JOURNAL OF MARITIME RESEARCH

Vol XXIII. No. I (2026) pp 157–164

ISSN: 1697-4840, www.jmr.unican.es

Pilotage Management Practices and Maritime Risks in Seaports: An Overview of Pilotage Services in Nigerian Ports

Dr. Edih University Ovuokeroye[1,*], Enakpobomene Mina Irejeh[2], E. Yerin Yerin[3]

ARTICLE INFO

Article history:
Received 02 Jan 2025;
in revised from 24 Jan 2025;
accepted 05 Mar 2025.

Keywords:
maritime risks, management practices, Nigerian port, overview, pilotage services, seaports.

ABSTRACT

The study examined pilotage management practices and maritime risks in seaports: an overview of pilotage services in Nigerian ports. The objective of the study is to understand the importance of pilotage services in curtailing maritime risks in seaports, especially in Nigerian ports. The methods of research adopted by the study are exploratory and theoretical research which assisted in unraveling the findings of previous studies. It is discovered that pilotage management practices are fundamental to port operations to ensure safety, efficiency and competitiveness. Pilotage services are mandatory in international maritime logistics with emphasis on national sovereignty and navigational safety. It is recommended that administrators (Nigerian Maritime Administration and Safety Agency NIMASA and Nigeria Ports Authority, NPA) of ports in Nigeria should ensure that pilotage services are deployed as components of port operations. The government should equip the seaports with modern pilotage facilities and trained manpower on pilotage management practices, among others.

1. Introduction.

Pilotage management practices are fundamental elements of modern port operations, essentially crucial to ensure safety, efficiency and competitiveness in an increasingly complex maritime world (Adib, 2024). Thus, maritime services include the coordination, deployment and support of maritime pilots which in turn help ports and ships to navigate challenges, improves performance and reduces environmental impact. Effective pilotage management and services are more than logistical necessity but strategies that generate multiple advantages. Pilotage is mandatory in international maritime logistics for the considerations of national sovereignty and navigational safety (Xuehao,Mingyang,Wentai,Wenwei,and,Yiying,2025).

Narrowly, or traditionally, pilotage involves experienced navigators applying charts and personal knowledge to steer seaborne vessels. In modern times, pilotage services and management have evolved to incorporate advanced technology, digital scheduling, and real-time tracking which optimize operations and reduce maritime risks. Pilotage services encompasses maritime components that are synergized to ensure smooth operations and these services include, scheduling and dispatching, tracking, communication, compliance with safety regulations, e.t.c. Scheduling and dispatching entail the assignment of pilots based on vessel's needs, arrival and departure time as well as port's traffic conditions. Scheduling is a complex task which must accommodate fluctuating shipping schedule and last minute changes. To meet up with changes in scheduling demands digital tools and automated technologies are deployed to reduce delays and increase or maintain efficiency. To ensure accurate real time tracking and monitoring of the movements of pilots and vessels, the use of GPS and digital communication tools are to be employed. Also, coordination communication enables everyone involved to have up to date information on port operations and conditions, safety protocols and vessel's movements(Adib, 2024).

In major seaports across the globe, pilotage is a compulsory requirement for most calling vessels due to safety and security purposes. A particular concern is for foreign vessels and large

[1]Department of Maritime Economics and Finance. Nigeria Maritime University, Okerenkoko. Delta State, Nigeria.
[*]Corresponding author: Edih University Ovuokeroye. E-mail Address: oweilade123uni@gmai.com.

sized vessels (Wu *et al.,* 2020). Accordingly, before a vessel can berth at a port, it has to wait at the pilot boarding point on the sea until the pilot boat arrives. The pilot boat delivers pilots to the vessels who will go on board and guide the vessels through the channels into the port. The number of pilots required vary according to the size of vessels and may be, its type (Xiao, *et al*., 2020). Usually in practice, the pilot can go ashore when the vessel berths at the port and continue to perform other functions. When the vessel is unberth from the port, the pilot(s) is required to be on board to guide the vessels to the disembarking point on the sea. At this point the pilot is picked up by the pilot boat to continue other routine tasks. Due to the relatively large number of vessels waiting for pilot guidance at the boarding and disembarking points, more carbon emissions are generated. For instance, a 20,000TEU container vessel may emit 90,000kg of carbon dioxide per year and a 500-thousand-ton bulk cargo vessel can emit up to 225, 000kg (Budiyanto *et al.,* 2022).

Maritime risks and challenges are limiting factors to maritime logistics performance. Several challenges to maritime services have been identified in studies, such as lack of port infrastructure (Benson and Adekemi., 2018; Ekpo , 2012). This is a challenge of decline in the number of vessels calling at ports in Nigeria. Records are showing a reduction of calls at the ports by 2.72% .Also, the problem of poor data base or platform arising from poor computerization of daily activities as well as manpower. Because of a series of disturbing challenges, shippers tend to call at ports with no or less congestion issues, with standard port facilities (Edih,*et al.,* 2022). Several studies agreed that human error is one the major causes of maritime accidents (Jesus,et al,2022; ALLIANZ, 2020; Antao, and Guides, 2008; EMSA, 2020; Wrobel, 2021).

Among the numerous maritime risks (accidents) and challenges bedevilling the operations at the ports or maritime business, ship collision ranks high on the list. On this basis, efforts are being made to reduce their consequences (Jesus et al., 2022; Zhang *et al.,* 2018). In line with the policy or objective of cost reduction, the need for automated ships are promoted towards downsizing of humans and Officers On Navigational Watch. It is noted that devising DSS/CAS to ship's trajectory planning is a common proposal till date. According to Jesus et al., (2022), all DSS/CAS must count on COLREGS 72, the legal framework to define situations to be avoided at the primary source for possible maritime risks. Adequate knowledge of this standard is crucial to assess critical situations and take appropriate actions. In concluding their study, COLREGS 72 attempts to establish safe coordination in the movement of two vessels in a given close quarters or collision encounter. As a universal guideline, it establishes a series of rules that respond to the technical means of the time. COLREGS 72 establishes specific communication protocols such as Rule 9 d, e, & f, and Rule 34, among others.

The link between port operations and ship pilotage is an important guarantee to maintain the normal production and operation order of competitive ports. This is related to the competitive nature of ports, and national sovereignty. It means that when pilotage risks are controlled, it boosts the safety of navigation of ships. Normal operations of ports and promotion of healthy and high quality development of the port's economy (Yan, 2019). The study of Guangzhou port of ship piloting risk pre control management basic risk is to promote the pilot safety culture construction and improve the pilot safety rules and regulations. It is also meant to carry out the pilot work safety responsibility, increase investments in pilotage safety and control the risks affecting safety of pilots, and many related issues.

In Xuehao *et al.,* (2025), the study explained in brief terms the influence of time window distribution of the cargo vessels in the real world. Accordingly, boarding and disembarking points in the real world could have different congestion conditions such that some container terminals boarding points in the pilotage network are usually busy due to the sea route conditions and the number of cargo vessels. It has been noticed that the busier pilotage network, the service time windows of the cargo vessels might be distributed in a small range (connoting a higher density) and more cargo vessels need to be served in a specific time period. In this scenario, the potential waiting time and the corresponding carbon emissions of the cargo vessels could be longer. The follow up is that distribution density is classified as low, middle and high. Arising from above, pilotage services and management are essential components of port operations. Such services remain indispensable to maritime logistics and businesses.

The whole essence of pilotage services are, to guarantee maritime safety for the ship, cargo and crew. Maritime safety is governed by the combination of international rules and regulations, national regulations, of flag States and port States, port regulations, and rules of classification societies and insurance companies. These measures are supported by conventions and treaties ratified by governments, such as , International Convention of Safety of Life at Sea (SOLAS), Standard for Training and Watchkeeping (STCW), and International Convention for the Prevention of Pollution from Ship (MARPOL). There are the International Convention on Load Lines (LL), Convention on International Regulations for Preventing Collision at Sea (COLREGS) , among others. Formerly, Safety Management Systems of shipping companies served as the framework for assessing the safety regimes in the World Maritime Industry. The introduction of IMO International Management Code for safety operations of ships and for pollution prevention altered the focus on vessels to human actions on board the vessels(Donatus, 2021). Collision can be as a result of physical impact between two ships, or between a ship and other structure at sea resulting in a damaging accident. Both local statutes and international conventions made provisions for collision prevention rules(Nzeribe, 2019).

2. Statement of the Problem.

With the increasing size of and complexity of ships as well as the pressure of global trade , pilotage management and services have become indispensable. The pilotage system is faced with several challenges that are hindering effective and efficient port operations in Nigeria. These challenges are unpredictable weather conditions, staffing shortages, and the complex and

large volume of maritime traffic, pilots availability, need for automated and autonomous vessels, lack of experts in the use of AI and Big data, and sustained use of technology to reduce carbon emissions, to optimize vessels movements as well as to promote environmental responsibility. There are several problems that ought to be addressed in pilotage studies, such as deployment and route planning of pilot boats with the constraints on the time windows of the pilot pickup and delivery of tasks, the number of pilots, and the capacity of pilot boats.

It is abundantly recorded that port and shipping are viable components of maritime logistics and there are 6189 container vessels and 13,632 bulk cargo vessels in the world (Clarkson, 2024). The contribution of the shipping segment to carbon emissions was estimated at 833mt in 2023, representing 2.2% of global total (Xuehao ,*et al.,* 2025). The need for carbon emissions reduction has been canvassed by the International Maritime Organization from a 50% reduction annually to a net zero emissions. It has been observed that studies on pilotage planning problems or services are few in literature (Xuehao, *et al.,* 2025).

With improvement in science and technology, understanding ship pilotage accidents has been deepened and the concept of safety management has also improved. Also, the management and control of ship pilotage accidents have presented new trends as well as characteristics. The emergency treatment of accidents has been transformed into future oriented crisis prevention and pre-accident prediction. As such, these changes have caused a shift from qualitative accidents and safety analysis to quantitative risk analysis and pre-control(Yan, 2019). Ship pilotage safety has become a research hotspot in the international shipping industry and a great concern to the governments of maritime nations (Yan, 2019). Such concern also extends to the private sector because poor pilotage services may not curtail or minimize maritime risks and challenges.

In order to reduce or eliminate these risks as well as challenges affecting port operations, there is the need to examine the importance of pilotage services in the Nigerian ports as well as correlate its relationship with or mitigate maritime risks or accidents.

3. Meaning and Components of Pilotage Management Practices.

The vivid description of pilotage services by Edwin(2018) is worth replicating here.The author commented that " the sea is a wide world on its own with several regions, and each region has its peculiarities, challenges and circumstances. Some regions are wide while others are narrow, some are clear while others are embedded with icebergs hidden below the sea level. These peculiarities can only be known by mariners who operate in those regions. No single sailor has the comprehensive knowledge of all ports and regions of the sea with their peculiarities ... This limitation of knowledge and the need to avoid disasters gave rise to the employment of men who are knowledgeable in the local conditions of each particular area of the sea... These men who are called knowledgeable in the local conditions of the sea are called pilots". Francis(1984) defines a pilot as a person other than the master or one of the crew of a vessel who is taken on board especially for the purpose of conducting it through the river, road, or from or into the port particularly with regard to his knowledge of local conditions. In other words, a pilot is a mariner who maneuvers a ship through dangerous or congested waters such as harbours, or river mouths and completes the berthing and unberthing operations of the ships by controlling the ship's maneuverability directly and the tugs and shore linesmen through a radio.

Pilotage services are indispensable to maritime operations all over the world. They are indispensable because of the vacuum that may be created and unimaginable risks associated with such avoidable vacuum without the services of maritime pilots. Nzeribe (2019) used the concept of indispensability of pilotage services to describe the central role(s) played by maritime pilots in the completion of maritime services or trade. According to Nzeribe, it is the primary desire that every vessel that sets out at sea completes its voyage in record time and in the safest possible condition. Pilotage services ensure safety in navigation, mooring and sailing at the ports and straits, also known as "narrow waters".

The introduction of pilotage services have ensured environmental safety by averting bunker ship accidents that could have caused oil spillage and sea pollution. Most of these accidents are caused by ignorance and errors of the master of the ships. Pilots assist in guiding the ship from the areas of danger to areas of safety. International Maritime Organization documents state that the share of human error in sea accidents is approximately 85.86%. It has been suggested that the share of the human error in sea accidents will drop down to near zero if organized pilotage services are carried out by maritime pilots (Capt. Ayuk Erol, 2000). Pilotage jurisdictions have set out the sizes of vessels that must be accompanied by a pilot before entering into the ports of those states. Therefore, the skill of experts in pilotage services cannot be over-emphasized in the improvement of port performance.

4. Importance of Pilotage Practices and Mitigation Maritime Risks.

A sustainable pilotage management and services are essential to effective port operations. As global shipping volumes are increasing on daily routines, ports are obliged to handle increasing port traffic in order to maintain safety, efficiency and environmental responsibility. The importance of pilotage system could be demonstrated under the following areas of operations in the ports;

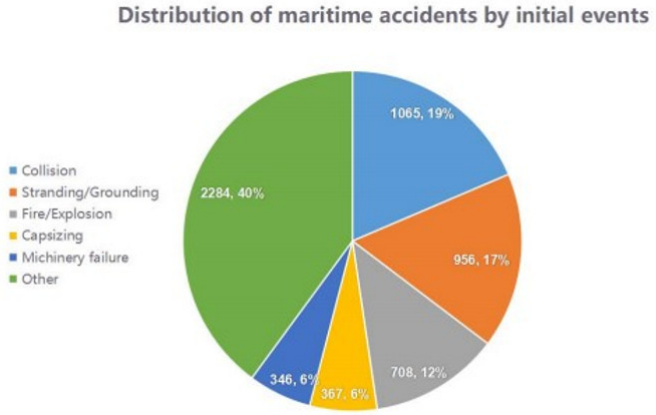
1. Maintaining Safety and Reducing Risks: A key function of pilotage management is to enhance the safety of maritime operations. To achieve this fundamental purpose, skilled pilots are deployed to guide vessels and minimize the risk of accidents such as groundings, collision, and oil spills. It is evident that unchecked and curtailed risks and challenges may result in severe consequences like environmental damage or degradation, economic losses, and threats to human existence.

2. Enhance Operational Efficiency: Effective pilotage management will reduce delays, and optimize vessels turnaround times. It will also assist Port's operators to maximize their capacity. In other words, ships can enter and leave port with scheduled time, and minimize waiting time and congestion.
3. Support to Economic growth and competitiveness: Ports facilitate both international and local economies. In this case, efficient pilotage services help port operations to be competitive by providing reliable and cost effective services. Effective pilotage services attract shipping lines since quicker turnaround is maintained and operational risks are reduced to the barest minimum.
4. Reduction in Environmental Impact: It has been noticed that when pilotage services and management are efficiently maintained, schedule and dispatch functions are done according to plan, and vessels spend less time waiting to dock, fuel consumption and emissions are drastically reduced. Such deliberate actions support eco-friendly practices which minimize ecological disruption.
5. The use of Technology: Advances in technology have revolutionized the pilotage management system, thereby making it more effective and efficient, accurate and responsive. Digital solutions are becoming integral components of modern pilotage management systems or practices through the employment of AI powered scheduling tools to real-time tracking systems
6. AI and Predictive Analytics: These high powered technologies have optimized scheduling and predict traffic patterns in port operations. AI and Predictive Analytics analyze historical data, weather forecast, and real time vessel movements to make accurate recommendations to port's authorities. In anticipation of an influx in demand, port authorities can allocate pilots appropriately, reduce delays as well as stimulate over efficiency in operations.
7. Real Time GPS Tracking: Through GPS technology, port authorities can monitor the exact location of pilots and vessels and also provide a clear view of operations. This information got through GPS assist in the response to changes required on time, such unexpected delays, and disruption of weather conditions, among others. This helps to correct or avert navigation errors.
8. Digital Communication Tools: Through digital communication tools, operations are easily coordinated, enhance port control, and coordinate vessel crews. Effective pilotage communication reduces misinformation and misunderstanding among vessel's crews and port's authorities.
9. Integrated Port Management System: The use of Integrated Management system in conjunction with pilotage management tools enhance billing, scheduling and logistical necessity. Moreso, administrative overhead is reduced while operational cohesion is improved. A comprehensive report provided by IPMS helps to identify and resolve issues within the shortest period (Adib,2024).

5. Maritime Risks and Challenges.

The study by Zhang *et al.,* (2021) on global maritime accidents between 2003 and 2018 found that ship collisions accounted for the highest proportion of maritime accidents at 19% (as shown by figure 1). Similarly, ship collisions in East Asia, China and Japan accounted for 40.33% of all maritime accidents, 30% higher than groundings, which occupied the second place. Global maritime accidents have been grouped into ship collision, stranding and grounding, fire and explosion, capsizing, machinery failure, and others.

Figure 1: Distribution of global maritime accidents by initial events.



Source: Adapted from Lu (2021), & Zhang *et al.,* (2021).

Lu (2021) argued among the many factors that contribute to ship collisions, human factors are the most causative factors. It is evident by studies that human errors account for more than 90% of all ship collisions. Ship collisions caused by defects in ship design, equipment failure, have been reduced by the development of better designed ships and advanced shipbuilding technology and state- of- the -art navigational equipment on ships. According to Lu (2021), there are different definitions of ship collision as provided by scholars. SI and Wu (1995) defines ship collision in the broad sense as the mutual contact between ships resulting in damage to one or both parties. Zhao and Wang (1995) defines ship collusion as an accident in which a ship collides or touches another ship while sailing or berthing, causing damage to the ship. Also, Chinese Maritime Law defines ship collision as an accident in which a ship comes into contact with other ships at sea. In navigable waters connected to the sea causing damage.

A study by Coraddu *et al.,(*2020) argued that marine accidents are complex events and analysis on human factors into collisions is a difficult task. Based on the International Maritime Organization (IMO) database, Paolo *et al.,(*2021) categorized themes from 1079 sea accidents and found that fatigue, stress, work pressure, and poor communication were factors that caused accidents in the 24-hour environment of shipping because ships and crews were pushed to the limit. In the study of Lu (2021) , ship collision investigation report is a conclusion

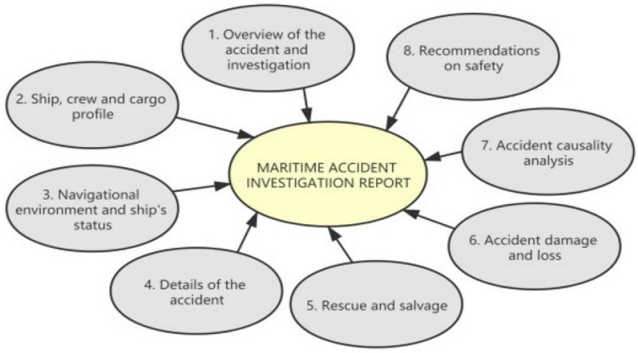
Figure 2: Ship collisionv.

Source: Lu (2021).

report based on the thorough investigation of the accident by the professional investigation

experts of the Maritime Authorities after the collision has occurred. An accident investigation report should include an overview of the accident and investigation, the ship, the crew, and cargo profile, the navigation environment and ship's situations, details of the accident, rescue and salvage, damage and loss, accident causality analysis, and advice on safety management.

Figure 3: Content of Ship Collision Investigation Report.



Source: Lu (2021).

Donatus (2021) defines a vessel accident as an unintended occurrence whose severity is dependent on the degree of damage to property and loss of life. Dogarawa (2012) indicated that between the year 2000 and 2009, a total number of 552 persons died either as a result of marine vessels and boat collisions in inland waters of Nigeria. It is an indication that the average fatality rate per year is 55 deaths. Arising from anecdotal evidence from investigated cases of vessels accidents, overload, excessive speeding, poor attention, to weather conditions, abandoned wrecks, on navigation channels, incompetence of pilots, and inadequate navigational aids were Identified as the determinant factors. The study of Donatus (2021) classified accidents as fatal and non- fatal accidents which revealed that over 65% of accidents at sea involving marine vessels were of fatal and non-fatal categories. And the causative factors are human factors, (50%), environmental factors (30%) and machinery factor (20%).

6. Roles of Maritime Pilots.

Maritime pilots are also known as harbour pilots,who are highly skilled professional with extensive experience in navigating challenging waterways. In short, they are empowered by localized knowledge with which vessels are maneuvered safely and efficiently through narrow channels, underwater hazards, and manage complex port's traffic. There are three key responsibilities of maritime pilots, namely;

1. Navigation and Maneuvering: Pilots are responsible for guiding vessels safely into and out of the ports. They are specially trained and supported to carry out these activities in the ports as well as the waterways.
2. Communication and Coordination: Maritime pilots liaise with port's authorities, tug operators, and ship captains to ensure safe entry and departure.
3. Risks Assessment: Harbour pilots do assess maritime related risks such as weather conditions, vessel's load, and port congestion.

7. Description of Ports in Nigeria.

According to Edih et al., (2020), there eight major ports and ancillary ports and jetties in Nigeria such as 1) Lagos port complex Apapa Port, 2)Tincan Island Port, 3) Port Harcourt Old Port, 4) Federal Ocean Terminals (One), 5)Warri port, 6) Calabar port, 7)Koko Port, and 8) Container Port (Lagos).

1. Lagos Port Complex: The first planned river port in Nigeria. The Lagos Port Complex, LPC started operations in 1921 with a quay length of 548.64 meters and a draught of 9.75m. The quay length was extended to 160 meters and draught to 10.5 meters in 1979. It has a total of 20 berths capable of handling general cargo vessels, reefer vessels, etc. It harbours 76,000 tons of silo storage capacity.
2. Tincan Island Port: It came into operation in 1977, however was developed in 1975. Tota quay length is 2500 meters which consist of seven break bulk general cargo berths, two RoRo berths and dry cargo import berth. Each berth has a maximum draught of 10 meters
3. Port Harcourt Old Port: Port Harcourt Old Port was built as a natural Port and the third largest in Nigeria. It has marine quay length of 1300 meters, draught of 7.6 meters, and 13 berths. The port is equipped with dockyard, five mooring berths and tankers bouy.
4. Federal Ocean Terminals: It was designated as the transshipment or hub port for West and Central Africa for deep draught ocean going vessels not capable of berthing in other conventional ports in Nigeria.Its draught is 13 meters, quay length is 1590 meters, six berths, four transit sheds, three warehouses, and 2000 square meters for container and bulk cargoes.

5. Warri Port: Warri port is the largest among the constellation of ports in the Delta area of Koko, Sapele, Burutu and Aladja Steel Jetty. The port is categorized into two : the old and new ports. The old Warri port has eight berths while the new Warri port has six berths including a RoRo berth (Roll on Roll off). Total quay length is 1600 meters, and draught is eight (**??**) meters.
6. Koko Port: This is a natural medium sized port located on the estuary of Benin River. Its quay length of 137 meters and draught of seven meters.
7. Calabar Port: This is one of the oldest natural harbours established by the British the British Chartered Company, the United African Company (USA) in the Coastal region of Nigeria. The quay length is 550 meters and a draught of eight meters with a contiguous free zone that offers wide latitude for import and export processing activities.
8. Container Terminal: The terminal is located at the third Apapa Wharf extension covering 144 hectares of land area. The terminal has installed capacity to handle 22000 teus (twenty equivalent units).

8. Review of Studies.

In the recent past, a large number of studies have been carried out in maritime transportation to address the increasing risks and challenges in the maritime industry. In Kong *et al.,* (2022), actions were taken to develop different green policies to motivate stakeholders to make decisions impacting on the environment. Also, in Bao *et al*.,(2022) and Ye *et al*., (2022), emissions control policies were recommended for formulation. In the areas of optimization studies in green maritime logistics, studies employed the bunker management, speed control and route schedule of ocean going vessels to improve operations. The bunker management strategy is used to reduce vessels total fuel consumption (De *et al.,* 2021).

The pilotage planning problem has been addressed in only a small amount of literature (Xuehao *et al.,*2025). Research on pilotage planning problems could be traced back to 1994 when Wermus and Pope 1994 developed a heuristic method to optimize pilot scheduling in congested ports. Pilot vessel planning is a core issue discussed in literature. Wu *et al.,* (2020) studied a seaport vessel pilotage planning problem from the perspective of VTS center which involves seaport vessel traffic scheduling and pilot work shift assignment to arrange a pilot to navigate a vessel at each work shift with the objective of minimizing the pilotage cost. Abou Kasm *et al.,* (2021) investigated the integrated vessel scheduling with pilotage and tugboat constraints utilizing a mixed integer programming model. It has been observed that the combination of berth allocation with the utilization of the navigation channels or anchorages is good for mitigating port congestion and enhancing vessel services (Jia *et al.,* 2020; Wu *et al.,*2022).

The study of Edih *et al.,* (2023) focused on the prospects and challenges of maritime business in Nigeria. The following challenges were Identified, poor funding, dearth of infrastructure, and poor integrated transport system. Others are port congestion, high container dwell time, high turnaround time of vessels as well as trucks, and poor logistics reports. Interference from the government impedes the smooth running of operations in the ports. Despite the challenges, port operations have increased the GDP of maritime nations, and Nigeria is not an exception. It's seen that port activities affect capital growth, increase fiscal revenue and economic growth.

Jesus and Reyes (2022) carried out a study on COLREGs and their application in collision avoidance algorithms where ship collision has manifested as the biggest risks in shipping. It is provided in the study that Decision Support System/Collision Avoidance Alert System (DSS/CAS) should be developed to prevent and avoid them. COLREGS (collision regulations) is conceived to have Officers Of the Navigational Watch(OONW), briefly coined Officers On Watch, (OOW). Therefore, in the design of DSS/CAS, interpretations of collision situations from a different perspective than that of an OONW should be avoided. The analysis of COLREGS 72 calls for immediate action to unify criteria for the calculation of DSS/CAS algorithms. Flowing from the results, IMO is advised to address the following issues; disparity in head-on sectors, uncertainty in the interpretation of overtaking in not sight vessels, lack of standardized classification of types of population, identification of special COLREGS areas, ambiguity in the application of rule 17.

Yan(2019) studied ship pilotage risk management and decision making in Guangzhou port where he analyzed the current situation of ship pilotage safety and pilotage accidents that occurred in a decade. The adopted the Bayesian risk prediction theory to predict the pilotage risks of Guangzhou port By the application of FSA (Former Safety Assessment) and Bayesian theory of ship piloting risks, pilot management decision maker will know how to control uncertainty of the future, give full considerations to the future possible status and risks constraints. The ship's pilotage at Guangzhou port was described to span six public waterways in the pearl river estuary which includes, Zhuhai, Shenzhen, Zhongshan, Dongguan, and Guangzhou. The ship's pilotage has long channel and limited scope of navigable waters, bend and complex flow, the ship type and number of density.

Lu (2021) investigated the human factors in ship collisions based on accident investigation reports where the human factors and classification system (HFACS) framework was utilized. The study examined 21 ship collision investigation reports that occurred in China under four detailed levels, namely; organizational influences, unsafe supervision, preconditions for unsafe acts, and unsafe acts. Findings revealed that unsafe acts were fully demonstrated in the investigation reports as direct and obvious factors. But, organizational influence and unsafe supervision are regarded as potential and non direct factors were not sufficiently revealed by the report as causative factors. It was observed that human factors remain difficult to address because it's a systemic problem. It requires a system approach to mitigate this systemic problem. The shipping industry, governments, and international organizations should work together to address the challenges of crew change and dispatch, the physical and mental health of seafarers in order to make the industry viable and sustainable in the future.

In the study of Donatus (2021), which investigated the determinants of accidents involving marine vessels in Nigeria's waterways, perceptual data were obtained through structured questionnaires administered to a random sample of marine vessels operators in Marine terminal and anchorage locations. The parametric test conducted was analyzed using a logit regression model and found that human and environmental factors significantly affect the probability of accidents involving marine vessels. The study supports the findings that 75-96% incidence of maritime vessels casualties and associated risk factors are partly caused by human errors. It was observed that cases of marine vessels accidents causing person's injury, death, destruction of property and damage to the environment have grown in proportion to the increase in oil prospecting and seaborne transportation activities in Nigeria.

Conclusions.

Given the explorative study, the following findings were discovered, viz;

1. Pilotage management practices are fundamental services to modern and efficient port operations(Adib, 2024).
2. Pilotage management services encompass the coordination, deployment and support of maritime pilots in discharging their duties.
3. Pilotage is mandatory in International Maritime Logistics with special recognition of national sovereignty and navigational safety (Xuehao *et al., 2025).*
4. Modern pilotage management practices incorporate scheduling, dispatching, tracking, communication, and compliance, e.t.c., with safety regulations.
5. The combination of berth allocation with utilization of navigation channels and anchorages mitigate port congestion and enhance vessel services (Jia *et al.,* 2020 ; Wu *et al.,* 2022).
6. The pilotage planning problem has been addressed in only small amount in literature (Xuehao *et al.,*2025).
7. To avoid ship collision, the Decision Support System / Collision Avoidance Alert System (DSS/CAS) should be deployed as a preventative measure (Jesus and Reyes, 2022).
8. Former Safety Assessment, FSA and Bayesian Theory of ship piloting risks are measures that help Pilotage Management Decision Makers to know how to control uncertainty of the future and ascertain risk constraints (Yan, 2019).
9. As regards ship collision, the human factor has been identified as a difficult issue because it is a systemic problem. Hence, the government and international organizations should consider challenges of crew change and dispatch, and the physical and mental health of seafarers (Lu, 2021).
10. If 75-96% of incidence of maritime vessels casualties and associated risk factors are partly caused by human errors (Danatus, 2021). This is necessitate training and retraining of the crew and seafarers on board the ship.

It is important to note that these recommendations should be tailored to the specific needs and priorities of Sitio Lamintao Barotac Nuevo, Iloilo. Local leaders, government agencies, and community organizations should collaborate to develop and implement a comprehensive and holistic approach to address the socio-economic challenges and improve the overall well-being of the community.

Recommendations.

1. Port Administrators (i.e, Nigeria Maritime Administration and Safety Agency, NIMASA and Nigeria Ports Authority, NPA) in Nigeria should ensure that pilotage management practices are deployed as a major component of daily port operations.
2. Government should equip the Nigerian seaports with modern pilotage management facilities.
3. Manpower be trained on the utilization of the pilotage management practices and facilities to enhance efficient delivery of services.
4. Seafarers should undergo routine medical checks to ascertain their physical and mental health status to prevent avoidable collisions at the ports.

References.

Abou Kasm,O., Diabat, A., and Bierlaire, M., (2021). Vessel scheduling with pilotage and tugging considerations. *Transp. Res.Part E: Logistics. Transport.Rev* .148,102231. https://doi.org/10.1016/j.tre.2021.102231.

ALLIANZ (2020). Safety and shipping review 2020[WWW Document]. URL, https://www.agcs.allianz.com/content/dam/onemarketing/agcs/agcs/reports/AGCS-Safety-Shipping-Review-2020.pdf.15.21.

Antao,P., and Guedes, S. C.(2008). Casual factors in accidents of high speed craft and conventional ocean going vessels. *Reliab. Eng. Syst. Saf.* 93, 1292-1304, https://doi.org/10.1016/j.ress.2007.07.010.

Bao, Z., Zang, X., and Fu, G., (2022). Factors influencing decisions in sulphur oxide emissions abatement for cruise shipping companies. *Int. Logist. Res. Appl*. 1-20. https://doi.org/10.1080/13675567.2022.2153814.

Clarksons, (2024). Shipping intelligence network (WWW Document). URL<https://www.clarksons.net.cn/sin> accessed 20 March, 2025.

Benson, I A., and Adekemi, O D. (2018). The roles of private ports operators on economic development in Nigeria: case study of Apapa Bulk Ltd. *Direct Research Journal of Social Science and Educational Studies*,5(3),16-22. https://doi.org/10.26765/DRJSSES.2018.5027.

Budiyanto, M. A., Habibie,M.R., and Shinoda,T. (2022). Estimation of CO2 emissions for ship activities at a container port as an effort towards a green port index. *Energy Rep.* 8,229-236. https:/doi.org/10.1016/j.egyr.2022.10.090.

Adib, A. (2024). Why is pilotage management essential for modern ports? https/www.innovez-ome.com . Accessed 20 March,2025.

Asika, N. (2004). Research methodology in the behavioral sciences,(3rd ed.). Longman Press Plc, Ikeja.

Capt. Ayuk, E.(2000). Pilotage services and competition. From Turkish ship world magazine, October 2000 issue.

Coraddu, A., One to, L., Maya, B. N. and Kurt, R. (2020). Determining the most influential human factors in maritime accidents: a data-driven approach. Ocean Engineering, 211, 107-588.

De, A., Wang, J., and Tiwari,M.K., (2021). Fuel bunker management strategies within sustainable container shipping operations considering disruption and recovery policies. *IEEE Trans. Eng. Manag.* 68(4),1089-1111. https://doi.org/10.1109/-TEM.2019.2923342.

Dogarawa, L. B. (2012). Marine accidents in Northern Nigeria: causes, prevention, and management. International Journal of Academic Research in Business and Social Sciences, 2(11), 378-389.

Donatus, E. O. (2013). Analysis of determinants of accidents involving marine vessels in Nigeria's waterways. Management Science and Engineering, 7(3), 39-45. https://dx.doi.-org/10.3968/j.mse.1913035X20130703.2611.

Edih, O. U., Igemohia, F., and Faghawari, N. D. (2022). Prospects and challenges of maritime business in Nigeria. *Direct Research Journal of Management and Strategic Studies*, 3(2), 8-13. https:/doi.org/10.26765/DRJMSS20967731.

Edwin, C. A. (2018). The indispensability of pilotage services in global maritime administration. [Available in internet].

Ekpo, I. E.(2012).Impact of shipping on Nigerian economy: implications for sustainable development. *Journal of Education and Social Research,* 2(7), Doi:10.590/jesr.2012.v3n7p107.

EMSA, (2020). Annual overview of marine casualties and incidents 2020[WWW Document].URL. https://www.emsa.europa.eu/publications/reports/items/4266-annual-overview-of-marine-casualties-and-accidents-html9.14.21.

Francis, R. (1984). The modern law of pilotage. Sweet and Maxwell, London.

Green,B., Tull, V. and Albaum (2010). Research design: concept and principles. McGraw Hills Inc. New York.

Hair, J., Bush, R. and Ortinau, D. (2006). Marketing research within a changing information environment. McGraw Hills Inc. New York.

Jesus, A. G. M., and Reyes, P. A. ((202). COLREGS and their application in collision avoidance algorithms: a critical analysis. *Ocean Engineering,* 261, 112029. https://doi.org/10.-1016/j.oceaneng.2022.112029.

Jia, S., Wu, I., and Meng, Q.,(2020). Joint scheduling of vessel traffic and pilots in seaport waters. *Transp.Sci.* 54(6),14-95-1515. https://doi.org/10.1287/trsc.2020.0990.

Kong, Y., Liu, J., and Chen, J., (2022). Exploring the carbon abatement measures in maritime supply chain: a scenario based system dynamics approach. *Int.J. Prod. Res.* 61(18),6131-6152. https://doi.org/10.1080/00207543.2022.2088427.

Lu, W. (2021). Analysis of human factors in ship collisions based on accident investigation reports. *Dissertation* on Master of Science at World Maritime University Dalian, China.

Nzeribe, E. A. (2019). Sea collision rules and damage liabilities in Nigeria. International Journal of Law, 5(3),94-98.

Olannye, P. A., (2006). Research methods for business: a skill building approach. Lagos and Asaba, Peejen Publication.

Paolo, F., Gianfranco, F., Luca, F., Marco, M., Andrea, M., Francesco, M., Vittorio, P., Mattia, P., and Patrizia, S. (2021). Investigating the role of the human element in maritime accidents using semi-supervised hierarchical methods. Transportation Research Procedia, 52, 262-259.

Shappell, S.A. and Wingmann, D. A. (2000). The human factors analysis and classification system, HFACS. Retrieved from https://commons.erau.efu/ publications/737

SI, Y. and Wu, Z. (1995). Ship collision law. Dalian: Dalian Maritime University Press.

Wermus, M., and Pope, J.A. (1994). Scheduling harbour pilots. *Interface s,* 24, (2), 44-52. https:/doi.org/10.1287/inte.24.2.44.

Wrobel, K. (2021). Searching for the origins of the myth: 80% human error impact on maritime safety. Reliab. Eng. Syst. Saf. 216. https://doi.org/10.1016/j.ress.2021.107942.

Wu, L., Jia, S., and Wang, S. (2020). Pilotage planning in seaports. *Eur.J. Oper. Res.* 287 (1), 90-105. https:/doi.org/10.1-016/j.ejor.2020.05.009.

Xiao, L., Sun, P., Wang, L., and He, M., (2024). Multi-class pilot dispatching problem with stochastic pilot duration. *Int. J. Prod. Res.* 62(10), 3585-3605. https:/doi.org/10.1080/002075-43.2023.22434.

Ye, G., Zhou, J., Yin, W., Feng, X., (2022). Are shore power and emissions control area policies always effective together for pollutant emission reduction?- an analysis of their joint impacts in the post-pandemic era. *Ocean Coast Manag.,* 224,106182. https:/doi.org/10.1016/j.oceancoaman.2022.106182.

Yomere, G. O., and Agbonifoh, B. A. (1999). Research methodology in management and social science. Benin City, Uniben Press.

Xuehao F., Mingyang,L., Wenwei,Y., and Yiying C., (2025). The impacts of pilots planning on green maritime logistics. *Regional Studies in Marine Science* 81,103989. https://doi.org/10-.1016/j.rsma.2024.103989.

Yan, G. (2019). Research on ship pilotage risks management and decision making in Guangzhou port. *Dissertation on* Master of Science at World Maritime University, Daliian China.

Zhang, G., Thai, V., Yuen, K. F., Loh, H.S.,and Zhou, Q. (2018). Addressing the epistemic uncertainty in maritime accidents modelling using Bayesian networks with interval probabilities. *Saf Sci.102*,211-225. https:/doi.org/10.1016/j.ssci.2017-.10.1016.