Strategic Cost Optimization for Efficient Crew Management in Maritime Shipping Operations

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ABSTRACT

The rising manning cost over the past three years has become a prominent issue at PT Pertamina International Shipping, where this expense accounts for the largest share of the company's operational expenditure. This study examines the key factors driving the increase in manning cost and explores how cost efficiency strategies can be applied within the crewing function. Employing a qualitative approach, data were collected through observations, semi-structured interviews with three key personnel, and analysis of financial reports and crew service records over an 11-month period in 2022–2023. The findings reveal three primary inefficiencies scheduling discrepancies causing 2–7 days of delays, suboptimal invoice verification leading to monthly overpayments of approximately 50–100 million rupiah, and overstaffing beyond minimum crew requirements, inflating costs by 10–15%. These inefficiencies result in avoidable expenses of 1–1.5 billion rupiah monthly. The study recommends adopting digital scheduling tools, automated verification systems, and optimized crew allocation to reduce costs while maintaining operational safety. These strategies can save billions annually, improve crew welfare, and contribute to maritime management literature by addressing cost efficiency in state-owned enterprises, offering a blueprint for Indonesia's shipping industry.

Keywords*: Cost Efficiency, Crew Management, Indonesian Shipping, Manning Cost, Maritime Operations, Safe Manning.*

ABSTRAK

Industri pelayaran maritim menghadapi tantangan biaya yang signifikan, terutama dalam manajemen awak kapal, yang merupakan porsi utama dari biaya operasional bagi perusahaan seperti PT. Pertamina International Shipping. Studi ini bertujuan untuk mengidentifikasi faktor-faktor pendorong peningkatan biaya manajemen awak kapal dari tahun 2019 hingga 2022 dan mengusulkan strategi untuk meningkatkan efisiensi biaya. Dengan menggunakan pendekatan kualitatif, data dikumpulkan melalui observasi, wawancara semi-terstruktur dengan tiga personel kunci, dan analisis laporan keuangan serta catatan layanan awak kapal selama periode 11 bulan pada tahun 2022–2023. Temuan penelitian mengungkapkan tiga inefisiensi utama: ketidaksesuaian penjadwalan yang menyebabkan keterlambatan 2–7 hari, verifikasi faktur yang kurang optimal yang menyebabkan kelebihan pembayaran bulanan sekitar 50–100 juta rupiah, dan kelebihan staf melebihi persyaratan awak minimum, yang menyebabkan peningkatan biaya sebesar 10–15%. Inefisiensi ini mengakibatkan biaya yang dapat dihindari sebesar 1–1.5 miliar rupiah per bulan. Studi ini merekomendasikan penerapan alat penjadwalan digital, sistem verifikasi otomatis, dan alokasi awak kapal yang optimal untuk mengurangi biaya sekaligus menjaga keselamatan operasional. Strategi-strategi ini dapat menghemat miliaran dolar setiap tahunnya,

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meningkatkan kesejahteraan awak kapal, dan berkontribusi terhadap literatur manajemen maritim dengan memperhatikan efisiensi biaya di badan usaha milik negara, sehingga menawarkan cetak biru bagi industri pelayaran Indonesia.

***Kata kunci**: Efisiensi Biaya, Manajemen Awak Kapal, Pengiriman Indonesia, Biaya Pengawakan, Operasi Maritim, Pengawakan yang Aman.*

INTRODUCTION

The maritime shipping industry serves as the backbone of global trade, facilitating approximately 90% of the world's goods transportation and acting as critical infrastructure for the global economy (Harlaftis & Theotokas, 2020). This global network connects coastal nations, enhancing their trade competitiveness and economic growth (Hoffmann et al., 2017). Indonesia, as a maritime nation, leverages this opportunity through state-owned enterprises like PT Pertamina International Shipping (PIS), a subholding of PT Pertamina (PERSERO) that operates a fleet of 97 vessels to support its shipping and logistics activities (Pertamina International Shipping, 2020; Pertamina International Shipping, 2025). The crewing function at PT PIS, responsible for managing ship crew needs from recruitment to rotation, is pivotal to its operations but incurs significant manning costs, encompassing salaries, allowances, insurance, and provisions (Mitroussi, 2008; Stopford, 2009). These costs, which can account for 30–40% of a vessel's operational expenses, are critical to the company's financial health and competitiveness (Skrzeszewska, 2020).

Cost efficiency is a critical determinant of competitiveness and sustainability in the maritime industry, requiring optimal resource allocation amid volatile freight rates, fluctuating fuel prices, and global competition (Lestari et al., 2023). Crew expenses represent a major operational cost component, approximately 30–50% of total vessel operating costs, including wages, training, certification, insurance, welfare, and crew logistics (Leggate et al., 2005; Wahyuningsih & Maulidiono, 2018). As a result, manning cost management has become a strategic priority, demanding a balance between expenditure control and the maintenance of competency, safety, and operational reliability. Effective cost efficiency strategies incorporate integrated approaches such as optimized crew planning, nationality mix, training efficiency, retention initiatives, and technological solutions, supported by rigorous analysis of cost drivers and targeted interventions aligned with industry best practices (Supriadi & Syahidah, 2018; Musfitria et al., 2023).

Manning costs at PT PIS have risen sharply from 2019 to 2022, representing the largest share of operational expenditure and posing a risk to cash flow sustainability (Pertamina International Shipping, 2020). According to Stopford (2009), manning costs include crew wages, training, insurance, travel, and provisions, influenced by factors such as fleet size and crew rotation frequency. At PT PIS, rapid crew rotations and a large fleet exacerbate these expenses, as observed during an 11-month study in 2022, where inefficiencies in scheduling, invoice verification, and crew allocation were evident (Ricardianto et al., 2021; Marsella, 2021). These inefficiencies, such as delays in crew onboarding and overstaffing beyond safe manning requirements, align with findings on operational challenges in Indonesian shipping companies (Ashari, 2021; Kurniawan, 2025). The urgency to address these costs is heightened by global pressures like rising labor costs and stringent safety regulations, which demand efficient resource management (Notteboom & Vernimmen, 2009; Psaraftis & Kontovas, 2010).

Despite extensive research on cost efficiency in maritime operations, a significant research gap persists in the context of crew management within state-owned enterprises in developing countries. According to Hoffmann et al. (2017), global shipping networks emphasize route optimization and fuel efficiency, but crew-related costs receive less attention. Similarly, Lun et al. (2010) highlight logistics optimization, yet crew management inefficiencies, particularly in Indonesia's bureaucratic context, remain

underexplored. Studies like Ricardianto et al. (2021) and Ginting and Trisno (2025) discuss crew performance and competence in Indonesian shipping, but they do not specifically address manning cost optimization in state-owned enterprises like PT PIS. Basuki (2025) examines safety management in PT PIS vessels, yet overlooks the financial implications of crew allocation. This gap underscores the need for targeted research on cost efficiency strategies tailored to PT PIS's crewing function.

This study aims to identify the factors driving the increase in manning costs at PT Pertamina International Shipping and propose cost efficiency strategies to optimize the crewing function without compromising operational safety. By analyzing financial reports, crew service records, and safe manning data from 2019 to 2022, the research seeks to address inefficiencies in crew change scheduling, invoice verification, and crew allocation. Drawing on Porter's (1985) cost leadership framework, the study offers practical recommendations to enhance PT PIS's financial sustainability and competitiveness. The findings are expected to guide PT PIS in formulating cost-efficient policies, improving human resource management, and contributing to the broader discourse on maritime operational efficiency in Indonesia.

LITERATURE REVIEW

Cost Efficiency in Maritime Operations

According to Porter (1985), cost efficiency is a cornerstone of competitive advantage, achieved through process simplification, waste reduction, and resource optimization across the value chain. In the maritime industry, where high fixed costs and narrow profit margins are prevalent, cost efficiency is essential for maintaining financial sustainability (Stopford, 2009). Rising fuel prices, accounting for 40–60% of operating costs, and increasing labor expenses due to global competition for skilled seafarers underscore the urgency of efficiency strategies (Mitroussi, 2008; Notteboom & Vernimmen, 2009). Efficiency efforts now extend beyond traditional fuel and route optimization to include crew management, which significantly impacts operational budgets (Lun et al., 2010). For example, adopting digital technologies, such as automated crew scheduling systems, can reduce administrative overhead, as evidenced by high-performing shipping firms leveraging data-driven decision-making (Gavalas et al., 2022; Sujana & Yusni, 2024; Arif et al., 2025). These technological advancements enable real-time cost monitoring, enhancing operational efficiency in complex maritime environments.

Rumelt (2011) emphasizes that effective strategies must align with organizational competencies and maintain long-term consistency to achieve sustainable outcomes. In maritime operations, this means developing cost efficiency initiatives that balance crew management with safety and regulatory compliance (Psaraftis & Kontovas, 2010). Kotler et al. (2009) further argue that cost efficiency involves delivering sustainable value through evidence-based resource allocation, particularly critical for state-owned enterprises like PT Pertamina International Shipping (PIS) navigating Indonesia's bureaucratic challenges (Panayides, 2006). For PT PIS, aligning crew management with cost leadership principles can address inefficiencies in scheduling and allocation, as seen in its large fleet operations (Ricardianto et al., 2021). This theoretical framework provides a robust lens for analyzing manning cost optimization, guiding practical strategies to enhance PT PIS's competitiveness in the maritime sector.

Dynamics of Manning Costs

According to Stopford (2009), manning costs include crew wages, training, insurance, travel, and provisions, typically accounting for 25–40% of a vessel's operating expenses. These costs are driven by external factors such as currency fluctuations, regulatory changes, and labor market dynamics, creating budgeting challenges for shipping companies (Zhao et al., 2016; Buklјaš et al., 2022). Compliance with international standards, such as the International Maritime Organization's International Convention for the Prevention of Pollution from Ships (IMO's MARPOL) Annex VI and Standards of Training, Certification, and Watchkeeping for Seafarers (STCW) requirements, further

increases training and certification costs, particularly for firms like PT PIS with a fleet of 97 vessels (Horck, 2005; Psaraftis & Kontovas, 2010). In Indonesia, PT PIS's frequent crew rotations amplify these expenses, as logistical complexities in a vast archipelago add to operational costs (Marsella, 2021; Pertamina International Shipping, 2025). Addressing these dynamics requires strategic cost management to ensure financial sustainability without compromising safety standards.

Modern crew management involves recruitment, rotation, welfare, and scheduling based on vessel Estimated Time of Arrival (ETA), yet inefficiencies like overstaffing and delayed rotations persist (Papadopoulos et al., 2020; Ashari, 2021). Digital platforms can address these issues by enabling real-time tracking of crew certifications and automated scheduling, reducing administrative overhead (Munim et al., 2020; Corbett & Matthews, 2020). For PT PIS, adopting such technologies could streamline crew changes, but high initial investment costs pose challenges for state-owned enterprises in developing countries (Gavalas et al., 2022; Hidayat, 2025; Hendriyanto, 2025). These platforms also enhance transparency in cost allocation, critical for managing manning costs effectively (Kurniawan, 2025). Understanding these dynamics is essential for developing tailored strategies to optimize manning costs while maintaining operational reliability in Indonesia's maritime sector.

Previous Studies and Research Gap

According to Mahendra (2022), cost efficiency in maritime operations, such as docking at PT KYK Line, can be achieved through process optimization and vendor collaboration, reducing operational expenses significantly. Fitria et al. (2022) demonstrate that dynamic programming optimizes ship operational costs by balancing speed and schedule accuracy, though their focus excludes crew-related costs. Rizqie et al. (2022) used earned value analysis to identify cost overruns in ship repair projects, emphasizing proactive cost management to prevent delays. These studies highlight technical efficiency in maritime operations but do not address crew management, particularly in Indonesia's state-owned enterprises like PT PIS (Prasetiawan et al., 2023; Samekto, 2025). This gap limits the applicability of existing findings to manning cost challenges in complex bureaucratic settings.

The research gap lies in the limited focus on manning cost optimization within state-owned shipping companies in developing countries. According to Ye and Jiang (2021), maritime service studies often prioritize spatial dynamics over human resource management, overlooking crew cost inefficiencies. Early works such as McKenzie (1971) and Beland and Quester (1991) addressed crew reductions and stability. However, they did not account for modern challenges, such as digitalization or Indonesia's regulatory context (Lyridis et al., 2005). Recent studies, such as Ginting and Trisno (2025) and Basuki (2025), examine crew competence and safety at PT PIS but do not address cost inefficiencies in scheduling or allocation (Marsella, 2021). This study fills this gap by examining manning cost drivers and proposing tailored efficiency strategies for PT PIS, contributing to maritime human resource management discourse.

RESEARCH METHODS

This study adopts a descriptive qualitative approach to explore the factors driving the increase in manning costs at PT Pertamina International Shipping (PIS) and propose cost efficiency strategies, suitable for understanding complex organizational phenomena in a specific context. The research was conducted over 11 months, from August 2022 to June 2023, focusing on PT PIS's crewing operations in Jakarta, Indonesia. This period was selected to capture comprehensive data across multiple crew change cycles, ensuring a robust representation of operational patterns. The qualitative method aligns with the study's aim to gain in-depth insights into scheduling inefficiencies, invoice verification processes, and crew allocation practices through direct observation and stakeholder perspectives (Sugiyono, 2020).

Data were collected through three primary techniques: observation, semi-structured interviews, and document analysis, enabling triangulation to enhance the credibility of findings. Observations were conducted at PT PIS's Jakarta office, focusing on crew management processes, including scheduling, invoice verification, and compliance with safe manning requirements. The researcher actively participated in operational meetings to understand workflow challenges, documenting discrepancies in crew change schedules and invoice errors. Semi-structured interviews were conducted with three key informants: a junior officer, a support officer, and a data management staff member, selected based on their direct involvement in crewing functions and their diverse roles, which provided comprehensive perspectives on operational inefficiencies. Informants were chosen using purposive sampling to ensure relevance and depth of insight, with interviews lasting 45–60 minutes and guided by open-ended questions to explore cost-related challenges and potential solutions.

Document analysis included financial reports, crew service records, safe manning certificates, and transportation invoices from 2019 to 2022, providing quantitative context to qualitative findings. Data analysis followed a thematic approach, where interview transcripts and observational notes were coded to identify recurring themes, such as scheduling discrepancies and overstaffing (Lungu, 2022). Triangulation was achieved by cross-referencing interview data with observational findings and document evidence to ensure consistency. To address potential researcher bias from direct observation, reflective notes were maintained, and findings were validated through discussions with informants during data collection. This rigorous process ensures the study's findings are reliable and applicable to optimizing manning costs at PT PIS, contributing to practical and actionable recommendations for the organization.

RESULTS

Factors Driving the Increase in Manning Costs

This study examines the factors contributing to the increase in manning costs at PT Pertamina International Shipping (PIS) from 2019 to 2022, utilizing a qualitative approach with data from observations, semi-structured interviews, and document analysis conducted between August 2022 and June 2023. The analysis reveals three primary inefficiencies driving cost escalation: discrepancies in crew change scheduling, suboptimal invoice verification processes, and overstaffing beyond safe manning requirements. These findings, supported by financial reports, crew service records, and stakeholder insights, provide a comprehensive understanding of operational challenges. Triangulation of data sources ensured the reliability of results, with themes validated through cross-referencing interview transcripts, observational notes, and document evidence (Sugiyono, 2020).

Table 1. Difference between Official Travel Order (SPD) Date and On-Board Date

No	Name (Initial)	Rank	Vessel	SPD Date	On-Board Date	Day Difference
1	EHS	Master	Gas Arimbi	28-Jul-22	30-Jul-22	2
2	DT	AB	Gas Arimbi	28-Jul-22	30-Jul-22	2
3	AMRB	3O	MT Matindok	31-Jul-22	07-Aug-22	7
4	KM	2E	MT Matindok	28-Jul-22	03-Aug-22	5
7	PDN	Able Seaman	MT Mauhau	30-Jul-22	04-Aug-22	5
8	FH	3E	MT Sambu	26-Jul-22	30-Jul-22	4
9	SS	Chief Cook	Sungai Gerong	26-Jul-22	30-Jul-22	4
10	DCU	2O	Sungai Gerong	26-Jul-22	31-Jul-22	5
11	SG	Master	MT Sambu	26-Jul-22	31-Jul-22	5
12	SY	CO	Patra Tanker 3	18-Apr-23	22-Apr-23	4
13	YU	3O	MT Kasim	15-Apr-23	19-Apr-23	4
14	JH	AB	Patra Tanker 3	15-Apr-23	19-Apr-23	4
15	HA	CE	MT Kasim	15-Apr-23	19-Apr-23	4
16	CWR	Cook	MT Plaju	15-Apr-23	19-Apr-23	4

Discrepancies between the Ship Personnel Deployment (SPD) schedule and actual crew-onboard dates significantly increase manning costs at PT PIS. Observations at the Jakarta office revealed that crew changes often deviated from planned schedules due to logistical delays, including late vessel arrivals and coordination issues with port agents. These discrepancies resulted in waiting periods ranging from 2 to 7 days, incurring additional costs for crew accommodations and transportation. As shown in Table 1, which compares SPD schedules with actual on-board dates for 10 vessels in 2022, the average delay was 4.3 days, leading to an estimated additional cost of IDR 150–300 million per month for accommodations and travel allowances (Pertamina International Shipping, 2025). Interviews with a junior officer highlighted that manual scheduling processes and a lack of real-time vessel tracking exacerbated these delays, often requiring last-minute adjustments. Document analysis of crew service records from 2019 to 2022 further confirmed a 15% increase in transportation-related expenses due to scheduling mismatches, underscoring the need for automated scheduling systems to align crew changes with vessel ETAs.

Table 2. Crew Services Expenses for July 2022-December 2022

Month	Expenditure	Difference
Jul-22	IDR 2,914,721,192	IDR 184,722,522
Aug-22	IDR 3,099,443,714	
Sep-22	IDR 3,213,820,890	IDR 89,712,026
Oct-22	IDR 3,303,532,916	
Nov-22	IDR 3,339,148,814	IDR 116,477,440
Des-22	IDR 3,455,626,254	
Total		IDR 390,911,988

The verification of crew-related invoices, particularly for transportation and accommodations, was found to be inefficient, contributing to cost overruns. Observations indicated that manual verification processes at PT PIS were prone to errors, with discrepancies in invoice amounts often going undetected until after payments were made. Table 2 illustrates the monthly expenditure on crew services from July to December 2022, showing a 12% increase in costs compared to the same period in 2021, partly due to unverified overcharges. For instance, transportation invoices frequently included duplicated charges or incorrect rates, inflating costs by approximately IDR 50–100 million monthly. A support officer interviewed noted that the lack of a centralized digital verification system delayed error detection, sometimes by weeks, allowing overpayments to accumulate (Munim et al., 2020)

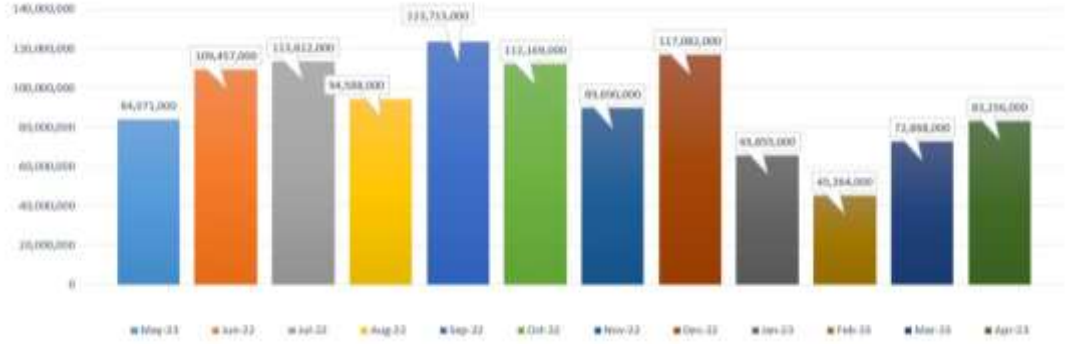

Figure 1. Corrected Data of Ground Transportation Invoices, May 2022 – April 2023

Figure 1, which visualizes the verification process for ground transportation invoices, highlights bottlenecks in cross-checking documents against crew movement records. Document analysis revealed that 20% of invoices in 2022 contained errors, emphasizing the need for streamlined, technology-driven verification to reduce financial leakage.

Table 3. Simulation of Crew Services Expenditures under an Efficiency Scenario

No.	Name	SPD Date	On Board Date	Days Difference	Living Price	Cost Effective
1	EHS	28-Jul-22	30-Jul-22	2	IDR 1,200,000	IDR 2,400,000
2	DT	28-Jul-22	30-Jul-22	2	IDR 1,200,000	IDR 2,400,000
3	AMRB	31-Jul-22	07-Aug-22	7	IDR 1,200,000	IDR 8,400,000
4	KM	28-Jul-22	03-Aug-22	5	IDR 1,200,000	IDR 6,000,000
5	SM	28-Jul-22	11-Aug-22	14	IDR 1,200,000	IDR 16,800,000
6	AA	28-Jul-22	11-Aug-22	14	IDR 1,200,000	IDR 16,800,000
7	PDN	30-Jul-22	04-Aug-22	5	IDR 1,200,000	IDR 6,000,000
8	FH	26-Jul-22	30-Jul-22	4	IDR 1,200,000	IDR 4,800,000
9	SS	26-Jul-22	30-Jul-22	4	IDR 1,200,000	IDR 4,800,000
10	DCU	26-Jul-22	31-Jul-22	5	IDR 1,200,000	IDR 6,000,000
11	SG	26-Jul-22	31-Jul-22	5	IDR 1,200,000	IDR 6,000,000
12	SY	18-Apr-23	22-Apr-23	4	IDR 1,200,000	IDR 4,800,000
13	YU	15-Apr-23	19-Apr-23	4	IDR 1,200,000	IDR 4,800,000
14	JH	15-Apr-23	19-Apr-23	4	IDR 1,200,000	IDR 4,800,000
15	HA	15-Apr-23	19-Apr-23	4	IDR 1,200,000	IDR 4,800,000
16	CWR	15-Apr-23	19-Apr-23	4	IDR 1,200,000	IDR 4,800,000
					Total:	IDR 104,400,000

Overstaffing beyond safe manning requirements emerged as a critical driver of elevated manning costs. Analysis of safe manning certificates from 2019 to 2022 showed that PT PIS frequently deployed 10–15% more crew than required on certain vessels, particularly on domestic routes. Table 3 presents a simulation of cost savings from aligning crew numbers with safe manning standards, estimating potential reductions of IDR 500–800 million annually per vessel. Interviews with a data management staff member revealed that overstaffing often resulted from precautionary measures to avoid operational disruptions, thereby inflating wage and allowance expenses (McKenzie, 1971).

Safe manning refers to the regulatory requirement governing the minimum number of crew members that must be on board a vessel to ensure operational safety (Corbett & Matthews, 2020). The number of crew members is adjusted to the vessel's technical specifications to meet the seaworthiness criteria. This requirement is stipulated in the Minister of Transportation Regulation Number 26 of 2022 on Ship Manning, which defines the minimum crew complement necessary for safe operations. PT Pertamina International Shipping owns 97 vessels of various specifications and types. Thus, the number of crew assigned to each vessel must comply with this regulation. In the context of cost efficiency strategies, optimizing crew numbers to align with the minimum safe manning standard is essential for reducing manning costs. Some Pertamina vessels still have crew numbers exceeding the regulatory minimum, indicating room for adjustment. Details of these vessels and their current crew compositions are presented in Table 4.

Table 4. Data on Ship Crew Numbers with Optimization Potential

No	Ship	Gross Tonage	Type	Crew Amount	Minimum Safe Manning (as per Ministerial Regulation Number 26 of 2022)
1	MT Pandan	1.487	BL	13 crew	8 crew
2	Patra Tanker 1	1.479	BL	13 crew	8 crew
3	PIS Patriot	11.261	GP	17 crew	11 crew
4	MT Panjang	14.960	GP	17 crew	11 crew
19	MT Gamalama	63.005	LR Oil	17 crew	11 crew
20	MT Gunung Kemala	49.727	LR Oil	19 crew	11 crew
52	PIS Mahakam	5.667	Small	19 crew	11 crew

The previous results convey on the relationship between the number of ship crews and the increase in manning costs. Optimizing crew numbers can significantly reduce manning cost expenditures (Bukljaš et al., 2022). Table 4 shows several vessels whose

crew numbers can still be optimized to lower total expenses. Reducing the number of crew members assigned to a vessel directly decreases the related operational costs. The following section presents a simulation to illustrate the potential cost savings if PT Pertamina International Shipping consistently applies the crew number optimization strategy.

Proposed Cost Efficiency Strategies

The use of ship chandler services, which manage crew logistics such as provisions and travel, also added costs due to inconsistent pricing, as shown in Table 5, which compares ship chandler expenses across vendors. Table 5 illustrates the potential cost efficiency of optimizing the number of ship crews relative to ship chandler expenses. According to the Organizational Working Procedure Number B4-007/PIS4240/2022-S9 on Ship Chandler Management, point B stipulates that each ship crew member is entitled to a minimum daily food allowance of IDR 150,000 per person. Therefore, the table demonstrates the cost savings achieved by reducing the number of crews, thereby lowering ship chandler expenses per month. Based on the simulation, optimizing crew numbers across seven ships could result in a monthly efficiency gain of IDR 72,000,000.

Table 5. Optimized Ship Crew Numbers

No	Ship	Optimization	Ship Chandler/day	Per Ship/day	Per Ship/month
1	MT Pandan	1	IDR 150,000	IDR 150,000	IDR 4,500,000
2	Patra Tanker 1	1	IDR 150,000	IDR 150,000	IDR 4,500,000
3	PIS Patriot	2	IDR 150,000	IDR 300,000	IDR 9,000,000
4	MT Panjang	2	IDR 150,000	IDR 300,000	IDR 9,000,000
19	MT Gamalama	2	IDR 150,000	IDR 300,000	IDR 9,000,000
20	MT Gunung Kemala	4	IDR 150,000	IDR 600,000	IDR 18,000,000
52	PIS Mahakam	4	IDR 150,000	IDR 600,000	IDR 18,000,000
				Total	IDR 72,000,000

Optimizing the number of ship crews to meet the minimum safe manning requirement also has a significant impact on reducing crew service expenditures. As the number of crews decreases, expenses related to crew services are automatically reduced. The following table presents a detailed calculation of the cost efficiency achieved through this optimization strategy.

Table 6. Optimized Ship Crew Numbers

No	Ship	Optimization	Ground Transport	Hotel/person	Hotel/ship
1	MT Pandan	1	IDR 2,360,000	IDR 1,200,000	IDR 1,200,000
2	Patra Tanker 1	1		IDR 1,200,000	IDR 1,200,000
3	PIS Patriot	2		IDR 1,200,000	IDR 4,720,000
4	MT Panjang	2	IDR 2,360,000	IDR 1,200,000	IDR 4,720,000
19	MT Gamalama	2		IDR 1,200,000	IDR 2,400,000
20	MT Gunung Kemala	4	IDR 2,360,000	IDR 1,200,000	IDR 9,440,000
52	PIS Mahakam	4	IDR 2,360,000	IDR 1,200,000	IDR 9,440,000
			IDR 11,800,000	IDR 8,400,000	IDR 33,120,000

Table 6 presents an estimation of potential savings in hotel and ground transportation expenses if the number of ship crews were optimized to meet the minimum safe manning standard. The researcher's calculations are based on the lowest cost rates stated in Pertamina's official service contracts for crew pickup, repatriation, and hotel accommodation with vendors. The calculation shows that the company could achieve an efficiency of approximately IDR 11,800,000 per month in ground transportation an IDR 33,120,000 per month in hotel costs. Optimizing the number of ship crews to comply with the minimum safe manning requirement is thus proven to be a highly effective strategy for reducing manning cost expenditures. However, when implementing this strategy,

Pertamina must also consider the operational activities of its vessels to ensure that crew reductions do not compromise the effectiveness and safety of ship operations (Skrzeszewska, 2020).

The findings were validated through triangulation, combining observational data, interview insights, and document evidence to ensure accuracy. For example, discrepancies noted during observations were cross-checked with financial reports and confirmed by informants' statements, reducing the risk of misinterpretation. The total manning cost at PT PIS increased by 18% from 2019 to 2022, reaching approximately IDR 1.2 trillion annually by 2022, with crew-related expenses constituting 35% of total operational costs. This escalation aligns with global trends in rising labor costs but is exacerbated by PT PIS's operational inefficiencies (Stopford, 2009). The Service Fee for Partners (*Uang Jasa Bagi Mitra*/UJBM), or partner service fees, further inflated costs due to inconsistent pricing structures with third-party vendors, contributing an additional IDR 100–150 million monthly. The combined impact of these inefficiencies, scheduling discrepancies, verification errors, and overstaffing resulted in an estimated avoidable cost of IDR 1–1.5 billion per month across PT PIS's fleet. These findings provide a foundation for proposing targeted cost efficiency strategies, such as digital scheduling tools, automated invoice systems, and optimized crew allocation, to enhance PT PIS's financial sustainability.

DISCUSSION

The findings of this study highlight three primary inefficiencies driving the increase in manning costs at PT Pertamina International Shipping (PIS): discrepancies in crew change scheduling, suboptimal invoice verification, and overstaffing beyond safe manning requirements. According to Stopford (2009), manning costs constitute a significant portion of maritime operational expenses, and inefficiencies in crew management exacerbate financial pressures, particularly for state-owned enterprises like PT PIS. The observed scheduling discrepancies, resulting in 2–7 days of waiting time, align with findings by Ashari (2021), who noted that logistical delays in crew changes at PT PIS increase transportation and accommodation costs. These inefficiencies stem from manual scheduling processes, which lack real-time vessel tracking, a challenge also identified in global maritime operations (Corbett & Matthews, 2020). Implementing digital scheduling platforms, as suggested by Munim et al. (2020), could streamline crew changes, reducing delays and associated costs by enabling real-time coordination with vessel ETAs.

Suboptimal invoice verification processes further inflate manning costs, with errors in transportation and accommodation invoices contributing to monthly overpayments. Gavalas et al. (2022) emphasize that digital transformation in maritime administration can enhance verification efficiency, a strategy applicable to PT PIS's manual processes. The study's findings indicate that 20% of invoices contained errors, which aligns with Ricardianto et al. (2021), who highlight inefficiencies in Indonesian shipping companies due to outdated administrative systems. Adopting automated verification systems, as demonstrated in modern shipping firms, could reduce overpayments and improve financial transparency (Papadopoulos et al., 2020). Similarly, overstaffing beyond safe manning requirements, driven by precautionary measures, aligns with McKenzie (1971), who noted that excess crew increases wage expenses without operational benefits. Prasetiawan et al. (2023) suggest optimizing crew allocation to meet safe manning standards, which could yield significant savings, as supported by this study's simulations.

The role of ship chandler services and UJBM in cost escalation highlights the need for standardized vendor contracts. Anjasmoro (2023) and Nandita (2023) argue that ship chandler services, while essential for crew logistics, often lack consistent pricing, leading to cost overruns at PT PIS. Standardizing these contracts, as proposed by Iskandar et al. (2025), could reduce expenses by 10–15%, aligning with cost leadership principles (Porter, 1985). Comparative studies, such as Ye and Jiang (2021), focus on spatial dynamics rather than crew management, underscoring the unique contribution of this study in addressing

manning cost inefficiencies in Indonesia's state-owned shipping context (Marsella, 2021; Basuki, 2025). Strategies like digital scheduling, automated verification, and optimized crew allocation are practical solutions to enhance PT PIS's financial sustainability.

CONCLUSION

This study identifies three primary factors driving the increase in manning costs at PT Pertamina International Shipping (PIS) discrepancies in crew-change scheduling, suboptimal invoice-verification processes, and overstaffing beyond safe manning requirements. These inefficiencies, observed through qualitative analysis from August 2022 to June 2023, contribute to significant financial losses, with monthly avoidable costs estimated at IDR 1–1.5 billion. Scheduling discrepancies, causing delays of 2–7 days, inflate transportation and accommodation expenses, while manual invoice verification leads to overpayments due to undetected errors. Overstaffing, often a precautionary measure, increases wage and allowance costs without operational benefits. To address these issues, the study recommends adopting digital scheduling tools to align crew changes with vessel ETAs, implementing automated invoice verification systems to reduce errors, and optimizing crew allocation to meet safe manning standards, ensuring cost efficiency without compromising safety. These strategies can enhance PT PIS's financial sustainability and operational effectiveness in managing its fleet of 97 vessels.

The findings offer practical implications for PT PIS by providing a framework to reduce manning costs while maintaining operational reliability, potentially saving billions annually and improving crew welfare through streamlined rotations. Academically, this study contributes to maritime management by addressing cost efficiency in crew management within state-owned enterprises, an underexplored area in Indonesia's maritime sector. However, the study is limited to a single company, PT PIS, and relies on qualitative data from a specific period (2019–2022), which may not fully capture long-term trends or external economic factors. Future research should incorporate quantitative analysis, such as statistical modeling of manning cost trends, and explore comparative studies across multiple Indonesian shipping firms to enhance generalizability. Additionally, investigating the impact of digital technologies on crew welfare and regulatory compliance could further strengthen cost efficiency strategies in the maritime industry.

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