age. Specifically, ships in the younger age group exhibit an average deficiency count of 0.79, whereas older ships show a substantially higher average of 1.78. This trend suggests that aging ships are more prone to deficiencies.

Table 2: *Deficiencies numbers based on risk based ship type and age*

Ship	Ship Type	Ship Age	Risk for Ship Age	Risk for Ship Type	Number of Deficiency
A	Oil Tanker	21	HRS	HRS	2
B	Liquefied Gas Carrier	19	HRS	HRS	1
C	Chemical Tanker	21	HRS	HRS	1
D	Bulk Carrier	22	HRS	HRS	2
E	General Cargo	14	HRS	LRS	3
F	Ro-Ro	12	LRS	LRS	2
G	Container	07	LRS	LRS	1

In terms of ship type, vessels categorized as lower type record an average of 1.80 deficiencies, compared to 1.13 for higher type vessels, indicating a meaningful relationship between ship type and deficiency frequency. When ship type and age are assessed together, the highest average deficiency count (2.03) is observed in older ships of lower type, while the lowest (0.83) is seen in younger ships of lower type. High-type young ships show the least deficiencies (0.77), whereas high-type older vessels report a moderately increased average of 1.41.

To determine whether the independent variables—ship type and ship age—have a statistically significant effect on the dependent variable, which is the number of deficiencies, the relationship between the variable groups is presented in Table 3.

Table 3: *Deficiencies numbers based on risk based ship type and age*

Ship Type	Ship Age	Mean	Std. Deviation	N
Low	Low	0.83	1.242	174
	High	2.03	2.021	761
	Total	1.80	1.956	935
High	Low	0.77	1.211	393
	High	1.41	1.830	506
	Total	1.13	1.619	899
Total	Low	0.79	1.220	567
	High	1.78	1.969	1267
	Total	1.47	1.830	1834

According to Table 4, two types of effects are identified. The first is the main effect, which refers to the individual impacts of ship type and ship age. The ANOVA results show that the main effect of ship type is statistically significant, with an F value of 28.817 and a p-value less than the critical threshold of 0.01. This indicates that ship type has a significant impact on the number of deficiencies, and there is a meaningful difference in deficiency counts across different ship types.

Table 4: *Interaction results of ship type and age with the number of defects*

Source	Sum of Squares	Degrees of Freedom	Mean Square	F Value	p-value
Corrected Model	499.779	3	166.593	54.098	0.000
Intercept	3983.756	3983.756	1	3983.756	0.000
Ship Type	88.741	1	88.741	28.817	0.000
Ship Age	265.456	1	265.456	86.201	0.000
Ship Age*Ship Type	27.381	1	27.381	8.891	0.003
Error	5635.465	1830	3.079		
Total	10119.000	1834			
Corrected Total	6135.244	1833			

Ship age, with an F value of 86.201 and a p-value below 0.01, appears to be the variable with the most substantial effect on deficiency numbers. The second type of effect is the interaction effect, which refers to the combined impact of ship type and age. The interaction effect is also significant ($F = 8.891$; $p < 0.05$), indicating that the influence of ship type on deficiencies varies by ship age. These findings support the hypotheses proposed earlier in the study.

To visually compare group means and interpret both main and interaction effects, the Estimated Marginal Means plot generated via SPSS is presented in Figure 1.

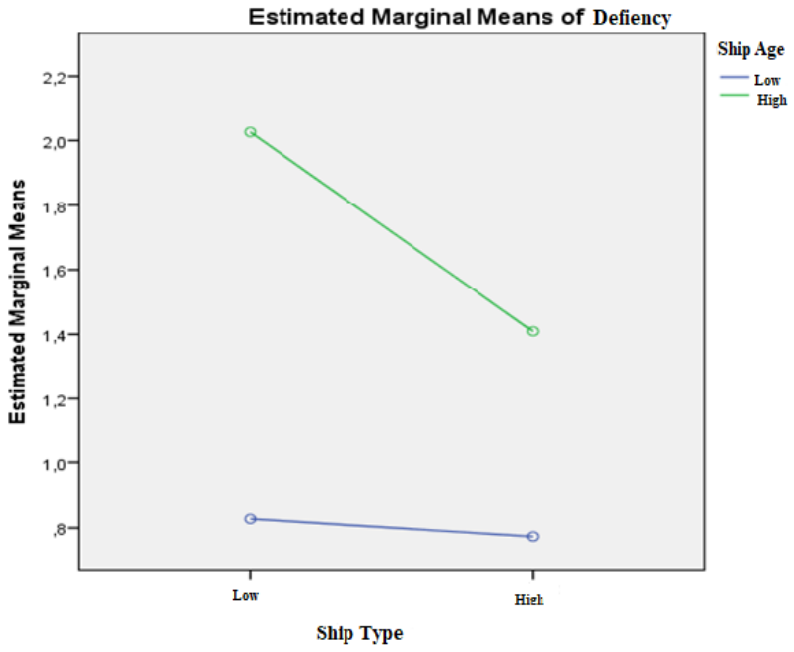


Figure 1: Estimated marginal means of deficiency

This figure illustrates a noteworthy finding: although ships categorized as high-risk would typically be expected to exhibit a higher number of deficiencies, the analysis reveals that ships classified as low-risk actually show a greater number of recorded deficiencies.

When examined by ship age, vessels under 12 years of age—considered lower risk—were associated with fewer deficiencies, whereas those aged 12 years and above demonstrated a substantially higher number of deficiencies.

Further analysis of the interaction between ship age and ship type indicates that the highest average number of deficiencies was observed in ships over 12 years old belonging to the low-risk type category. These were followed by ships over 12 years of age classified as high-risk. Among vessels under 12 years, although the differences were relatively small, low-risk ship types showed a slightly higher number of deficiencies compared to high-risk types.

4 Discussion

Port State Control (PSC) inspections are essential for ensuring the operational safety of ships, compliance with international maritime conventions, and the identification of substandard vessels. In order to enhance the efficiency and effectiveness of these inspections, it is crucial to analyze the deficiencies identified during PSC procedures with respect to vessel type and age. Such analyses enable the detection of high-risk vessel categories, allowing for the development of targeted preventive measures. This approach not only strengthens maritime safety but also promotes higher compliance with international regulations.

While existing literature on PSC inspections remains limited, most previous studies have focused primarily on detention rates or specific types of deficiencies. In contrast, this study adopts a different approach by analyzing the impact of vessel type and age on the number of deficiencies identified during inspections.

The analysis revealed that vessel age is the most significant factor influencing deficiency rates. In particular, ships aged 12 years and older exhibited a statistically significant increase in deficiencies. Notably, approximately 69% of the inspected vessels were in this age group, highlighting the need to consider vessel age as a primary factor during risk-based inspection planning. These findings align with previous studies, such as those by Yang et al. (2018), Fu et al. (2020), and Gezici (2024), which emphasized the influence of ship age on both deficiencies and detentions. For instance, Yang et al. (2018) reported that vessel age above 15 years significantly increased detention probability, with older general cargo and bulk carriers exhibiting up to 60% more deficiencies compared to newer vessels. This finding is consistent with our result, which shows an average deficiency count of 1.78 in ships older than 12 years—more than double the rate of younger vessels (0.79). Similarly, Fu et al. (2020) identified general cargo ships as the leading contributors to safety-related deficiencies, a conclusion that parallels our own finding where older general cargo ships were the most deficiency-prone category. In Gezici's (2024) study based on 2022 Med MoU data, fire safety and life-saving equipment failures were dominant, particularly among vessels above 20 years of age. Our study also reflects a similar trend, suggesting that aging vessels not only show increased overall deficiencies but may also have systemic issues in critical safety areas.

Although structural deterioration in older ships is expected, the high deficiency rates in such vessels cannot solely be attributed to age-related wear. Extended maintenance intervals and increased repair costs may lead some operators to delay or neglect necessary procedures, thereby compromising safety and environmental compliance. In contrast, newer vessels generally demonstrate better alignment with regulatory standards. Therefore, adjusting inspection frequencies and maintenance planning based on vessel age could significantly reduce operational deficiencies.

The study also found discrepancies when comparing vessel types. Contrary to expectations, vessels categorized as low-risk—such as general cargo ships—were found to have more deficiencies than some high-risk categories. General cargo vessels, in particular, stood out due to their older designs, limited onboard resources, and operational complexity. These factors contribute to deficiencies related to navigation, safety, and environmental protection. Prior studies, including those by Im and Sim (2017) and Gezici (2024), have similarly identified general cargo vessels as leading contributors to detention and deficiency statistics.

Furthermore, the combined analysis of vessel age and type indicated that older vessels within low-risk categories displayed a disproportionately high number of deficiencies. This finding suggests the need for revised inspection strategies and more focused regulatory oversight for this segment. Supporting this, Cariou and Wolff (2015) found that ships over 30 years of age—including livestock carriers, general cargo, refrigerated, and Ro-Ro vessels—exhibited higher detention and deficiency rates.

Although PSC operations in Kocaeli Port have generally been effective, the findings underscore the importance of restructuring inspections according to ship type and age. Enhanced use of digital platforms such as Thetis-Med and harmonized practices among Mediterranean MoU member states will further strengthen inspection efficiency and consistency across regional ports.

5 Conclusions

Within the framework of the Mediterranean Memorandum of Understanding (Med MoU), Turkey has emerged as the leading country in terms of the number of Port State Control (PSC) inspections conducted, with Kocaeli—its largest port—playing a pivotal role in this achievement. The high inspection volume recorded at Kocaeli Port highlights the strategic importance placed on maritime safety and environmental protection. These extensive inspection activities have yielded a robust and comprehensive dataset, offering consistent and valuable insights for analyzing trends in ship deficiencies and identifying areas for regulatory improvement. The findings of this study clearly indicate that vessel age is a dominant factor influencing the number of deficiencies observed during inspections. Older ships, particularly those aged 12 years and above, exhibit significantly higher deficiency rates, thereby posing elevated risks in terms of navigational safety, crew welfare, cargo integrity, and environmental sustainability. This underscores the need for enhanced preventive maintenance, timely repairs, and stricter operational oversight for aging vessels. Aligning such practices with international safety regulations is vital for minimizing safety risks and ensuring long-term operational sustainability.

Another noteworthy outcome of the analysis challenges traditional assumptions regarding ship risk categorization. Contrary to expectations, vessels classified as low-risk based on type were found to exhibit higher deficiency rates than some high-risk categories. Specifically, general cargo ships recorded the highest number of deficiencies among all ship types, signaling a potential misalignment in the current risk profiling systems used for inspection targeting. These findings suggest that the criteria used to classify vessel risk levels should be reevaluated and refined in order to better capture the actual safety performance of different ship types. When vessel type and age are considered in combination, the study reveals that older ships belonging to nominally low-risk categories—such as general cargo vessels—constitute the most critical group in terms of deficiencies. This implies that risk assessment models should be adapted to prioritize such vessels in inspection schedules. Furthermore, container ships and Ro-Ro vessels in older age brackets also warrant increased inspection frequency and scope. In light of these conclusions, it is recommended that port authorities implement more targeted inspection strategies, including focused inspection campaigns aimed at older general cargo ships. This approach will contribute to a more efficient allocation of inspection resources and promote higher compliance with

safety and maintenance standards, ultimately enhancing maritime safety and regulatory effectiveness across the region.

Despite the robustness of the findings, this study has several limitations. First, the analysis is limited to inspection data from a single port—Kocaeli—within a specific time frame (2020–2024), which may affect the generalizability of the results to other regions or time periods. Second, while risk categorization was based on ship type and age, other relevant factors such as flag state, company performance, and previous detention history were not included due to data availability constraints. Lastly, the analysis was primarily quantitative and did not incorporate expert judgment or qualitative insights that might provide additional explanatory value. These limitations should be considered when interpreting the results and planning future studies.

This study contributes to the literature by offering a data-driven approach to understanding how ship characteristics influence inspection outcomes at a regional level. By applying ANOVA to real-world PSC data, it provides a replicable framework that can be expanded in future studies. Researchers may build upon these findings by incorporating additional variables such as flag state, class society, or inspection history. Moreover, comparative analyses between multiple ports or MoUs could help assess the consistency of risk assessment models across jurisdictions, offering broader insights into inspection efficiency and maritime safety governance.

6 Declarations

6.1 Acknowledgements

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6.2 Funding source

No financial support was received for this research.

6.3 Competing Interests

There is no conflict of interest in this study.

6.4 Authors' Contributions

Uğur AKBAŞ : Contribution to the article. (Planning the materials and methods to reach the results, taking responsibility for the experiments, organizing and reporting the data, taking responsibility for the explanation and presentation of the results, taking responsibility for the literature review during the research, taking responsibility for the creation of the entire manuscript or the main part, reworking not only in terms of spelling and grammar but also intellectual content)

Ozan Hikmet ARICAN: Contribution to the article. (Developing ideas or hypotheses for the research and/or article, planning the materials and methods to reach the results, taking responsibility for the explanation and presentation of the results, taking responsibility for the creation of the entire manuscript or the main part)

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