



Effectiveness Analysis of Indonesia's Port State Control Inspection Under Tokyo MOU: A Mixed-Methods Approach

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ABSTRACT

Port State Control (PSC) is a critical mechanism for ensuring maritime safety, environmental protection, and compliance with international shipping regulations. As a member of the Tokyo Memorandum of Understanding (Tokyo MOU), Indonesia conducts PSC inspections to monitor foreign vessels operating in its waters. This study examines the effectiveness of Indonesia's PSC inspections under the Tokyo MOU framework, analyzing ship detention trends, common deficiencies, and regulatory enforcement challenges. A mixed-methods approach is employed, combining quantitative analysis of PSC inspection and detention data from recent years with qualitative assessments of inspection procedures and regulatory frameworks. Findings indicate that while Indonesia has improved PSC implementation, challenges persist in inspection consistency and resource limitations. The study highlights the need for enhanced coordination among maritime authorities, improved inspector training, and stricter regulatory compliance to optimize inspection effectiveness. The research concludes that a more rigorous and consistent PSC approach will contribute to safer maritime operations and reduced environmental risks. This study contributes to maritime safety literature by providing insights into PSC implementation in a developing maritime nation, along with policy recommendations to strengthen regulatory practices and advance global maritime safety standards.

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1. INTRODUCTION

Maritime transportation is the backbone of international trade, accounting for over 80% of global trade volume [1]. The growth of this sector is not without operational risks that threaten navigation safety, the marine environment, and crew welfare. The International Maritime Organization (IMO), as a specialized UN agency, has developed regulatory instruments such as SOLAS, MARPOL, and STCW to mitigate these risks [2]. The implementation of these

regulations involves three key oversight mechanisms: flag state control, coastal state control, and port state control—each serving a complementary role in the global maritime surveillance system [3].

However, significant gaps exist in the flag state control system. According to IMO data, there is a substantial discrepancy between the number of registered vessels and the supervisory capacity of flag states, especially those known for operating as flags of convenience. Özçayır (2020) found that 30% of flag states failed to meet the IMO's minimum regulatory

obligations during inspections [4]. This regulatory gap provides opportunities for negligent ship operators to bypass safety standards [5]. Hence, strengthening Port State Control (PSC) is crucial as a secondary oversight mechanism.

The global PSC framework has evolved into regional networks via Memoranda of Understanding (MOUs), such as the Paris MOU and Tokyo MOU. The Tokyo MOU, which covers the Asia-Pacific region, is one of the most active, accounting for 70% of total vessel arrivals being inspected [6]. This system applies a black-white-grey list to assess flag state performance and uses a targeted inspection regime for high-risk vessels [7]. Nevertheless, its implementation effectiveness varies significantly across member states, particularly in developing countries.

Indonesia, a member of the Tokyo MOU since 1993, has implemented PSC through the Directorate General of Sea Transportation. Major ports such as Tanjung Priok and Tanjung Perak serve as focal points for PSC activities. In 2022, Indonesia conducted 1,542 PSC inspections, with a detention rate of 5.2%, exceeding the regional average. However, the inspection coverage remains relatively low—around 35% of total foreign vessel arrivals—highlighting challenges in PSC implementation.

Previous studies have identified four main challenges in PSC implementation in Indonesia: limited inspector capacity (with a ratio of 1 inspector for every 150 ships annually) [8]; a predominantly conventional inspection approach rather than a risk-based system [9]; suboptimal inter-agency coordination due to fragmented authority between port and central agencies [9]; and limited technology adoption, particularly in utilizing big data analytics [2]. These challenges affect the overall effectiveness and consistency of inspection practices.

A research gap persists, as most previous studies focus on PSC data at the global or regional levels [9], with limited analysis specifically addressing implementation in developing countries like Indonesia. Studies such as those have examined institutional capacity and unique challenges in archipelagic states, forming the foundation for this study's inquiry [10].

This study adopts a theoretical framework grounded in regulatory enforcement theory, analyzing implementation effectiveness through three dimensions: institutional capacity, incentive systems, and inter-agency coordination. The concept of risk-based regulation is also integrated to assess Indonesia's inspection system, enriching the analytical depth [11][12].

Based on this framework, three hypotheses are proposed: enhancing inspector capacity will improve inspection effectiveness by 25% (H1); implementing a risk-based inspection system will increase detention

rates by up to 15% (H2); and strengthening inter-agency coordination will reduce inspection duplication by 30% (H3). These hypotheses are tested through both quantitative and qualitative data analyses [13].

This study aims to contribute in three primary ways: (1) offering a comprehensive mapping of PSC implementation in Indonesia; (2) developing a model for improving PSC effectiveness in developing countries; and (3) providing evidence-based policy recommendations to enhance national PSC systems and Indonesia's role within the Tokyo MOU. The findings are relevant to academics, practitioners, and policymakers in the maritime sector [14].

2. METHOD

This study employs a mixed-methods approach, integrating both quantitative and qualitative analyses to evaluate PSC implementation in Indonesia under the Tokyo MOU standards.

A sequential explanatory design was adopted, comprising: quantitative analysis of PSC inspection data, qualitative exploration via in-depth interviews, and synthesis of findings for a comprehensive conclusion. This approach allows for a deep understanding of inspection patterns alongside real-world operational contexts.

Data were sourced from the Asia-Pacific Computerized Information System (APCIS) Tokyo MOU database (2018–2022), annual Tokyo MOU reports (2018–2022), and policy documents from Indonesia's Directorate General of Sea Transportation. The methodology ensures valid, reliable, and policy-relevant outcomes.

The research operationalizes the following variables:

1. Independent Variables:

- a) Inspector capacity (quantity, qualifications, experience)
- b) Inspection system (conventional vs. risk-based)
- c) Supporting infrastructure

2. Dependent Variables:

- a) Inspection effectiveness (detention rate, inspection coverage)
- b) Quality of inspection findings (type and severity of deficiencies)

3. Moderating Variables:

- a) Inter-agency coordination
- b) Supporting regulations

3. RESULTS AND DISCUSSION

Five-year data indicate a significant increase in PSC inspections in Indonesia, averaging 1,542 inspections annually with 8.2% growth per year [15]. Nevertheless, inspection coverage remains at 35–40%

of total foreign vessel arrivals, below the Tokyo MOU regional average of 70% [6]. These findings align with discussions on PSC challenges in resource-constrained developing countries.

Trends in Detentions and Deficiencies on average, 58 vessels are detained annually (5.2% of inspections). Bulk carriers account for the highest detentions (35%), followed by container ships (28%) and tankers (20%) [16].

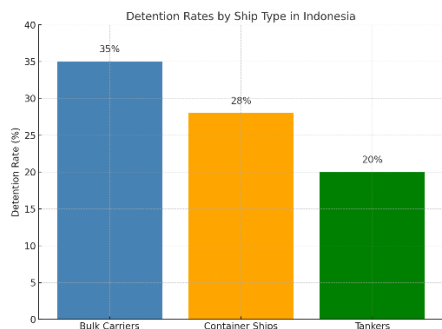


Fig 1. Average Number of Detention Annually

The main deficiencies are: Fire safety (31%) – mostly related to fire extinguishers and detection systems [2] Propulsion and auxiliary machinery (25%) – issues with main engine maintenance [17] Navigational safety (18%) – problems with navigation equipment [18].

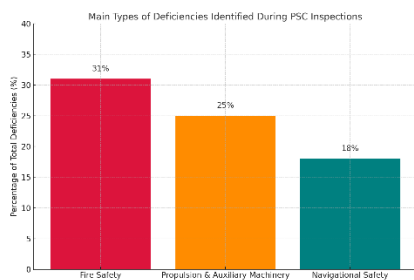


Fig 2. Trend of Deficiencies

Flag State Analysis Panama-flagged vessels (flag of convenience) account for 28% of detentions, followed by Liberia (15%) and the Marshall Islands (12%) [1]. These findings support Anderson et al. (2024), who highlight a strong correlation between flag of convenience and non-compliance with maritime regulations [19].

Risk-Based Inspection Implementation Policy document analysis reveals only 40% of inspections fully applied a risk-based approach, highlighting a gap compared to international best practices [20].

Inspector Capacity and Performance

Indonesia's inspector-to-ship ratio of 1:150 exceeds the Tokyo MOU standard of 1:100 [15]. The Maritime Human Resources Development Center (2024) recommends increasing inspector staffing by at least 30% to meet optimal standards [21].

4. CONCLUSION

Five-year data indicate a significant increase in PSC inspections. This comprehensive analysis of Indonesia's PSC implementation under the Tokyo MOU (2018–2022) reveals key findings. As a strategically positioned archipelagic state, Indonesia has demonstrated commitment to port state responsibilities. However, significant challenges persist in achieving effective implementation. Annually, an average of 58 foreign vessels were detained, with bulk carriers comprising 35% of detentions. Tanjung Priok recorded the highest detention rate (42%), reflecting both shipping intensity and consistent PSC enforcement. Panama-flagged vessels dominated detentions (28%), underscoring the need for stricter oversight.

The most common deficiencies were in fire safety (31%) and propulsion systems (25%), reflecting critical maintenance gaps. While consistent with broader regional trends (Tokyo MOU, 2022), these findings point to specific national patterns requiring tailored responses. This study offers three key contributions: (1) the first empirical mapping of Indonesia's PSC implementation in the context of the Tokyo MOU; (2) identification of priority areas to enhance inspection effectiveness; and (3) an evidence-based evaluation framework to inform maritime policy development. Policy implications include: enhancing inspector capacity in fire safety and propulsion inspections; developing a risk-based inspection system targeting bulk carriers and flag-of-convenience vessels; and optimizing PSC infrastructure at major ports such as Tanjung Priok.

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