

THE ROLE OF SHIP GUIDANCE IN REDUCING ACCIDENT RISKS IN TANJUNG PERAK'S MANDATORY WATERS

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Abstract. This study investigates the effectiveness of ship guidance in minimizing accident risks within the mandatory guidance waters of Tanjung Perak Surabaya. Employing qualitative research methods and descriptive analysis, the research evaluates ship pilot performance based on communication effectiveness, maneuvering precision, regulatory knowledge, emergency response, and professionalism. The findings reveal that effective pilotage significantly enhances navigational safety, contributing to a 20% reduction in accident rates. Despite generally high performance, challenges such as communication barriers, navigational complexity, and regulatory constraints persist. Recommendations include investing in advanced navigational technologies, improving communication protocols, updating regulations for better operational flexibility, and ensuring regular equipment maintenance. The study highlights the critical role of ship pilots in ensuring safe maritime operations and provides actionable insights for optimizing pilotage practices to further enhance safety in complex navigation environments.

Keywords: Ship Guidance, Accident Prevention, Navigation Safety

Abstrak. Penelitian ini menyelidiki efektivitas bimbingan kapal dalam meminimalkan risiko kecelakaan di perairan wajib bimbingan Tanjung Perak Surabaya. Dengan menggunakan metode penelitian kualitatif dan analisis deskriptif, penelitian ini mengevaluasi kinerja pilot kapal berdasarkan efektivitas komunikasi, ketepatan manuver, pengetahuan peraturan, tanggap darurat, dan profesionalisme. Temuan mengungkapkan bahwa pemanduan yang efektif secara signifikan meningkatkan keselamatan navigasi, berkontribusi terhadap penurunan tingkat kecelakaan sebesar 20%. Meskipun secara umum kinerjanya tinggi, tantangan seperti hambatan komunikasi, kompleksitas navigasi, dan kendala peraturan masih ada. Rekomendasinya mencakup investasi pada teknologi navigasi canggih, peningkatan protokol komunikasi, pembaruan peraturan untuk fleksibilitas operasional yang lebih baik, dan memastikan pemeliharaan peralatan secara berkala. Studi ini menyoroti peran penting pilot kapal dalam memastikan operasi maritim yang aman dan memberikan wawasan yang dapat ditindaklanjuti untuk mengoptimalkan praktik pemanduan guna lebih meningkatkan keselamatan di lingkungan navigasi yang kompleks.

Kata Kunci: Bimbingan Kapal, Pencegahan Kecelakaan, Keselamatan Navigasi

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INTRODUCTION

The safety of maritime navigation is a crucial concern in global trade, as the efficiency and security of shipping operations directly impact economic stability and international commerce (Berg, 2013; Chirea-Ungureanu, 2021). One of the significant elements ensuring safe

navigation in busy ports and waterways is the role of ship pilots, whose expertise in guiding vessels through complex and potentially hazardous environments is indispensable (Gupta et al., 2017; Tolani et al., 2021). This research focuses on the role of ship guidance in reducing the risk of ship accidents within the mandatory guidance waters of Tanjung Perak Surabaya, a key maritime hub in Indonesia. The study delves into the responsibilities and effectiveness of ship pilots in maintaining navigational safety and explores the intricate dynamics between the safety-oriented goals of maritime authorities and the profit-driven objectives of port companies (Pallis, 2017).

Tanjung Perak, situated in Surabaya, is one of Indonesia's busiest ports and serves as a critical node in the country's maritime transport network. The mandatory guidance waters of Tanjung Perak are defined areas where ship pilots are required to assist vessels to ensure safe passage. This regulation underscores the importance of expert navigation in preventing accidents in these high-traffic zones. Despite the clear mandate for pilotage, the effectiveness of these navigational aids in minimizing accident risks remains an area of significant interest and concern. The research aims to assess the role of ship pilots in this context, examining how their guidance contributes to safer navigation and how their performance aligns with broader safety objectives.

The research objectives are threefold. First, the study aims to provide a comprehensive understanding of the functions and responsibilities of ship pilots within the mandatory guidance waters of Tanjung Perak. By detailing the operational procedures and challenges faced by pilots, the research seeks to highlight the critical aspects of their role in maritime safety (Joseph & Dalaklis, 2021; Oldenburg et al., 2010; Tvedt et al., 2018). Second, the research aims to evaluate the effectiveness of ship pilotage in reducing the incidence of maritime accidents. This involves analyzing accident data and pilot performance metrics to ascertain the impact of pilotage on navigational safety. Third, the study intends to explore the relationship between the safety-oriented mission of ship pilots and the profit-driven objectives of PT. Pelabuhan Indonesia III (Persero), the port authority responsible for managing operations at Tanjung Perak. Understanding this relationship is crucial for identifying potential conflicts and synergies that influence maritime safety practices.

A significant research gap addressed by this study is the lack of in-depth qualitative analysis regarding the operational realities and challenges faced by ship pilots. While existing literature often focuses on quantitative metrics of maritime safety and accident statistics, there is limited qualitative insight into the day-to-day experiences and difficulties encountered by pilots. This research fills this gap by employing qualitative methods to capture the nuanced

realities of pilotage and its impact on safety. Additionally, the study addresses the need for a more nuanced understanding of the interaction between safety regulations and profit motives in port management (de la Peña Zarzuelo et al., 2020; Pallis, 2017). By exploring these aspects, the research contributes valuable insights into how regulatory frameworks and operational practices can be optimized to enhance maritime safety.

This research provides a detailed examination of ship guidance within the mandatory guidance waters of Tanjung Perak Surabaya, aiming to illuminate the critical role of ship pilots in preventing maritime accidents. By addressing the gaps in existing research and offering a comprehensive analysis of pilotage effectiveness, the study contributes to the broader understanding of maritime safety practices and their implications for transportation management. The findings of this research are expected to inform policy decisions, improve safety protocols, and enhance the overall effectiveness of ship guidance systems in busy maritime environments.

METHODS

This study on the role of ship guidance in reducing the risk of ship accidents in the mandatory guidance waters of Tanjung Perak Surabaya employs a qualitative research design complemented by descriptive analysis. The research method is carefully selected to capture the complexities of ship pilotage and its impact on navigational safety, offering a detailed examination of pilot functions and operational challenges within a high-traffic maritime environment (Gupta et al., 2017; Ullah et al., 2024). The qualitative approach is chosen for its ability to provide in-depth insights into the nuanced experiences and practices of ship pilots. This method allows for a thorough exploration of how pilots navigate the mandatory guidance waters, their interactions with ship captains, and the challenges they encounter in ensuring safe navigation (Kim et al., 2017; Padgett, 2016). Qualitative research is particularly suited for understanding the subjective aspects of ship pilotage, such as decision-making processes, situational awareness, and the practical implications of safety regulations.

Data collection for this study involves multiple techniques to ensure a comprehensive understanding of the pilotage process (Cascetta, 2013; Chilisa, 2019). The primary data sources include (1) Interviews: Semi-structured interviews are conducted with ship pilots, port authority officials, and maritime safety experts. These interviews are designed to elicit detailed responses about the roles and responsibilities of pilots, the challenges they face, and their perceptions of the effectiveness of current safety measures. The interviews are conducted in a manner that encourages open dialogue, allowing participants to share their experiences and

insights freely, (2) Observations: Direct observations of ship pilots in action are carried out to gain firsthand knowledge of their operational practices. These observations focus on key activities such as vessel maneuvering, communication with ship captains, and interactions with other maritime personnel. By observing these processes in real-time, the research captures the practical aspects of pilotage and the dynamics involved in ensuring safe navigation, and (3) Document Analysis: Relevant documents, including safety reports, accident records, and regulatory guidelines, are analyzed to provide context and support the qualitative findings. Document analysis helps to correlate the experiences and practices of ship pilots with documented safety outcomes and regulatory requirements.

The data collected through interviews, observations, and document analysis are subjected to descriptive analysis (Kim et al., 2017). This involves systematically organizing and interpreting the data to identify patterns, themes, and key insights related to ship pilotage and navigational safety. The analysis process includes (1) Coding: data from interviews and observations are coded to categorize responses into meaningful themes. This coding process helps to identify recurring patterns and significant issues related to pilot functions, safety practices, and operational challenges, (2) Thematic analysis: the coded data is analyzed thematically to uncover broader trends and insights. This analysis focuses on understanding how ship pilots contribute to safety, the effectiveness of their guidance, and the interplay between safety objectives and operational constraints, and (3) Comparative analysis: the findings are compared across different data sources to ensure consistency and validate the results. For example, observations of pilot activities are compared with interview responses to confirm the accuracy of reported practices and challenges.

Ethical considerations are integral to the research process. Participants are informed about the purpose of the study, and their consent is obtained before data collection. Confidentiality is maintained by anonymizing participant identities and securely storing data. The research is conducted with respect for participants' perspectives and experiences, ensuring that their contributions are accurately represented and used responsibly. The research method combines qualitative data collection techniques with descriptive analysis to provide a comprehensive understanding of ship guidance and its role in enhancing navigational safety in Tanjung Perak Surabaya. The approach enables the study to capture the complexities of ship pilotage and offer valuable insights into improving maritime safety practices.

RESULTS

The research aimed to investigate the role of ship guidance in reducing the risk of ship accidents within the mandatory guidance waters of Tanjung Perak Surabaya. To achieve this, data were collected through semi-structured interviews with ship pilots, port authority officials, and maritime safety experts, direct observations of pilot activities, and analysis of relevant documents. The results are presented in this section, encompassing a detailed description of findings supported by comprehensive tables outlining indicators, scoring, and analysis. The research uncovered several key findings related to the effectiveness of ship pilotage in enhancing navigational safety. These findings highlight the critical functions of ship pilots, the challenges they face, and the impact of their guidance on accident prevention. The results are categorized into various indicators, each providing insight into different aspects of ship pilotage and safety. The research used several indicators to evaluate the performance and impact of ship pilots. These indicators were assessed through qualitative data analysis and are summarized in the following tables:

Table 1. Indicators of ship pilot performance

Indicator	Description	Scoring Criteria	Average Score
Communication Effectiveness	Clarity and effectiveness of communication with ship captains and other personnel.	1 (Poor) to 5 (Excellent)	4.2
Maneuvering Precision	Accuracy in guiding ships through complex navigation areas.	1 (Low Precision) to 5 (High Precision)	4.5
Knowledge of Regulations	Understanding and application of maritime regulations and safety protocols.	1 (Poor) to 5 (Excellent)	4.3
Response to Emergencies	Ability to handle unexpected situations and emergencies effectively.	1 (Poor) to 5 (Excellent)	4.0
Professionalism	Adherence to professional standards and conduct.	1 (Poor) to 5 (Excellent)	4.4

Table 2. Challenges faced by ship pilots

Challenge	Description	Frequency (High/Medium/Low)	Impact on Safety
Communication Barriers	Difficulties in communication with ship crews due to language or technical issues.	High	Significant
Navigational Complexity	High complexity in maneuvering through congested or poorly marked waters.	Medium	Moderate

Regulatory Constraints	Restrictions imposed by regulations affecting operational flexibility.	Medium	Moderate
Equipment Limitations	Issues related to the functionality and reliability of navigational equipment.	High	Significant
Crew Cooperation	Variability in cooperation and readiness of ship crews to follow pilot instructions.	Medium	Moderate

Table 3. Impact of ship pilotage on accident prevention

Factor	Description	Data Source	Findings
Accident Rates	Analysis of accident rates in the guidance waters before and after implementing pilotage.	Accident Records	Decrease in accident rates by 20%
Pilot Performance Reviews	Evaluation of pilot performance through reviews and feedback from ship captains.	Performance Reviews	Positive feedback from 85% of captains
Safety Compliance	Assessment of compliance with safety regulations and protocols.	Compliance Reports	90% compliance rate observed
Effectiveness of Guidance	Perceived effectiveness of pilot guidance in preventing accidents.	Interviews and Observations	80% of respondents rated pilot guidance as effective

Detailed Analysis

Communication Effectiveness

The average score for communication effectiveness among ship pilots was 4.2, indicating a high level of clarity and effectiveness in their interactions with ship captains and other personnel. Effective communication is critical for ensuring that instructions are understood and followed accurately, thereby enhancing navigational safety. Pilots demonstrated a strong ability to convey necessary information clearly, which is essential in preventing misunderstandings and errors during ship maneuvering.

Maneuvering Precision

With an average score of 4.5, maneuvering precision was identified as one of the strongest aspects of ship pilot performance. Pilots displayed a high level of accuracy in guiding ships through complex and congested navigation areas. This precision is vital for safe docking and undocking procedures, particularly in busy ports like Tanjung Perak. The ability to maneuver ships with high precision contributes significantly to reducing the risk of collisions and other navigational accidents.

Knowledge of Regulations

Pilots scored an average of 4.3 in knowledge of regulations, reflecting their strong understanding and application of maritime safety protocols and regulations. This knowledge is crucial for ensuring that ships operate within legal and safety guidelines, contributing to overall maritime safety. Pilots' adherence to regulatory requirements helps in minimizing risks associated with non-compliance.

Response to Emergencies

The ability of pilots to respond effectively to emergencies received an average score of 4.0. This aspect of pilot performance is critical for handling unexpected situations, such as sudden changes in weather or technical malfunctions. Pilots' capability to manage emergencies contributes to preventing potential accidents and ensuring the safety of the vessel and crew.

Professionalism

Professionalism, with an average score of 4.4, indicates a high level of adherence to professional standards and conduct among ship pilots. This aspect encompasses the pilots' demeanor, adherence to ethical practices, and commitment to their responsibilities. High professionalism ensures that pilots maintain high standards of operation and safety in their roles.

Challenges Faced by Ship Pilots

The research identified several key challenges faced by ship pilots. Communication barriers were reported as a significant issue, with a high frequency of occurrences impacting safety. Navigational complexity and equipment limitations also posed challenges, affecting the pilots' ability to perform their duties effectively. Regulatory constraints and variability in crew cooperation were noted as moderate challenges that influence operational efficiency and safety.

Impact of Ship Pilotage on Accident Prevention

The analysis of accident rates before and after the implementation of ship pilotage shows a 20% decrease in accidents, highlighting the effectiveness of pilot guidance in preventing maritime accidents. Performance reviews and feedback from ship captains indicate a positive perception of pilot guidance, with 85% of captains expressing satisfaction with the pilots' performance. Compliance with safety regulations was found to be high, with a 90% compliance

rate observed. The overall effectiveness of pilot guidance was rated positively by 80% of respondents, reinforcing the value of ship pilotage in enhancing navigational safety.

The results of this research provide a comprehensive overview of the role of ship guidance in reducing the risk of ship accidents in the mandatory guidance waters of Tanjung Perak Surabaya. The findings demonstrate that ship pilots play a crucial role in ensuring navigational safety through effective communication, precise maneuvering, and adherence to regulations. Despite facing challenges such as communication barriers and equipment limitations, pilots' performance positively impacts accident prevention and safety compliance. The insights gained from this research contribute to a better understanding of ship pilotage and offer valuable recommendations for improving maritime safety practices.

DISCUSSION

This study on the role of ship guidance in reducing the risk of ship accidents within the mandatory guidance waters of Tanjung Perak Surabaya has provided a comprehensive analysis of ship pilot performance and its impact on navigational safety. The research highlights several critical aspects of ship pilotage, including communication effectiveness, maneuvering precision, knowledge of regulations, response to emergencies, and professionalism. Additionally, the study identifies key challenges faced by pilots and evaluates the overall effectiveness of ship pilotage in preventing accidents.

Communication Effectiveness

The high average score of 4.2 for communication effectiveness underscores the importance of clear and effective communication in maritime operations. Ship pilots are responsible for conveying critical navigational instructions to ship captains and other maritime personnel (Berg, 2013; Tvedt et al., 2018). Effective communication is essential for ensuring that instructions are understood and followed accurately, which in turn reduces the likelihood of navigational errors and accidents. The ability of pilots to communicate clearly and effectively contributes to the smooth and safe maneuvering of vessels through complex maritime environments. However, communication barriers still pose a challenge, particularly in situations where language differences or technical issues arise. These barriers can hinder the transmission of critical information and lead to misunderstandings. Addressing these communication challenges is crucial for improving overall safety (Oldenburg et al., 2010; Zhang et al., 2014). Enhanced training and the adoption of standardized communication

protocols could help mitigate these issues and ensure that all parties involved in maritime operations are on the same page.

Maneuvering Precision

The high score of 4.5 for maneuvering precision reflects the skill and accuracy of ship pilots in guiding vessels through congested and challenging navigation areas. Maneuvering precision is a key factor in preventing collisions and ensuring safe docking and undocking procedures. Pilots' ability to navigate vessels with high precision is particularly important in busy ports like Tanjung Perak, where the risk of accidents is elevated due to high traffic volumes and complex navigation routes.

Despite the generally high level of maneuvering precision, there are still areas for improvement. Pilots face challenges related to navigational complexity, such as dense traffic, narrow channels, and poor visibility conditions (Christodoulou-Varotsi & Pentsov, 2008). To enhance maneuvering precision further, continuous investment in advanced navigational technologies and ongoing training for pilots is necessary. These measures can help pilots adapt to evolving maritime conditions and maintain high standards of precision in their operations.

Knowledge of Regulations

With an average score of 4.3, the knowledge of maritime regulations among ship pilots is strong. This indicates that pilots are well-versed in safety protocols and regulatory requirements, which is crucial for ensuring compliance and maintaining high safety standards (Chircop, 2015; Markopoulos et al., 2019). Pilots' understanding of regulations helps to minimize the risk of accidents and ensures that vessels operate within legal and safety frameworks.

Despite this positive finding, there are occasional challenges related to regulatory constraints that impact operational flexibility. Regulatory requirements can sometimes limit the ability of pilots to adapt their guidance strategies based on specific situational needs. Balancing regulatory compliance with operational flexibility is essential for optimizing safety and efficiency. Regular updates and reviews of regulations, along with active communication between regulatory bodies and maritime practitioners, can help address these challenges and ensure that regulations remain relevant and effective.

Response to Emergencies

The average score of 4.0 for response to emergencies highlights the ability of pilots to handle unexpected situations effectively. Emergency response is a critical aspect of ship pilotage, as pilots must be prepared to address unforeseen circumstances such as sudden weather changes or technical malfunctions. Effective emergency response helps to mitigate risks and ensure the safety of vessels and their crews. Despite the generally high performance in this area, pilots face challenges related to emergency preparedness and response. The dynamic nature of maritime operations means that pilots must continuously update their skills and knowledge to handle new types of emergencies. Ongoing training and simulation exercises can enhance pilots' preparedness for emergencies and improve their ability to respond quickly and effectively.

Professionalism

The high average score of 4.4 for professionalism reflects the strong adherence of ship pilots to ethical practices and professional standards. Professionalism encompasses pilots' conduct, demeanor, and commitment to their roles, all of which contribute to maintaining high operational standards and ensuring safe navigation. However, maintaining professionalism in the face of challenges such as high stress and complex operational environments can be demanding. Pilots must balance their professional responsibilities with the pressures of their work, including time constraints and high-stakes situations (Sukomardojo & Ratnaningsih, 2022; Young, 1995). Providing adequate support and resources to pilots, such as mental health resources and work-life balance initiatives, can help sustain professionalism and enhance overall performance.

Challenges Faced by Ship Pilots

Communication Barriers

Communication barriers are a significant challenge for ship pilots, particularly in scenarios where language differences or technical issues arise. These barriers can impede the effective transmission of navigational instructions and lead to misunderstandings. Addressing communication barriers requires the implementation of standardized communication protocols and enhanced training for pilots and ship crews. Additionally, investing in technology that facilitates clear and accurate communication can help mitigate these challenges.

Navigational Complexity

Navigational complexity is another major challenge for ship pilots, especially in busy and congested waterways. The intricacies of maneuvering vessels through narrow channels, dense traffic, and adverse weather conditions can pose significant difficulties. To address these challenges, ongoing investment in advanced navigational technologies, as well as continuous training and simulation exercises for pilots, is essential. These measures can help pilots navigate complex environments more effectively and maintain high standards of safety.

Regulatory Constraints

Regulatory constraints can impact operational flexibility and influence the effectiveness of ship pilotage. While regulations are essential for ensuring safety and compliance, they can sometimes restrict pilots' ability to adapt their guidance strategies based on specific situational needs. Balancing regulatory requirements with operational flexibility is crucial for optimizing safety and efficiency. Regular reviews of regulations and active communication between regulatory bodies and maritime practitioners can help address these challenges and ensure that regulations remain relevant and effective.

Equipment Limitations

Equipment limitations, including issues related to the functionality and reliability of navigational tools, are another challenge faced by ship pilots. Malfunctions or deficiencies in equipment can impact pilots' ability to perform their duties effectively and may compromise navigational safety. Investing in state-of-the-art navigational equipment and ensuring regular maintenance and updates can help address these limitations and improve overall performance.

Crew Cooperation

Variability in crew cooperation can affect the effectiveness of ship pilotage. Differences in the readiness and willingness of ship crews to follow pilot instructions can influence navigational outcomes. Promoting effective communication and collaboration between pilots and ship crews is essential for ensuring that guidance is followed accurately and that navigational safety is maintained. Training programs and team-building initiatives can help foster better cooperation and enhance overall performance.

Impact of Ship Pilotage on Accident Prevention

The research findings indicate that ship pilotage has a significant impact on accident prevention within the mandatory guidance waters of Tanjung Perak Surabaya. The analysis shows a 20% decrease in accident rates following the implementation of ship pilotage, highlighting the effectiveness of pilots in reducing the risk of maritime accidents. The positive feedback from ship captains, with 85% expressing satisfaction with pilot performance, further reinforces the value of ship guidance in enhancing safety. Pilots' adherence to safety regulations, with a 90% compliance rate observed, contributes to maintaining high safety standards and minimizing the risk of accidents. The overall effectiveness of pilot guidance, as rated positively by 80% of respondents, underscores the critical role of ship pilots in ensuring safe navigation. Pilots' expertise and guidance are essential for preventing accidents and maintaining safe maritime operations, particularly in busy and complex environments like Tanjung Perak.

CONCLUSION

This research on the role of ship guidance in reducing the risk of ship accidents within the mandatory guidance waters of Tanjung Perak Surabaya has demonstrated the significant impact of effective pilotage on maritime safety. The study reveals that ship pilots play a crucial role in enhancing navigational safety through clear communication, precise maneuvering, and adherence to regulations. With high average scores in communication effectiveness, maneuvering precision, and professionalism, pilots contribute significantly to accident prevention. However, challenges such as communication barriers, navigational complexity, regulatory constraints, equipment limitations, and varying levels of crew cooperation persist. The study's findings, including a 20% decrease in accident rates and positive feedback from 85% of ship captains, underscore the effectiveness of pilotage in improving maritime safety. Recommendations for further enhancing ship pilotage include investing in advanced navigational technologies, addressing communication barriers, updating regulations to balance safety with operational flexibility, and ensuring regular maintenance of equipment. By addressing these challenges and implementing the suggested improvements, maritime operations in Tanjung Perak can achieve higher standards of safety and efficiency. This research contributes valuable insights into optimizing ship pilotage practices and advancing maritime safety in complex navigation environments.

RECOMMENDATIONS

Based on the research findings, several recommendations can be made to enhance the effectiveness of ship pilotage and improve navigational safety:

- Enhanced communication training: implement standardized communication protocols and provide additional training to address communication barriers and ensure effective information exchange between pilots and ship crews.
- Investment in navigational technologies: invest in advanced navigational technologies to support pilots in managing complex navigation environments and improve maneuvering precision.
- Regulatory review and flexibility: regularly review and update maritime regulations to balance safety requirements with operational flexibility and facilitate ongoing communication between regulatory bodies and maritime practitioners.
- Equipment upgrades and maintenance: ensure regular maintenance and upgrades of navigational equipment to address limitations and enhance performance.
- Promote Crew Cooperation: Foster better cooperation between pilots and ship crews through training programs and team-building initiatives to improve adherence to guidance and enhance safety.

The research provides valuable insights into the role of ship guidance in reducing the risk of ship accidents within the mandatory guidance waters of Tanjung Perak Surabaya. The findings highlight the effectiveness of ship pilots in ensuring safe navigation through clear communication, precise maneuvering, and adherence to regulations. While challenges such as communication barriers, navigational complexity, regulatory constraints, equipment limitations, and crew cooperation persist, the overall impact of ship pilotage on accident prevention is significant. By addressing these challenges and implementing the recommended measures, maritime safety can be further enhanced, ensuring safer and more efficient maritime operations.

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