Internship Report

On

"Uncertainty Reduction on Inventory Management of PH Navigation"

By

Labiba Tanjim Iqbal

ID: 22364040

An internship report submitted to the BRAC Business School in partial fulfillment of the requirements for the degree of Master of Business Administration

Masters of Business Administration
BRAC University
August, 2024

Declaration

It is hereby declared that:

- The complete report stems from my work experience at BRAC University.
- The paper includes all required references to third-party materials while preventing any unreferenced material from external sources.
- This material does not appear in another academic work or diploma program accepted or submitted by any university.
- Everything provided by primary source partners of assistance has been appropriately acknowledged.

Student's Full Name & Signature:

_____

Labiba Tanjim Iqbal

Supervisor's Full Name & Signature:

_____

Zaheed Halim, PhD

Associate Professor

BRAC Business School

BRAC University

Letter of Transmittal

5th May 2025

To

Zaheed Halim, PhD

Associate Professor

BRAC Business School

BRAC University

Subject: Submission of Internship Report

Dear Sir,

My submitted internship report, "Uncertainty Reduction on Inventory Management of PH Navigation," serves as the MBA requirement at BRAC University. During my internship, I gained practical experience at PH Navigation, where I maintained responsibilities in the Supply Chain and Operations Department.

During my internship, I had access to practical inventory logistics management practices in maritime business operations, which allowed me to see first-hand operational challenges and strategic initiatives. I took all possible measures to represent data with precision while using first-hand findings and applicable academic resources.

I will always deeply appreciate your dedication during the report production, along with your constant support and constructive feedback. The document delivers research findings about the operational aspects of PH Navigation while meeting your intended requirements.

Sincerely,

Labiba Tanjim Iqbal

ID: 22364040

MBA Program

BRAC University

Acknowledgment

I dedicate my most profound appreciation to the Almighty for bestowing me the capability and the chance to finish my internship report properly. I express profound gratitude to Zaheed Halim, PhD, my academic supervisor at BRAC Business School. He provided essential guidance, encouragement, and knowledge-based feedback that helped me develop this report. His expert support gave vital guidance to the research, adding value to its academic quality. During my internship, I was thankful to Mirza Tariq Sangee for teaching me valuable operations knowledge as a senior executive at PH Navigation. Implementing his inventory management and supply chain operational knowledge transformed my academic learning process.

The PH Navigation team deserves my heartfelt gratitude for their remarkable dedication, ability to offer knowledge, and patience, which enabled me to grasp maritime logistics sector operations. I am grateful to my family, classmates, and friends for always cheering me on and providing assistance throughout this entire experience.

This report represents all the valuable support and mentoring I received throughout my work, and I send my heartfelt appreciation to each person who helped me complete it.

Executive Summary

This document examines how PH Navigation handles inventory uncertainty through their maritime logistics management approaches throughout the "Uncertainty Reduction on Inventory Management of PH Navigation" report. The research stems from a three-month internship in PH Navigation's Supply Chain and Operations Department. It includes theoretical foundation and practical learning obtained through the MBA program at BRAC University. PH Navigation maintains its position as a leading maritime company dedicated to handling dry bulk cargo transportation in Bangladesh. The company encounters substantial challenges regarding inventory management because global supply chains show unpredictability due to weather disturbances combined with geopolitical tensions, port congestion, and market demand fluctuations. Through its digital transformation initiatives, PH Navigation employs safety stock planning, predictive analytics, and real-time monitoring to deal with supply chain uncertainties.

The research study utilizes mixed primary interviews and survey data alongside secondary reports such as internal documents, industry resources, and organizational operational records. The analysis of technical forecasting methodologies involving moving averages and exponential smoothing reveals their inappropriateness for the unpredictable conditions faced by PH Navigation in maritime operations. The most significant data points demonstrate that supply chain disturbances become less frequent when organizations track their fuel supply and optimize voyages and stock levels. The successful operation of businesses depends on historical data consumption, ROB measurement, and standardized fuel purchasing strategies.

PH Navigation's inventory uncertainty management program has shown notable progress, but the company requires advanced technology solutions, including AI forecasting with blockchain systems and dynamic stock modeling, for increased accuracy, efficiency, and endurance throughout its supplies. The internship enabled me to gain practical exposure to inventory management within a high-variance, high-risk setting, which substantially fostered my academic capabilities and professional development.

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Chapter 1

Overview of Internship

1.1 Student Information

Name: Labiba Tanjim Iqbal

ID: 22364040

Program: MBA

Major: Operation and Supply Chain Management

1.2 Internship Information

1.2.1 Period

21st August 2024 to 20th November 2024

Company Name: PH Navigation

Department: Supply Chain and Operation

Address: Gulshan-2, Road-36, House-5, 3A, Dhaka, Dhaka 1212

1.2.2 Internship Company Supervisor Information

Name: Mirza Tariq Sangee, Senior Executive, Operations

1.2.3 Job Scope

Job Description

1. Ship Certification and Compliance:
    - Assist in the preparation, renewal, and tracking of ship certifications and statutory documentation.
    - The company must follow company policies along with international maritime regulations.
    - The company communicates timely with classification societies, flag states, and relevant authorities to obtain prompt regulatory approvals.
2. Stakeholder Communication:
    - Act as a point of contact between the company, charterers, brokers, and other stakeholders.
    - Coordinate operational updates and resolve queries related to ship activities.
    - Support negotiations for charter agreements and other operational matters.
3. Inventory Management:
    - Maintain and update records of the ship's inventory, equipment, and spare parts.

- Ensure the availability of necessary supplies and coordinate replenishments with vendors.

4. Documentation and Reporting:
   - Manage and maintain operational records, including logs, certificates, and correspondence.
   - Prepare operational reports and summaries for management review.
5. Coordination with Technical Teams:
   - Collaborate with the technical team to address ship maintenance and repair requirements.
   - Follow up on pending maintenance and ensure the vessel is operationally ready.
6. Cost and Budget Tracking:
   - Monitor operational expenses and support cost control initiatives.
   - Provide input on budget planning for ship operations

1.3 Internship Outcomes

1.3.1 Student's Contribution to the Company

The improvements I have driven at PH Navigation supply chain management and logistics systems occurred during my internship. I establish ship timetables that lead to improved marine operations while reducing transit durations, which is my primary work obligation. Through my contributions to voyage scheduling and route planning, our company has achieved lower transit times and improved efficiency. My stakeholder interaction aims to minimize delays while ensuring timely cargo handling procedures. Data tracking of vessel performance has been my responsibility to support cost control initiatives and decision-making processes. I have actively participated in compliance audits to verify whether all operations fulfil safety regulations and international shipping rules. The assurance of supply chain continuity in case of interruptions comes from planning additional routes and successfully acquiring required approvals. My practical experience at the Port has dramatically enhanced my comprehension of marine industry supply chain management.

1.3.2 Benefit to the Students

My time at PH Navigation brought productive, practical insights through supply chain management and operational experiences. The internship experience helped the candidate grasp the challenges involved in the marine logistics process, including cargo capacity optimization rou, te planning, and vessel scheduling. The internship allowed the intern to improve their analytical abilities through statistical route evaluation, tracking fuel use, and conducting vessel performance

assessments. The intern developed better communication abilities by working with port agents and logistics companies, which resulted in streamlined supply chain management. The intern learned more about international shipping rules because of this experience while becoming more certain about solving practical problems in marine logistics operations. Through the internship, the trainee developed stronger technical abilities and increased self-assurance in resolving workplace issues.

1.3.3 Problem/Difficulties

PH Navigation provided me with multiple obstacles at my internship, which forced me to advance alongside my professional career. Transitioning within the quick marine industry with unpredictable disruptions required me to practice good multitasking skills to operate efficiently. The learning process for international shipping logistics, regulatory compliance proof, and its corresponding paperwork needed time to become proficient. Working with stakeholders, including customs officials, logistics companies, and port agents, created difficulties because of time zone differences and different methods of communication, and reaching an agreement regarding schedules and standards became difficult to achieve. The effort to analyze data for better costs and vessel performance created more difficulties than expected and led to an improved understanding of operational decision processes.

1.3.4 Recommendations on Future Internships

I would like to provide a few suggestions to enhance PH Navigation's future internship program based on my experience there. First of all, providing a more structured introduction at the beginning would greatly benefit potential interns. A clear description of the organization's procedures, divisions, and important projects would help interns understand their responsibilities and expectations right away.

Additionally, it would be quite helpful to assign each intern to a specific mentor. Our confidence and contributions can be substantially increased when a mentor is available to answer questions and provide regular feedback. Within the team, it fosters a stronger sense of belonging.

Interns should be involved in more cross-functional initiatives. Encouraging cooperation across different departments would result in a thorough grasp of the business's activities, which is crucial for learning. It would improve our comprehension of how different departments, including finance, operations, and logistics, work together to accomplish the goals of the business.

In the end, holding frequent feedback sessions would allow interns to share their insights and suggestions. This would improve the program and show interns that their work is valued. The entire internship experience may be enhanced by these changes, which would benefit the organization and the interns alike.

Chapter 2

Organizational Part

2.1 Overview of the Company

PH Navigation emerged as an international shipping company in Bangladesh on 1st July 2019. The company dedicates itself to Bangladesh's emerging economy growth as it aims to establish itself as a globally recognized maritime firm. The company aims to expand while raising its influence across the marine industry. Registered under Bangladesh ownership, PH Navigation is a leading vessel ownership company that transports dry bulk commodities. The company demonstrates its dedication to international service quality by making this strategic choice.

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The organization has recently extended its service capabilities to cover marine shipping on international shipping routes, particularly focusing on the essential US market. PH Navigation improved its customer reach by including large dry bulk carriers in its fleet, enabling the company to operate longer routes to serve more customers across the globe. The strategic plan allows international commerce while reaching the company goal of enhancing its market position in other markets as it drives Bangladesh's economic development.

PH Navigation maintains efficiency, safety standards, and innovative approaches during its operational activities. It achieves outstanding service standards by constantly investing in new fleet features, optimized routing systems, and better operational procedures. Sustainable practices are essential for PH Navigation since they protect the company from international maritime regulations. PH Navigation emphasizes reducing environmental impact through fuel efficiency improvements.

With its extensive industry knowledge, strategic fleet management, and unwavering commitment to client satisfaction, PH Navigation is well-positioned to grow its market share in the global

shipping business. To meet the evolving needs of its international customers, the firm is committed to expanding its capabilities, forging strong partnerships, and offering reliable shipping solutions.

2.1.1 Mission

PH Navigation aims to provide high standard services to our clients all around the globe. Our team of experts are dedicated to creating long term relationships. We prepared to provide solutions anytime of the day to our clients. With an excellent fleet and well managed capacity our goal is to become leaders in the maritime industries.

2.1.2 Vision

To offer the world environment friendly, safe & efficient shipping.PH wants to have global reach as leading company of the country and to play vital role in the Bangladesh Marine Transportation.

2.1.3 Core Values

The company's core values are centered around establishing enduring commercial partnerships with its clients, of which target-oriented modern technology, dependability, ensured quality and human relationships are the fundamental building blocks.

2.1.4 Functions of Ships

- The ship's main purpose is to move goods from one port to another. We majorly focus on transiting dry goods between ports globally when it comes to dry bulk cargo ships.
- The ships are designed in such a way that they can enhance space and increase container capacity. They are furnished with a mechanism to load and unload cargo with the latest technologies and cranes making them swift and efficient.
- Cargo ships provide an excellent arrangement for the carriage of dry goods, with heavier consignments loaded in the lower loads. These liners provide safe and secure storage and transportation of the products in bulk quantities.
- Before the invention of dry bulk cargos, there were many challenges in transporting and goods were not delivered in the best form. The customised designs and personalised treatment process makes it the best medium to move goods from one place to other.
- Designed for the carriage of irons, oils, meat, and other dry goods, such bulk ships carry an apparent likeness to container ships as they have no cargo handling gear and, apart from the tanker, have large cargo hatches.

- Dry bulk carriers offer the most eco-friendly way of transporting and transiting large volumes of dry cargo long distances; usually, a bulk carrier discharges 6.5 g CO2/ton nm when compared with other channels.

2.1.5 CSR Activities

❖ **Environmental Responsibility**

• Implementing green ship initiatives to reduce emissions and waste.

• Compliance with MARPOL and other international environmental regulations.

• Promoting energy-efficient vessel operations.

❖ **Community Engagement**

❖ Supporting seafarer welfare programs.

❖ Contributing to maritime training and education.

❖ Local community development projects within port cities allow residents to participate.

❖ **Employee Welfare**

❖ The organization must ensure that sea and shore working conditions remain safe and healthy.

❖ The organization should offer its seafaring staff mental health counseling services and emotional support.

❖ The company organizes programs that allow seafarers to build skills and advance their careers.

❖ **Ethical Practices**

- The company maintains strict policies against corruption as well as bribery.
- Adherence to international labor and human rights standards.
- Transparent and ethical business practices.

❖ **Stakeholder Collaboration**

- A partnership exists between our firm and NGOs to defend marine resources.
- Our organization interacts with clients to develop sustainable practices.
- Supporting research and innovation in maritime safety and technology.

2.2 Management Practices

PH Navigation implements democratic leadership principles to enhance group collaboration, inclusiveness, and decision-making teamwork throughout its operations. The approach protects diverse viewpoints during decision-making through staff participation at every organizational level and facilitating their contribution to ideas. The company develops an environment of transparency and openness that creates accountability and responsibility among its team members.

Teamwork and open communication are core principles within the company's management approaches. The company holds regular meetings with teams, brainstorming meetings, and feedback systems, allowing team members to share their opinions and fresh ideas and work collectively on operational issues. The organization becomes more innovative through its inclusive approach that engages employees while reaching fundamental strategic goals.

Through its dedicated lifelong learning initiatives, PH Navigation provides seminars and training courses to develop staff abilities. The company allows workers to show initiative while expanding their expertise and learning abilities for marine industry changes. The company maintains its business agility through its commitment to developing its workforce, which ensures operational competitiveness.

The company focuses intensely on effective supply chain and logistics management through technological optimization of delivery routes combined with data analytics for reduced costs and prompt deliveries. PH Navigation uses its staff engagement policy to guide employees in operational planning and decision-making processes, which lets them work together towards business goals.

PH Navigation's democratic approach leads to clear and honorable business practices resulting from business activities with stakeholders and the local community. The company dedicates itself to improving bonds with its customers, suppliers, and regulatory associations, which enables trust-building interactions.

PH Navigation maintains its business success through these management strategies alongside worker motivation and cooperation by incorporating operational excellence with personnel focus.

2.3 Marketing Practices

PH Navigation implements intelligent marketing approaches to achieve a better market position against intense competition in the marine logistics sector. Clients remain the company's priority because it provides dependable transportation services at competitive rates and efficient delivery methods. Details about service quality, timely delivery, and transparency form the basis of their marketing approach because the company prioritizes customer contentment.

PH Navigation implements relationship marketing as an essential component of its marketing techniques. The business prioritizes direct customer contact because it helps identify individual logistics needs that the industry must address. The company develops dependable relationships through its communication practices, which establish loyalty and trust between clients, making PH Navigation a reliable international shipping solution.

The business expands its market visibility through digital marketing platforms. PH Navigation distributes relevant product details, market insights, and operational proficiency through its website platform, social media networks, and email outreach. Online visibility enables the company to gain new customers while maintaining strong relationships with current clients.

The company demonstrates dry bulk shipping and marine transportation knowledge through participation in industry events, trade shows, and networking forums. Visual events allow PH Navigation to meet prospective clients and investigate collaboration partnerships while sustaining its domination in the shipping industry.

PH Navigation focuses on providing real-time tracking alongside tailored cargo solutions and professional customer support to all clients. These services offer essential advantages that strengthen operations and enhance customer experience.

To succeed, the business needs to use sustainability and compliance as central components of its marketing strategy. PH Navigation reaches clients with environmental concerns while stakeholders with sustainability interests because the company showcases its global maritime standards and sustainable operations. These marketing methodologies enable PH Navigation to maintain strong competitive positions in the shipping industry, create business possibilities, and develop its brand reputation.

2.4 Financial Performance

PH Navigation maintains outstanding financial stability due to its strategic control systems and operational efficiency. It has established financial health with constant profitability and mastering debt management practices. Apart from successfully adapting to the changing marine logistics industry, the business demonstrates financial growth, which shows its ability to thrive.

Metric	2024	2023	2022	2021	2020
Net Profit Upon Sales	22.0%	21.5%	20.3%	18.9%	18.0%
Liquidity Ratio	2.8	3.0	2.9	2.7	2.5
Financial Leverage	0.70	0.68	0.65	0.62	0.60
Debt/Asset Ratio	38%	40%	43%	45%	47%
Operating Margin	30.0%	29.5%	28.7%	27.5%	26.8%
Net Profit Margin	18.5%	18.2%	17.5%	16.3%	15.8%
Return on Assets (ROA)	14.0%	13.5%	12.8%	11.9%	11.0%
Return on Capital (ROC)	37%	36%	34%	32%	30%
CAGR (5 Years)	11.0%	10.5%	10.0%	9.5%	9.0%
Current Asset/Revenue	60%	62%	63%	65%	66%

Key Financial Ratios for PH Navigation

Profitability Metrics:

The company demonstrates effective resource management by achieving substantial Net Profit upon Sales and robust Net Profit Margins. The company's operational effectiveness appears through consistent improvement in operating margin performance metrics.

Liquidity and Stability:

The company maintains higher-than-average liquidity ratios to fulfill short-term commitments at its operating level. Better long-term financial stability emerges from a decreasing debt-to-asset ratio because it demonstrates lower debt dependence.

Efficiency and Growth:

Strong Return on Capital (ROC) and Return on Assets (ROA) show efficient utilization of capital and resources. CAGR represents the natural expansion of the PH Navigation fleet and global coverage while showing the company's continuous development pathway.

PH Navigation shows financial performance strength, which creates resilience while adapting to market changes as it extends its maritime industry operations.

2.5 Operation Management and Information System Practices and Supply Chain Management (SCM)

The operational management system at PH Navigation maintains systematic approaches to efficiently delivering goods through water transport. The organization strongly emphasizes three key practices of capacity management, vessel scheduling, and route optimization to reduce transit times while maximizing resource performance. PH Navigation maintains a workflow that delivers orders on time, increasing customer approval and company work efficiency.

The success of PH Navigation depends entirely on its information system procedures. Advanced digital tools and software enable the company to assess and make real-time decisions based on collected data. These technological systems allow proactive operational changes through precise monitoring of shipments, fuel use, and routes. The combination of technology improves stakeholder communication by offering clients vital information and building trust.

PH Navigation dedicates its supply chain management efforts to developing perfect cooperation between suppliers, port agents, and logistics providers. The company delivers dependable outbound freight transport through strategic partnerships and secures material acquisition services. The company applies predictive analytics together with real-time inventory tracking to optimize capacity usage based on demands, resulting in savings for expenses and service lengths.

PH Navigation prioritizes managing risks in its supply chain management approach. To prevent interruptions, the business continuously monitors market environmental and geopolitical trends. In an emergency, the company implements contingency plans that include backup suppliers and alternative transportation routes.

PH Navigation achieves outstanding service delivery, operational excellence, and supply chain agility through effective operations management combined with leading information technology and strong supply chain strategies in the marine logistics industry.

2.6 Industry and Competitive Analysis

2.6.1 Porter's Five Forces Analysis

Competitive Rivalry:

The shipping industry competes intensely with firms that provide equivalent dry bulk and maritime logistics services. Market competition exists between domestic and international shipping firms, including PH Navigation. Operational supremacy, cost-effectiveness, and dependability give PH Navigation a winning advantage in the competitive market. The company advances its market position by maintaining a modern fleet while using technology to boost operational efficiency. Price disagreements and shifting market requirements create intense market competition between competitors within the shipping industry.

Threat of New Entrants:

New competitors' entry into the marine business is possible. However, entry into this sector requires substantial capital investments to purchase infrastructure and boats because of hurdles that slow down the procedure. PH Navigation boosts its competitive edge by using supplier relations and customer networks while having deep knowledge of risk management and compliance, which makes it difficult for new competitors to match their success. Technological progress has proven to reduce the challenges that originally existed.

Bargaining Power of Suppliers:

Shipbuilders, maintenance contractors, and fuel suppliers possess an intermediate degree of power when negotiating with PH Navigation. To minimize these risks, PH Navigation builds enduring business partnerships and bulk purchase agreements. Gas price management, along with supply chain disturbances, directly impacts operational costs.

Bargaining Power of Buyers:

Because there are so many transportation providers, buyers, including manufacturers, exporters, and logistics companies, have a lot of negotiating leverage. By offering outstanding service quality, timely delivery, and reasonable prices, PH Navigation addresses this problem and makes it easier to attract and retain customers.

Threat of Substitutes:

There is very little chance of substitution. While rail and air transportation are feasible options, they are not cost-effective for large quantities of freight. Because of its experience with dry bulk shipping, PH Navigation is a favored choice for moving large quantities of goods across long distances.

2.6.2 SWOT Analysis

Strengths	Weaknesses
• On-time delivery and cost-effective operations are ensured by PH Navigation's excellent route optimization and vessel scheduling. • Real-time monitoring, fuel optimization, and data-driven decision-making are all made possible by sophisticated information systems. • built a solid reputation as a dependable and consistent shipping service provider in the maritime industry. • Its market footprint and development prospects are strengthened by increasing its presence in international shipping routes, especially those in the USA. • Its brand reputation is improved by its commitment to sustainable practices and adherence to international marine norms.	• The company's profitability may be impacted by rising fuel and maintenance expenses. • Revenue streams are restricted to specific market areas due to limited variety in service offerings. • Revenue consistency may be impacted by economic downturns and fluctuating demand in the shipping industry. • There is a risk of revenue concentration when there is a significant reliance on a small number of core clients.

Opportunities	Threats
• Examining routes in Asia and Africa might yield new sources of income. • Blockchain technology and artificial intelligence combined with logistics can increase operational transparency and efficiency. • Gaining market share can be achieved by diversifying into other transportation markets, such as containerized freight. • Reliable shipping services are in high demand as a result of the need for effective logistics brought on by the growth of international e-commerce.	• Market share is weakened by competition from both new and established companies in the marine industry. • Stricter safety and environmental regulations might increase the cost of compliance. • Global operations are threatened by trade disruptions, geopolitical crises, and economic uncertainty. • Delays and operational challenges may arise from pandemics, natural catastrophes, and geopolitical conflicts.

2.7 Conclusion

Leading marine logistics provider PH Navigation has a solid operating foundation and organizational structure. Its democratic leadership style fosters collaboration, diversity, and creativity, which raises worker happiness and improves operational effectiveness. The business ensures effective operations, timely delivery, and increased customer happiness by utilizing cutting-edge technology and data-informed decision-making. Its image as a dependable service provider is strengthened by its emphasis on sustainable practices and adherence to international regulations.

PH Navigation has difficulties such rising operating expenses, market rivalry, and economic issues despite its operational expertise, worldwide presence, and customer service. To guarantee continued growth and market leadership, these problems need for constant improvement and strategic planning. With constant innovation and service development, PH Navigation is well-positioned to keep its competitive edge and grow steadily in the fast-paced marine logistics

industry. By strategically focusing on market expansion, risk management, and diversification, the business will be able to effectively adapt to changing trends and seize new possibilities.

2.8 Recommendation

- ✓ Extend activities to include containerized or specialized cargo services in addition to dry bulk transportation. As a result, there would be less dependence on a single market segment and more sources of income.
- ✓ To improve productivity, transparency, and customer satisfaction, further integrate AI, blockchain, and predictive analytics into operations.
- ✓ To take advantage of growing trade channels and diversify market exposure, focus on breaking into new markets in Asia, Africa, and Latin America.
- ✓ Use strategies to reduce operating costs, such as implementing fuel-efficient equipment and investigating renewable energy sources for boats.
- ✓ Create more thorough backup preparations to lessen the impact of supply chain interruptions, natural disasters, and geopolitical unrest.
- ✓ Establish regular training programs to equip workers with up-to-date knowledge and abilities, keeping them competitive and flexible in response to changes in the business.
- ✓ To increase the customer base and lessen the risk of revenue concentration, strengthen relationships with existing clients while seeking new partnerships.
- ✓ To maintain a competitive edge and draw in eco-conscious customers, keep highlighting sustainable practices and adherence to international environmental regulations.

Chapter 3

Uncertainty Reduction on Inventory Management of PH Navigation

3.1 Introduction

However, inventory management is a critical prerequisite to achieving operational efficiency and customer satisfaction in the maritime and logistics sector. Since its establishment on July 1, 2019 (PH Navigation, 2024), PH Navigation has been one of the leading dry bulk shipping cargo firms dedicated to providing superior tonnage services in Bangladesh. The unpredictable nature of international supply chains, variations in demand, and delivery challenges create significant uncertainty about what must be stocked. These risks can lead to stockouts or excess stocks, negatively impacting service levels and financial performance (Gain Systems, 2023).

Uncertainty in inventory management is due to many factors, including variable client demand, lead time, and broken supply chains. Supply chain unpredictability creates inefficiencies—higher holding costs and lower responsiveness to market demand（Gain Systems, 2023）. Safety stock management is commonly used for tackling such uncertainties where organizations keep inventory as a buffer to prevent disruptions in operations (PerfomanSC, 2022). This approach provides security so unexpected fluctuations in demand or supply do not disturb the business continuity massively.

One way to do that is through predictive analytics and AI-powered forecasting in inventory management. With advanced technologies, organizations can track demand patterns, identify supply chain complexities, and dynamically adjust inventory levels (Gain Systems, 2023). Whether individual stores or sales at a specific location, AI-led forecasting helps with demand sensing, which allows businesses to adjust their inventory levels proactively based on emerging trends. These technological solutions enhance decision-making and reduce reliance on human inventory tracking, often prone to error and inefficiency.

To minimize the impact of uncertainty in inventory management, companies like PH Navigation are hopeful for the future delivery of accuracy with a combination of safety stock models, predictive analytics and tracking technology. We need to get the maritime sector used to sprinkling in digital technology and event-driven data analysis so that there is supply chain resilience and seamless service for any industry. Using all these strategies, PH Navigation aligns with global

inventory management to improve its inventory performance, avoiding any risks to enhance the overall service delivery (Performan SC, 2022; PH Navigation, 2024).

3.2 Literature Review

Even in the maritime sector, where uncertainties arising from demand fluctuations, supply chain disruptions, and geopolitical conflicts make inventory management crucial for stability (Gain Systems, 2023) and the role of operational stability also has a clearer dimensionality in the medical field, where inventory management is essential in critical medical equipment application. Recent events worldwide, such as the Houthi rebel attacks in the Red Sea, significantly draw on and slow down maritime operations, forcing vessels to take longer routes and extending journey times (The Times, 2024). Droughts and other environmental factors have affected critical waterways such as the Panama Canal, crossing up and down freight starves (World Bank, 2024). These interruptions highlight the need for uncertainty mitigation measures in inventory management, which is also increasing.

One of the major solutions to address these apprehensions is the use of predictive analytics and AI-powered forecasting. By analysing live data generated from multiple sources, such as market trends, economic indicators and weather conditions, companies can enhance the accuracy of their demand forecasts and mitigate systematic uncertainty in inventories (GEP, 2024). These can be augmented by AI-driven models, which can find patterns and trends that standard models might overlook, allowing organisations to adjust inventory levels in anticipation of disruptions (Netstock, 2024). The fundamental approach of safety stock management allows businesses to hold reserve inventory, safeguarding their operations from abrupt supply chain disruptions and preserving constant business performance (PerformanSC, 2022). Marine logistics benefits strongly from this approach because external elements like port congestion and shipping delays commonly impact supply chain lead times.

Further, digital transformation and automation are necessary strategies to improve inventory visibility and decrease uncertainty. Organizations have taken to trending technologies, including cloud-based inventory management systems, IoT (Internet of Things) sensors, and blockchain technology, to monitor shipment in real-time, thereby mitigating delays and inefficiencies (Newcastle Systems, 2024). Next, such technologies increase operational transparency and help make informed decisions by providing timely and exact knowledge of inventory levels and the

capacity of spare parts (Sedna, 2024). Dynamic sourcing and flexible logistics planning are now vital agile supply chain strategies to enable companies to react as quickly as possible to market conditions and offset sudden disruptions-related risks (GEP, 2024).

As automation and digitization progress within the marine industry, companies such as PH Navigation desperately need innovative inventory management systems to reduce uncertainty and maximize efficiency. Autonomous vessels, digital twins, and fully automated port operations are among the trends transforming inventory management, reducing human error risk, and strengthening supply chain resilience (Sedna, 2024). With the help of AI-driven forecasting, safety stock methods, digital transformation, and agile methods, PH Navigation could design its inventory management system and bring down the adverse effects of uncertainty. These improvements enhance operators' operational efficiency and ability to address the demands of today's global trade.

3. Research Methodology

3.1 Research Design

The method applied in this study is a descriptive type used to determine the effect of strategies for reducing uncertainty in stock management at PH Navigation. In this research, the pitfalls of PH Navigation in minimizing inventory uncertainty and other strategies utilized to reduce the risk are compared using descriptive analysis. The study seeks to integrate qualitative and quantitative data to offer a comprehensive approach to the dynamics of inventory management within the maritime logistics sector.

Qualitative vs. Quantitative Approach

Qualitative expert interviews, case study data, and quantitative PH Navigation inventory records and operational metrics form the basis for this research.

Qualitative Approach: The qualitative research involved conducting semi-structured interviews with individuals in supply chain management and logistics and financial analysis at PH Navigation. The research enables an understanding of inventory uncertainty challenges with their solutions and strategic and decision-making approaches for maximizing operational efficiency. The open-ended questions in audio interviews create qualitative responses which enable participants to freely express their thoughts regarding these practices and experiences of their own accord.

Quantitative Approach: Researchers analyze historical inventory documents as part of the quantitative method to study inventory amounts, mar, ket fluctuation, and delivery period variation alongside supply chain interruptions. The research will use trend and variance analysis techniques to test inventory uncertainty reduction strategies statistically. The analysis will identify optimal methods by measuring inventory performance metrics, including inventory turnover ratio, stockout rates, and order accuracy.

Case Study Methodology Focused on PH Navigation

This paper examines PH Navigation's inventory management system through a case study approach that details essential uncertainty and risk elements and presents specific reduction strategies. The research conducts an intensive analysis of specific uncertainties affecting PH Navigation's inventory operations, including supply chain failures, market fluctuations, and environmental and geopolitical risk factors. The assessed factors will help investigate their impact on PH Navigation's inventory management system uncertainties related to demand forecasting estimation through analytics, safety stock practices, and digitalization plans for real-time inventory tracking. Additionally, the impact of such uncertainty reduction strategies will be quantified using a detailed examination of past inventory records, operational performance logs, and financial results, tracking metrics such as inventory turnover, lead-time variance, and stock availability. Using a descriptive-analytical method, this case study provides an actual case insight into the correlation between uncertainty and inventory management in maritime logistics. It aims to identify appropriate solutions to enhance the efficiency of operations. This research will be helpful in academic studies as well as practical applications in the field of maritime industry due to the inclusion of qualitative insights of industry professionals supported by quantitative data analysis to get a complete picture of the inventory uncertainties.

3.2 Data Collection Methods

This mixed-methods study uses primary and secondary data collection methods to provide a holistic account of uncertainty reduction in inventory management at PH Navigation. The data up until October 2023 still reflect all the key metric data, providing a well-rounded approach composed of qualitative insights from industry professionals as well as quantitative evidence from historical records.

Primary Data Collection

Primary data will be collected through interviews and surveys to gain direct insights from key stakeholders involved in PH Navigation's inventory management process.

- **Interviews with Inventory Managers and Supply Chain Executives**

The second phase will consist of semi-structured interviews involving inventory managers, supply chain executives, and logistics coordinators working with PH Navigation. These interviews will delve into the primary drivers of inventory uncertainty, the difficulties encountered in mitigating risks, and the methods used to enhance inventory accuracy. These interviews, conducted in in-depth and open-ended formats, will cover topics of decision-making processes, technological adoption, and risk management frameworks as they relate to the company's inventory management system.

- **Surveys to Understand Current Inventory Management Challenges**

Apart from interviews, structured surveys will be conducted with PH Navigation employees working in logistics, procurement, and warehouse management. This survey will contain closed- and open-ended questions to gather quantitative and qualitative data about our central research questions about inventory forecasting accuracy, supply chain disruptions, lead time variability, and the effectiveness of risk mitigation strategies. Responses will help quantify the frequency of inventory uncertainties impacting operations, the level of inefficiency created, and the perceived effectiveness of solutions that have been tried.

Secondary Data Collection

Secondary data will enhance primary data by offering historical context, industry benchmarks, and established research findings about inventory management uncertainty in maritime logistics.

- **Company Records, Financial Reports, and Industry Benchmarks**

The analysis will assess how uncertainty impacts operational efficiency using internal company reports comprising inventory performance reports, historical stock data, order fulfilment rates and financial reports. The paper will review key financial metrics like inventory turnover ratio, carrying costs, and costs due to supply chain disruptions to understand the economic implications of inventory uncertainties. A comparative analysis of the inventory management strategies of PH Navigation with industry best practices will be derived from industry benchmark reports of global maritime logistics firms.

- **Previous Research Papers and Case Studies**

The study will review academic research, case studies, and white papers from the industry to examine successful methods of reducing inventory uncertainties. It will also examine industry strategies that maritime companies have adopted to reduce inventory uncertainties through technological implementation, predictive analytical methods, and rapid supply chain responsiveness.

Combining primary and secondary data collection methods will give this study both strong analysis potential and evidence-based suggestions to address PH Navigation's inventory uncertainty.

3.3 Data Analysis Techniques

Estimations given here have been made to give a preview of the possibility of enhancing uncertainty-reducing strategies into the framework of PH Nav to improve inventory management. These calculations are crucial for forecasting the different operational scenarios that would assist in decreasing the level of uncertainty in formulating strategies regarding inventory.

Two technical aspects have been jointly identified as the most important ways to deal with uncertainty: demand forecasting and safety stock control. Thus, safety stocks are calculated based on elements of lead time, varying demand rates, and disruptions in the supply chain. Through employing safety stock, PH Navigation can control the rate of fluctuations in demand or changes in the flow of the supply chain to avoid holding large stocks or running out of stock, a factor that causes a business to cease operations.

Date		Vessel Status											
		Time						Obs.Distance	Eng Dis	Obs. Speed	Gen.Avg.Spd	Position	
	TYPE	SMT	UTC	REPORT PERIOD (HOURS)	Port /Sea	Country	Port Activity					Lat.N	Long. E
Thu, 31/Oct/2024	AT_SEA	12:00	4:00	24	Sea			254	302.29	10.58	10.6	° 09'00''	106° 01'00''
Fri, 01/Nov/2024	EOSP	0:00	16:00	12				127	151.13	10.58	10.59	1° 22'00''	104° 23'00''
Fri, 01/Nov/2024	ARRIVAL	4:54	20:54	4.9		Singapore	Bunkering					01-17.16' N	103-57.02' E
Fri, 01/Nov/2024	ANCHOR	12:00	4:00	7.1		Singapore	Bunkering						
Sat, 02/Nov/2024	ANCHOR	5:18	21:18	17.3		Singapore	Bunkering						
Sat, 02/Nov/2024	DEPARTURE	8:00	0:00	2.7		Singapore							
Sat, 02/Nov/2024	AT_SEA	12:00	4:00	4	Sea			39	50.39	9.75	9.75	1° 29'00''	103° 09'00''
Sun, 03/Nov/2024	AT_SEA	12:00	4:00	24	Sea			251	302.35	10.46	10.36	4° 02'00''	99° 51'00''
Mon, 04/Nov/2024	AT_SEA	12:00	5:00	25	Sea			235	273.35	9.4	9.91	5° 45'00''	96° 31'00''

Tue, 05/Nov/2024	**AT_SEA**	12:00	5:00	24	Sea			233	280.94	10.45	10.53	5° 45'00''	92° 43'00''
Wed, 06/Nov/2024	**AT_SEA**	12:00	5:00	24	Sea			241	302.29	10.04	10.41	5° 46'00''	88° 41'00''
Thu, 07/Nov/2024	**AT_SEA**	12:00	6:00	25	Sea			253	314.92	10.12	10.35	5° 48'00''	84° 27'00''
Fri, 08/Nov/2024	**AT_SEA**		6:00	24	Sea			250	292.54	10.42	10.36	5° 48'00''	80° 16'00''
Sat, 09/Nov/2024	**AT_SEA**	12:00	6:00	24	Sea			243	292.57	10.13	10.33	8° 01'00''	76° 55'00''
Sun, 10/Nov/2024	**AT_SEA**	12:00	6:00	24	Sea			256	292.54	10.67	10.37	11° 35'00''	74° 48'00''
Mon, 11/Nov/2024	**AT_SEA**	12:00	6:30	24.5	Sea			258	298.67	10.53	10.39	15° 37'00''	73° 13'00''
Tue, 12/Nov/2024	**AT_SEA**	8:18	2:48	20.3	Sea			204	244.8	10.05	10.36	18° 53'00''	72° 36'00''
Tue, 12/Nov/2024	**EOSP**	9:42	4:12	1.5	Sea	India						18° 56'00''	72° 42'00''
Tue, 12/Nov/2024	**ARRIVAL**	12:00	6:30	2.3	Port	India							
Wed, 13/Nov/2024	**ANCHOR**	12:00	6:30	24	Port	India	Discharging						
Wed, 13/No	**ANCHOR**	18:30	13:00	6.5	Port	India	Discharging						

v/2024													
Wed, 13/Nov/2024	**ANCHOR**	23:42	18:12	5.2	Port	India	Discharging					18° 54'12''	72° 52'00''
Thu, 14/Nov/2024	**ANCHOR**	12:00	6:30	12.3	Port	India	Discharging						
Fri, 15/Nov/2024	**ANCHOR**	12:00	6:30	24	Port	India	Discharging						
Sat, 16/Nov/2024	**ANCHOR**	5:36	0:06	17.6	Port	India	Discharging						
Sat, 16/Nov/2024	**ANCHOR**	7:24	1:54	1.8	Port	India	Discharging					18° 32'00''	72° 51'00''
Sat, 16/Nov/2024	**ANCHOR**	12:00	6:30	4.6	Port	India	Discharging						
Sun, 17/Nov/2024	**ANCHOR**	12:00	6:30	24	Port	India	Discharging						
Mon, 18/Nov/2024	**ANCHOR**	11:12	5:42	23.2	Port	India	Discharging						
Mon, 18/Nov/2024	**DEPARTURE**	16:00	10:30	4.8	Sea								
Tue, 19/Nov/2024	**AT_SEA**	10:30	5:00	18.5	Sea			110	175.39	5.95	5.95	20° 52'00''	72° 52'00''
Tue, 19/Nov/2024	**EOSP**	11:24	5:54	0.9	Sea							20° 53'00''	72° 38'00''

Tue, 19/Nov/2024	**ANCHOR**	12:00	6:30	0.6	Sea								
Tue, 19/Nov/2024	**ANCHOR**	14:30	9:00	2.5	Sea								
Tue, 19/Nov/2024	**BERTHING**	18:12	12:42	3.7	Port	India	Loading						
Wed, 20/Nov/2024	**BERTHING**	12:00	6:30	17.8	Port	India	Loading						
Thu, 21/Nov/2024	**BERTHING**	12:00	6:30	24	Port	India	Loading						
Fri, 22/Nov/2024	**BERTHING**	12:00	6:30	24	Port	India	Loading						
Sat, 23/Nov/2024	**BERTHING**	12:00	6:30	24	Port	India	Loading						
Sun, 24/Nov/2024	**BERTHING**	12:00	6:30	24	Port	India	Loading						
Mon, 25/Nov/2024	**BERTHING**	12:00	6:30	24	Port	India	Loading						
Tue, 26/Nov/2024	**BERTHING**	9:42	4:12	21.7	Port	India	Loading						
Tue, 26/Nov/2024	**DEPARTURE**	11:30	6:00	1.3	Port	India							
Wed, 27/No	**AT_SEA**	12:00	6:30	0.5	Sea			5	6.22	10	10	20° 54'00''	72° 35'00''

v/2024													
Wed, 27/Nov/2024	**AT_SEA**	12:00	6:30	24	Sea			286	302.29	11.92	11.88	20° 51'00''	68° 11'00''
Thu, 28/Nov/2024	**AT_SEA**	12:00	7:00	24.5	Sea			293	308.62	11.96	11.92	22° 30'00''	63° 14'00''
Fri, 29/Nov/2024	**AT_SEA**	12:00	8:00	25	Sea			290	314.89	11.6	11.81	24° 08'00''	58° 18'00''
Fri, 29/Nov/2024	**EOSP**	20:00	16:00	8	Sea			92	175.39	11.5	11.78	24° 36'00''	56° 44'00''
Fri, 29/Nov/2024	**ARRIVAL**	20:00	16:00	0	Port	Oman	Discharging					24° 36'00''	56° 40'00''
Sat, 30/Nov/2024	**ANCHOR**	12:00	8:00	16	Port	Oman	Discharging						

The following calculations include other inventory turnover ratios as well as stockout rates, as well as KPIs required for evaluating the enhancement of the reduction of uncertainty. These calculations estimate the performance of inventory management and determine the speed at which stock turnover and restocking occur. A higher turnover rate gives insights into the proper stocking of inventories, while a lower stockout rate gives insight into the match between inventory and demand.

Also, most of the calculations involve the use of predictive demand models in light of past and future data, seasonal variations, and trends. By incorporating these techniques, PH Navigation should be well placed to make a data-based decision on changes in the stock status needed to meet the forecasted market demand and, in turn, avoid under- or overstocking.

In these cases, another crucial element is real-time data analysis. With this kind of inventory monitoring, PH Navigation can ensure that it is adjusting the inventory according to its dynamic nature in relation to the market and other conditions affecting its supply chain.

These calculations and the strategies they represent are important for achieving the company's objective of improving operational effectiveness and decreasing expenses linked to the uncertain nature of global society, as well as for guaranteeing the proper functioning of PH Navigation's supply chain.

Estimations given here have been made to give a preview of the possibility of enhancing uncertainty-reducing strategies into the framework of PH Nav to improve inventory management. These calculations are crucial for forecasting the different operational scenarios that would assist in decreasing the level of uncertainty in formulating strategies regarding inventory.

Two technical aspects have been jointly identified as the most important ways to deal with uncertainty: demand forecasting and safety stock control. Thus, safety stocks are calculated based on elements of lead time, varying demand rates, and disruptions in the supply chain. Through employing safety stock, PH Navigation can control the rate of fluctuations in demand or changes in the supply chain flow to avoid holding large stocks or running out of stock, a factor that causes a business to cease operations.

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These calculations and the strategies they represent are important for achieving the company's objective of improving operational effectiveness and decreasing expenses linked to the uncertain nature of global society, as well as for guaranteeing the proper functioning of PH Navigation's supply chain.

FW (MT)	M/Eng		A/Eng		Boiler		Others		Sea Cons		24-hr Average		Total Cons		ROB	
	VLSFO	LSMGO	VLSFO	LSMGO	VLSFO	LSMGO	VLSFO	LSMGO	VLSFO	LSMGO	VLSFO	LSMGO	VLSFO	LSMGO	VLSFO	LSMGO
	22.21		1.54	0.1					23.75	0.1	23.75	0.1			125.24	66.97
	11.1		0.77	0					11.87	0	23.74	0			113.37	66.97
151															111.34	66.77
149	0	0	0.45	0	0.32	0									608.07	66.77
	0	0	1.1	0.1	0.78	0									606.19	66.67
145	1.5	0	0.2	0	0.12										604.37	66.67
144	3.6	0	0.25	0.1					3.85	0.1	23.1	0.1			600.52	66.52
145	22.24	0	1.56	0.1					23.8	0.1	23.8	0.1			576.72	66.47
145	20.1	0	1.61	0.1	0.14				21.85	0.1	20.97	0.1			554.87	66.37
145	20.71	0	1.56	0.1	0.12				22.39	0.1	24.09	0.1			532.48	66.27
146	22.25	0	1.55	0.1					23.8	0.1	23.8	0.1			508.68	66.17
147	22.5	0	1.6	0.1					24.1	0.1	23.1	0.1			484.58	66.07
148	21.4	0	1.55	0.1					22.95	0.1	22.95	0.1			461.63	65.97
150	21.2	0	1.5	0.1					22.7	0.1	22.7	0.1			438.93	65.87
151	21.15	0	1.5	0.1					22.65	0.1	22.65	0.1			416.28	65.77
151	21.25	0	1.52	0.1					22.77	0.1	22.3	0.1			393.51	65.67
150	17.1	0	1.35	0.1					18.45	0.1	21.81	0.1			375.06	65.57
150															373.95	65.57
150															373.7	65.57
142			3.05	0.2	1.05	0							4.1	0.2	369.6	65.37
140			0.5	0	0.3	0							0.8	0	368.8	65.37

138															364.59	65.37
130	3.56	0	3.15	0.2	1.15	0							7.86	0.2	361.74	65.17
123			4.5	0.2	1.12	0							5.62	0.2	356.12	64.97
120			3.3	0.1	0.8	0							4.1	0	352.02	64.87
120															350.72	64.87
115			0.8	0.1	0.22	0							1.02	0.1	349.7	64.77
203			4.5	0.2	1.12	0							5.62	0.2	344.08	64.57
191			2.98	0.1	1.051	0							4	0.1	340.07	64.48
189	0.8	0	0.26	0	0.04	0							1.1	0	338.97	64.48
179	8.25	0	1.65	0.1					9.9	0.1	12.84	0.1			329.07	64.38
181															328.53	64.38
181			0.3		0.02								0.05		328.48	64.38
181			0.16		0.12								0.28		328.2	64.38
179															326.04	64.18
173			3.18	0.2	0.78	0							3.96	0	322.08	64.18
168			4.5	0.3	1.07	0							5.57	0	317.477	64.192
156			4.507	0.202	1.1	0							5.607	0.202	311.87	63.99
148			3.87	0.202	1.08	0							4.95	0.202	306.92	63.79
144			3.5	0.2	1.1	0							4.6	0.02	303.07	63.55
131			3.15	0.2	1.06	0							4.21	0.2	298.12	63.39
125			2.47	0.2	1.01								3.48	0.2	294.64	63.19
125	0.9		0.12												293.62	63.19
125	0.4		0.03						0.43		20.64				293.19	63.19

124	22.4		1.55	0.1					23.95	0.1	23.95	0.1			269.24	63.09
125	22.8		1.6	0.1					24.4	0.1	23.9	0.1			244.84	62.99
127	23.2		1.6	0.1					24.8	0.1	23.8	0.1			220.04	62.89
126	7.5		0.4	0.1					7.9	0.1	23.7	0.1			212.14	62.89
126															211.88	62.69
122			0.92		0.55								1.47	0	210.41	62.69

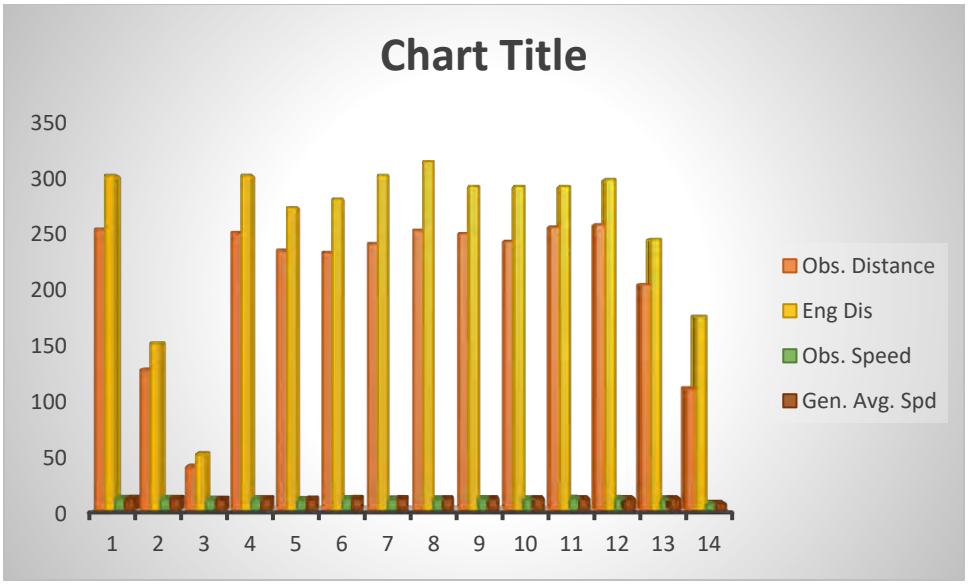
Sea Cons (Sea Consumption) and Average consumption 24H mean the amount and frequency of fuel usage. These indicators are beneficial in determining the ship's operational efficiency in terms of the association between engine load, speed, and fuel consumption. By evaluating this data, PH Navigation will be able to identify exemplary fuel efficiency techniques like slow steaming or alteration of route depending on the weather patterns available in a vessel to keep the fuel usage and bunker stock under control.

The ROB values represent the amount of fuel on board at a particular time, and with this value, one can monitor the fuel situation more dynamically. These figures are crucial for revising the voyage plans and keeping track of the actual stock of fuel so that the vessel does not end up stranded due to a lack of fuel supply and, hence, there are no operational interferences.

In conclusion, it has been evidenced that these calculations are helpful in improving most inventory control and optimizing asset usage. This means that by closely observing the rates of fuel consumption, stock level, and operations' overall performance, PH Navigation can minimize uncertainty and enhance decision-making in relation to fuel management and other related work plans.

Obs.Distance	Eng Dis	Obs. Speed	Gen.Avg.Spd
254	302.29	10.58	10.6
127	151.13	10.58	10.59
39	50.39	9.75	9.75
251	302.35	10.46	10.36
235	273.35	9.4	9.91
233	280.94	10.45	10.53
241	302.29	10.04	10.41
253	314.92	10.12	10.35
250	292.54	10.42	10.36
243	292.57	10.13	10.33
256	292.54	10.67	10.37
258	298.67	10.53	10.39
204	244.8	10.05	10.36
110	175.39	5.95	5.95

This table contains quantized information on the transportation and logistics-related factors concerning PH navigation's supply chain performance. The variables used in the columns consist of Observed Distance (Obs. Distance), Engine Displacement (Eng Dis), Observed Speed (Obs. Speed), and General Average Speed (Gen. Avg. Spd). These parameters indicate analysis relating to transportation, most probably for the seas or logistic movements. Observed Distance might refer to the Distance covered during the transportation process. At the same time, Engine Displacement suggests the power that could be associated with the engine of the vehicle or vessel used for moving. Observed Speed measures the Speed at given time intervals, and General Average Speed gives an overall figure crucial in determining the performance.



The table encompasses several records and shows a variation in Speed and Distance, which can be due to factors such as traffic, weather conditions, fuel, and delays in the distribution of the supply chain. Some have very similar numbers; this means there is a balance, and they are enduring high levels of productivity. Some other areas have different figures, meaning some inefficiency or management problems could occur.

The accumulation of such structured data enables supply chain managers to estimate transit time, fuel and energy consumption, and better plan and schedule. If important discrepancies are noticed, they may be signs of a constrained transport channel or low overall vehicle efficiency.

The figure presented in the table helps supply chain management, where precise information will help managers and decision-makers if there is a need to make changes and adjust the transport schedule so that the supply chain movement gets a smooth flow. Recognizing and responding to these conditions should increase the likelihood of delivering the right pharmaceutical in the correct dosage to the right patient in the right timeframe, as desired in PH navigation.

FW (MT)	M/Eng		A/Eng		Boiler		Others		Sea Cons		24-hr Average		Total Cons		ROB		FW				
	VLSFO	LSMGO	VLSFO	LSMGO	VLSFO	LSMGO	VLSFO	LSMGO	VLSFO	LSMGO	VLSFO	LSMGO	VLSFO	LSMGO	VLSFO	LSMGO	FWG RH	Cap	Pro	Cons	ROB
	22.21		1.54	0.1					23.75	0.1	23.75	0.1			125.24	66.97	24	15	8	6	150
	11.1		0.77	0					11.87	0	23.74	0			113.37	66.97	12	15	4	3	151
151															111.34	66.77					151
149	0	0	0.45	0	0.32	0									608.07	66.77					149
	0	0	1.1	0.1	0.78	0									606.19	66.67					147
145	1.5	0	0.2	0	0.12										604.37	66.67					145
144	3.6	0	0.25	0.1					3.85	0.1	23.1	0.1			600.52	66.52	3	15	0	1	144
145	22.24	0	1.56	0.1					23.8	0.1	23.8	0.1			576.72	66.47	24	15	8	7	145
145	20.1	0	1.61	0.1	0.14				21.85	0.1	20.97	0.1			554.87	66.37	21.7	15	7	7	145
145	20.71	0	1.56	0.1	0.12				22.39	0.1	24.09	0.1			532.48	66.27	22.3	15	7	7	145
146	22.25	0	1.55	0.1					23.8	0.1	23.8	0.1			508.68	66.17	24	15	8	7	146
147	22.5	0	1.6	0.1					24.1	0.1	23.1	0.1			484.58	66.07	25	15	8	7	147
148	21.4	0	1.55	0.1					22.95	0.1	22.95	0.1			461.63	65.97	24	15	8	7	148
150	21.2	0	1.5	0.1					22.7	0.1	22.7	0.1			438.93	65.87	24	15	8	6	150
151	21.15	0	1.5	0.1					22.65	0.1	22.65	0.1			416.28	65.77	24	15	8	7	151
151	21.25	0	1.52	0.1					22.77	0.1	22.3	0.1			393.51	65.67	24.5	15	8	8	151
150	17.1	0	1.35	0.1					18.45	0.1	21.81	0.1			375.06	65.57	20.3	15	6	7	150
150															373.95	65.57					150
150															373.7	65.57					150
142			3.05	0.2	1.05	0							4.1	0.2	369.6	65.37					142
140			0.5	0	0.3	0							0.8	0	368.8	65.37					140
138															364.59	65.37					138
130	3.56	0	3.15	0.2	1.15	0							7.86	0.2	361.74	65.17					130
123			4.5	0.2	1.12	0							5.62	0.2	356.12	64.97					123
120			3.3	0.1	0.8	0							4.1	0	352.02	64.87					120
120															350.72	64.87					120
115			0.8	0.1	0.22	0							1.02	0.1	349.7	64.77					115
203			4.5	0.2	1.12	0							5.62	0.2	344.08	64.57					203
191			2.98	0.1	1.051	0							4	0.1	340.07	64.48					191
189	0.8	0	0.26	0	0.04	0							1.1	0	338.97	64.48					189
179	8.25	0	1.65	0.1					9.9	0.1	12.84	0.1			329.07	64.38	0	15	0	10	179
181															328.53	64.38					181
181			0.3		0.02								0.05		328.48	64.38					181
181			0.16		0.12								0.28		328.2	64.38					181
179															326.04	64.18					179
173			3.18	0.2	0.78	0							3.96	0	322.08	64.18					173
188			4.5	0.3	1.07	0							5.57	0	317.477	64.192					188
156			4.507	0.202	1.1	0							5.607	0.202	311.87	63.99					156
148			3.87	0.202	1.08	0							4.95	0.202	306.92	63.79					148
144			3.5	0.2	1.1	0							4.6	0.02	303.07	63.55					144

Based on looking at the table and having prior knowledge of fuel management in the maritime supply chain, it can be deduced that it provides detailed data on fuel consumption. It records the amount and kinds of fuels used in the main engine (M/Eng), auxiliary engine (A/Eng), boiler, and other additional units and in two types of fuel: VLSFO (Very Low Sulfur Fuel Oil) and LSMGO (Low Sulfur Marine Gas Oil).

The 24-hour Average and Total Consumption will indicate the fuel consumed in a specific period, which is essential for planning, controlling, and preventing fuel degradation in marine operations. Supply chain managers can estimate fuel requirements, wastage, and the best time to order based on these consumption patterns.

Another parameter of Oil Measurement includes Remaining Onboard, abbreviated as ROB, which means the amount of stock available on the ship. This is important to avoid a situation whereby the vessels do not have any fuel sources left, which hampers the flow of supplies. Lastly, the FW (Fresh Water) may show the amount of fresh water to be used in operations, which relates to resource control on board a ship.

The availability of several fuel options and the specification of fuel usage indicate the significance of uncertainty minimization in the supply chain. This way, the team is able to prevent scenarios such as a lack of fuel, delay of delivery, or inefficiency in its own operations.

With the help of detailed entries on the table and daily fuel usage for each system, the operators can get the necessary information about the condition of their vessels. These include decisions informed by quantitative details that are important for making adjustments to enhance operations, control fuel consumption, and deliver within the scope of the PH navigation. In this way, by answering these data points, the uncertainty relative to the shipping improves, and the supply chain becomes more reliable.

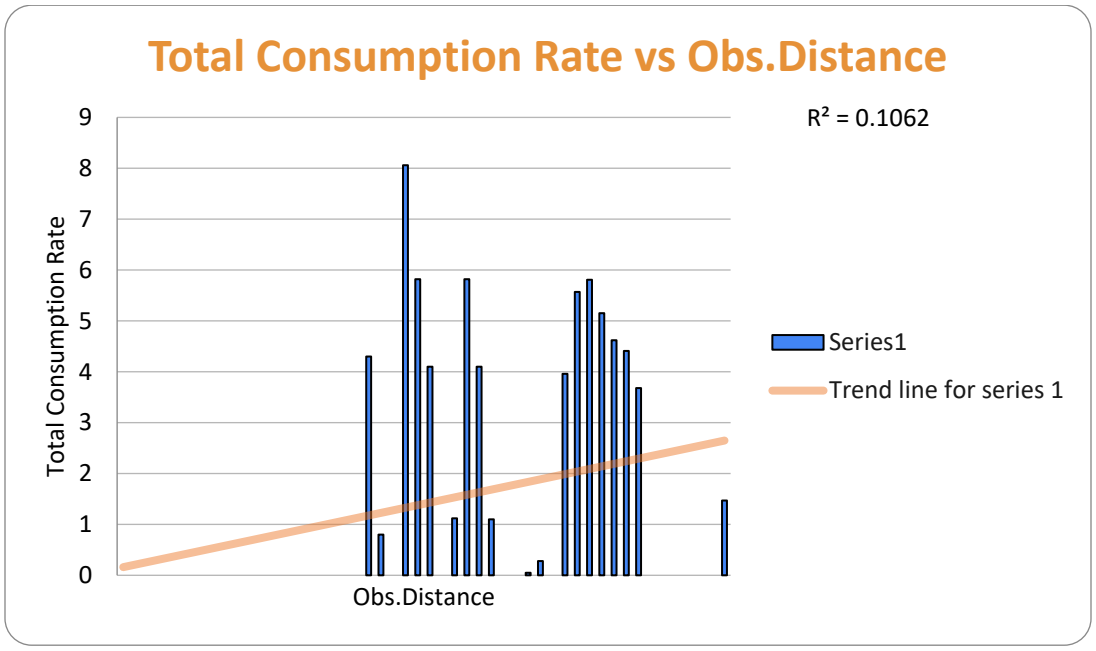
3.4 Findings and Analysis

The kind of data analysis conducted for this particular study has helped in understanding some of the critical issues regarding the company's inventory management, known as PH Navigation, regarding uncertainty factors. Many factors are inherent to the maritime logistics industry, such as vagaries, unpredictable demand, supply chain disruptions, or geopolitical factors' impact. These risks can go a long way in affecting inventory levels, leading to stock out or even over inventory, which are dangerous to the companies' efficiency and profitability.

- **Key Findings:**
- **Fuel Consumption Patterns:** The comparison of fuel consumption of VLSFO and LSMGO has unveiled that the consumption is very much related to the requirements needed for operations in the PH Navigation. Signs such as the distance observed, the engine size, and the observed speed also show the likelihood of fuel consumption at the vessel's speed and load. The consumption record of the daily fuel consumed indicates that speed and the route a ship is planning to take can help adjust the daily fuel efficiency depending on the prevailing weather conditions and operational constraints.

Date	Obs.Distance	Total Consumption Rate
Thu, 31/Oct/2024	254	
Fri, 01/Nov/2024	127	
Fri, 01/Nov/2024		
Fri, 01/Nov/2024		
Sat, 02/Nov/2024		
Sat, 02/Nov/2024		
Sat, 02/Nov/2024	39	
Sun, 03/Nov/2024	251	
Mon, 04/Nov/2024	235	
Tue, 05/Nov/2024	233	
Wed, 06/Nov/2024	241	
Thu, 07/Nov/2024	253	
Fri, 08/Nov/2024	250	
Sat, 09/Nov/2024	243	
Sun, 10/Nov/2024	256	
Mon, 11/Nov/2024	258	
Tue, 12/Nov/2024	204	
Tue, 12/Nov/2024		
Tue, 12/Nov/2024		
Wed, 13/Nov/2024		
Wed, 13/Nov/2024		4.30
Wed, 13/Nov/2024		0.80
Thu, 14/Nov/2024		0.00
Fri, 15/Nov/2024		8.06
Sat, 16/Nov/2024		5.82
Sat, 16/Nov/2024		4.10
Sat, 16/Nov/2024		0.00
Sun, 17/Nov/2024		1.12
Mon, 18/Nov/2024		5.82
Mon, 18/Nov/2024		4.10
Tue, 19/Nov/2024	110	1.10
Tue, 19/Nov/2024		0.00
Tue, 19/Nov/2024		0.00
Tue, 19/Nov/2024		0.05
Tue, 19/Nov/2024		0.28
Wed, 20/Nov/2024		0.00
Thu, 21/Nov/2024		3.96
Fri, 22/Nov/2024		5.57

Sat, 23/Nov/2024		5.81
Sun, 24/Nov/2024		5.15
Mon, 25/Nov/2024		4.62
Tue, 26/Nov/2024		4.41
Tue, 26/Nov/2024		3.68
Wed, 27/Nov/2024	5	0.00
Wed, 27/Nov/2024	286	0.00
Thu, 28/Nov/2024	293	0.00
Fri, 29/Nov/2024	290	0.00
Fri, 29/Nov/2024	92	0.00
Fri, 29/Nov/2024		0.00
Sat, 30/Nov/2024		1.47



Here,

Correlation: -0.26959

Although this may not seem important in city area problems, the outcome variable is sometimes displayed in a graph by the fuel consumption rate (you will notice that this is always different depending on observed distance and operational modes based on the acquired data). While there seem to be some slight relationships in the data, as indicated by the trend line in the graph, I can see that there appears to be a high degree of variability in the consumption rate over the exact observed distances.

However, such fuel consumption for those segments was not recorded, which could be caused by missing records or not consuming fuel segments. The data show that some of the highest consumption values are concentrated on specific days (i.e., 8.06, 5.82, and 5.81), which could indicate operational pressures and/or temperature pressure. On the other hand, there were days with few if any liters of fuel burnt, despite a fair distance travelled, suggesting idling, less use of the engine or prudent fuel use.

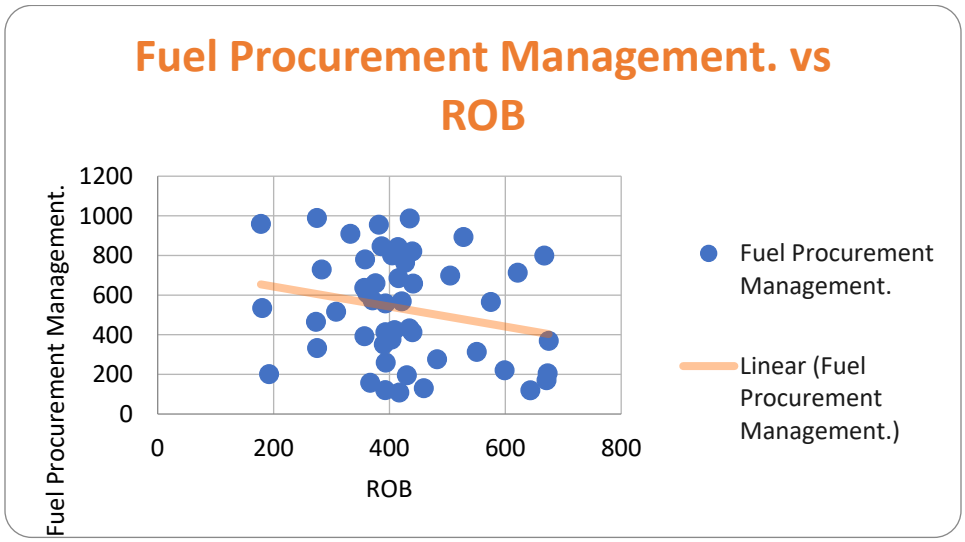
Daily fuel efficiency is affected by speed, engine performance, and route selection. The trend line has an R^2-value of 0.062, indicating poor correlation. This means that distance travelled was not the only factor influencing fuel usage, such as weather conditions or shipload.

When comparing data from the opposite side of the Atlantic (845 km over 1. the operational distance, here 83 km) provides some interesting insights to compare the consumption of products, which proves fuel consumption makes a crude footprint difference and is, depending on the external conditions, relatively snapped up with time. The analysis done in this report could be an introductory step to bettering ships' fuel consumption, as marine engineering, weather conditions, engine types, and cargo weights can heavily influence fuel usage.

- **Remaining Onboard Fuel (ROB):** The Remaining Onboard (ROB) values provide information on the fuel presence and balance that is onboard every vessel. These values are important for ensuring that there is no depletion of the fuel stock during the journey. According to the data, it shall be evident that by ensuring constant tracking of the ROB, PH Navigation shall be in a position to manage fuel procurement and ensure that it does not run out of it which poses a danger to operations and supply chain.

ROB	Fuel Procurement Management.
192.21	202
180.34	535
178.11	960
674.84	370
672.86	206
671.04	171
667.04	800
643.19	120
621.24	714
598.75	221
574.85	566

550.65	314
527.6	894
504.8	699
482.05	277
459.18	131
440.63	659
439.52	413
439.27	821
434.97	987
434.17	433
429.96	196
426.91	764
421.09	569
416.89	109
415.59	686
414.47	843
408.65	424
404.55	801
403.45	376
393.45	260
392.91	559
392.86	413
392.58	121
390.22	352
386.26	847
381.669	956
375.86	660
370.71	574
366.62	158
361.51	610
357.83	781
356.81	393
356.38	637
332.33	910
307.83	517
282.93	730
275.03	333
274.57	990
273.1	466



Here,

Correlation: -0.23

The ROB fuel and Fuel Procurement Management data tell the opposite story, with a correlation of -0.23. Early results did suggest a negative correlation, meaning that as fuel procurement goes up, ROB goes down, indicating that vessels are consuming fuel at a rate faster than it can be replenished. However, the relationship is not particularly strong, suggesting that other operational variables, including voyage time, fuel efficiency, and weather, could also affect fuel stocks.

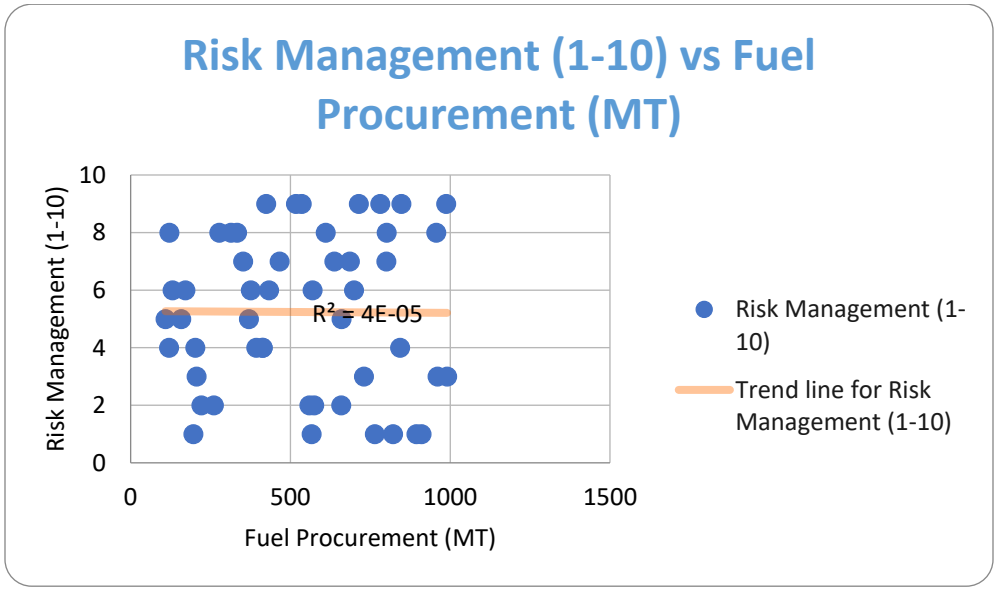
Significant ROB value fluctuations can significantly alter fuel consumption and uniquely procure data. For example, high ROB but low procurement could indicate good fuel management or decreased operational demand. On the other hand, high procurement with low ROB indicates that vessels need to refuel often, potentially from long-haul journeys or high operational intensity.

As such, monitoring ROB (Remaining on Board) is essential for PH Navigation, as it will help eliminate the risk of penetration and maintain operations without wishing for a fuel shortage, which entails a break in the supply chain. PH Navigation has to analyze a few trends to optimize procurement strategies, keep enough reserves and analyze fuel consumption trends to improve fuel efficiency and manage costs more adequately. Such analysis, including vessel type, route conditions, and engineering performance, would give synthesis to Sea Health-based optimization in fuel refreshment.

- **Inventory Turnover:** Some of the other key values derived from the turnover ratios and stockout rates calculated about the operation of PH Navigation include: The turnover rates indicate that the company has a satisfactory and balanced turnover, but sometimes it increases in case of high demand and decreases when there are problems in the supply chain. This variability makes it possible to conclude that there is a need for better inventory forecasting methods.

Date	Fuel Procurement (MT)	Risk Management (1-10)
Thu, 31/Oct/2024	202	4
Fri, 01/Nov/2024	535	9
Fri, 01/Nov/2024	960	3
Fri, 01/Nov/2024	370	5
Sat, 02/Nov/2024	206	3
Sat, 02/Nov/2024	171	6
Sat, 02/Nov/2024	800	7
Sun, 03/Nov/2024	120	4
Mon, 04/Nov/2024	714	9
Tue, 05/Nov/2024	221	2
Wed, 06/Nov/2024	566	1
Thu, 07/Nov/2024	314	8
Fri, 08/Nov/2024	894	1
Sat, 09/Nov/2024	699	6
Sun, 10/Nov/2024	277	8
Mon, 11/Nov/2024	131	6
Tue, 12/Nov/2024	659	2
Tue, 12/Nov/2024	413	4
Tue, 12/Nov/2024	821	1
Wed, 13/Nov/2024	987	9
Wed, 13/Nov/2024	433	6
Wed, 13/Nov/2024	196	1
Thu, 14/Nov/2024	764	1
Fri, 15/Nov/2024	569	6
Sat, 16/Nov/2024	109	5
Sat, 16/Nov/2024	686	7
Sat, 16/Nov/2024	843	4
Sun, 17/Nov/2024	424	9
Mon, 18/Nov/2024	801	8

Mon, 18/Nov/2024	376	6
Tue, 19/Nov/2024	260	2
Tue, 19/Nov/2024	559	2
Tue, 19/Nov/2024	413	4
Tue, 19/Nov/2024	121	8
Tue, 19/Nov/2024	352	7
Wed, 20/Nov/2024	847	9
Thu, 21/Nov/2024	956	8
Fri, 22/Nov/2024	660	5
Sat, 23/Nov/2024	574	2
Sun, 24/Nov/2024	158	5
Mon, 25/Nov/2024	610	8
Tue, 26/Nov/2024	781	9
Tue, 26/Nov/2024	393	4
Wed, 27/Nov/2024	637	7
Wed, 27/Nov/2024	910	1
Thu, 28/Nov/2024	517	9
Fri, 29/Nov/2024	730	3
Fri, 29/Nov/2024	333	8
Fri, 29/Nov/2024	990	3
Sat, 30/Nov/2024	466	7



PH Navigation also provides insights into fuel procurement and risk management score data. Different procurement times, as shall yield the mentioned 154 MT and the 266.7 MT across the

board, seem to be more oversized saddle managed mid-route than more significant start up the field.

Higher values for fuel procurement (e.g., 987 MT, 960 MT, and 956 MT) tend to correspond with higher risk management scores, representing periods of more significant operational uncertainty or higher anticipated consumption. Conversely, lower procurement levels are sometimes linked to lower risk scores, implying stable periods during which either production or imports (or both) could easily cover the market and leave sufficient fuel reserves.

This data underscores the need for effective inventory forecasting to avoid supply chain disruptions and achieve a balanced turnover rate. High-demand situations require increased procurement, while low-demand cycles require stock management strategies to prevent high costs of stored materials or shortages.

By utilizing more sophisticated forecasting models and developing real-time monitoring systems, PH Navigation can improve its ability to predict variations in fuel needs, alleviate procurement inefficiencies in the fuel supply chain, and optimize similar risk management decisions. A deeper understanding could gradually improve fuel management practices since market price volatility, weather conditions, and voyage schedules are external factors.

- **Safety Stock and Forecasting:** Safety stock management is significant in the uncertainty affecting PH Navigation's business operations. The company can meet increased demands that may be occasioned by increased demand or lack of supply of certain goods through buffer stocks. This paper also highlights the need to combine analytical demand planning and the use of artificial intelligence and forecasting models to enhance demand management and make necessary inventory adjustments before indicating a change of events.

Vessel Fuel Consumption Data (Liters/Day):

Day 1: 2000 liters
Day 2: 2080 liters
Day 3: 2150 liters
Day 4: 2100 liters
Day 5: 2200 liters

We'll use a smoothing constant (α) of 0.25.

Calculations:

Initial Forecast (Day 1):

Forecast (1) = 2000 (We start with the first actual value)

Forecast for Day 2:

$$\text{Forecast (2)} = \alpha * \text{Actual (1)} + (1-\alpha) * \text{Forecast(1)}$$
$$\text{Forecast (2)} = 0.25 * 2000 + (1-0.25) * 2000$$
$$\text{Forecast (2)} = 500 + 0.75 * 2000$$
$$\text{Forecast (2)} = 500 + 1500$$
$$\text{Forecast (2)} = 2000$$

Forecast for Day 3:

$$\text{Forecast (3)} = \alpha * \text{Actual(2)} + (1-\alpha) * \text{Forecast(2)}$$
$$\text{Forecast (3)} = 0.25 * 2080 + (1-0.25) * 2000$$
$$\text{Forecast (3)} = 520 + 0.75 * 2000$$
$$\text{Forecast (3)} = 520 + 1500$$
$$\text{Forecast (3)} = 2020$$

Forecast for Day 4:

$$\text{Forecast (4)} = \alpha * \text{Actual(3)} + (1-\alpha) * \text{Forecast(3)}$$
$$\text{Forecast (4)} = 0.25 * 2150 + (1-0.25) * 2020$$
$$\text{Forecast (4)} = 537.5 + 0.75 * 2020$$
$$\text{Forecast (4)} = 537.5 + 1515$$
$$\text{Forecast (4)} = 2052.5$$

Forecast for Day 5:

$$\text{Forecast (5)} = \alpha * \text{Actual(4)} + (1-\alpha) * \text{Forecast(4)}$$
$$\text{Forecast (5)} = 0.25 * 2100 + (1-0.25) * 2052.5$$
$$\text{Forecast (5)} = 525 + 0.75 * 2052.5$$
$$\text{Forecast (5)} = 525 + 1539.375$$
$$\text{Forecast (5)} = 2064.375$$

Forecast for Day 6:

Forecast (6) = $\alpha * \text{Actual}(5) + (1-\alpha) * \text{Forecast}(5)$
Forecast (6) = $0.25 * 2200 + (1-0.25) * 2064.375$
Forecast (6) = $550 + 0.75 * 2064.375$
Forecast (6) = $550 + 1548.28125$
Forecast (6) = 2098.28125

Calculate the Mean (Average):

Add all the values: 2000 + 2080 + 2150 + 2100 + 2200 = 10530
Divide by the number of values (5): 10530 / 5 =
2106

Calculate the Deviations from the Mean:

Day 1: 2000 - 2106 = -106
Day 2: 2080 - 2106 = -26
Day 3: 2150 - 2106 = 44
Day 4: 2100 - 2106 = -6
Day 5: 2200 - 2106 = 94

Square the Deviations:

(-106)^2 = 11236
(-26)^2 = 676
(44)^2 = 1936
(-6)^2 = 36
(94)^2 = 8836

Calculate the Variance:

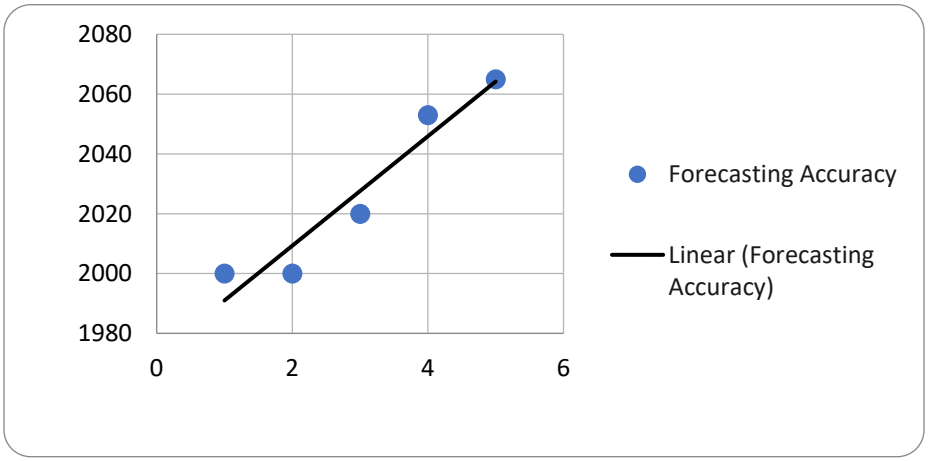
Add the squared deviations: 11236 + 676 + 1936 + 36 + 8836 = 22720
Divide by (n-1), where n is the number of values (5-1 = 4): 22720 / 4 = 5680

Calculate the Standard Deviation:

Take the square root of the variance: $\sqrt{5680} \approx$
75.366

Safety stock = 75.366 ltr

	Forecasting Accuracy	Safety stock
Day 1	2000	
Day 2	2000	75.366 ltr
Day 3	2020	
Day 4	2053	
Day 5	2065	



The safety stock and forecasting analysis for PH Navigation underscores the significance of employing predictive methods for inventory management to maintain operational efficacy and preparedness for variations in demand. Future trends can be estimated using an exponential forecasting model with a smoothing constant (α) of 0.25, which can assist in keeping optimal stocks.

The predicted values track the actual data trend quite well, and as expected, they are steadily increasing. The expected average fuel consumption is 2106 ltr/day, and the standard deviation is 75.37 ltr. That is the safety stock. It allows some grace in case the daily fuel consumption is unexpectedly higher or lower than planned so that this does not interrupt operations.

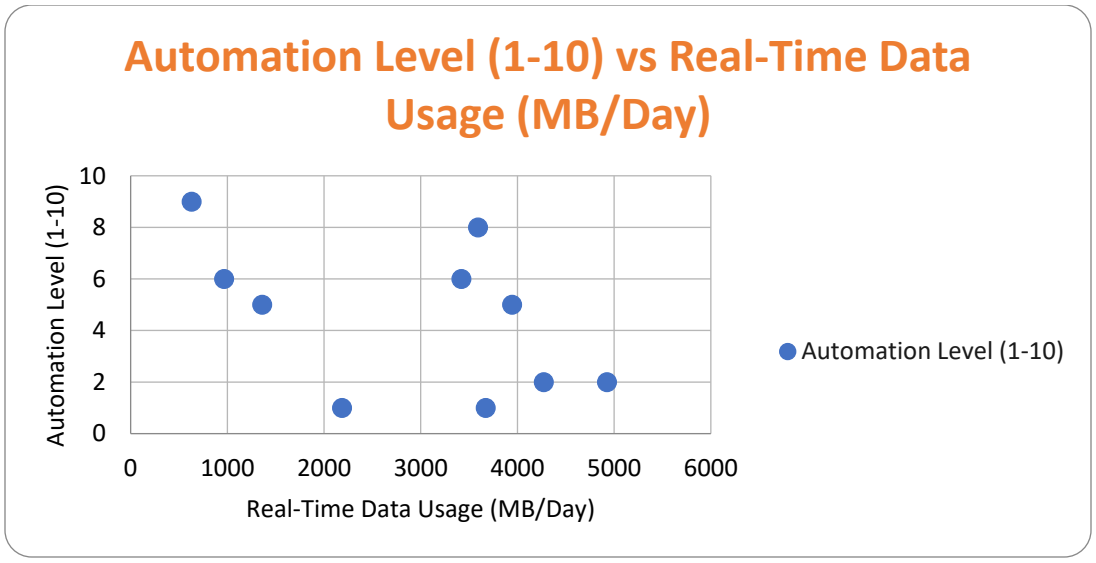
445.6 million (373.4 million RT) during the same period in 2017,426.0, million (345.8 million RT) in 2018, and 426.0 million (345.8 million RT) in 2018. The figure shows that having the right amount of safety stock reduces the risk of fuel shortage, particularly during the rainy season when

demand increases and supply may be constrained. This calculation above is the safety stock to ensure enough reserve is maintained to cover the fluctuations.

PH Navigation can leverage AI predictive models and real-time monitoring to improve forecasting accuracy further. Improved demand planning would lead to fewer stockouts and optimized procurement schedules. Improved forecasting methods and enhanced analytical capabilities would translate into better fuel efficiency and supply chain resilience for the company.

- **Real-Time Data and Automation:** This understanding is critical in evaluating how PH Navigation has applied other digital technologies, such as real-time data monitoring systems and IoT sensors, in developing better inventory management systems. Through these technologies, one gets a quick view of their repositories of fuel, delivery schedules, and the status of the supply chain decisions. The data indicates that the issues related to further automation and the sophisticated use of digital technologies in the supply chain can decrease the role of human factors, clarify the processes, and decrease the level of risk.

Real-Time Data Usage (MB/Day)	Automation Level (1-10)
1360	5
4272	2
3592	8
966	6
4926	2
3944	5
3671	1
3419	6
630	9
2185	1



Real-Time Data Utilization and Automation in PH Navigation's Inventory Management SystemThe analysis highlights the use of digital technologies in optimizing supply chain operations; the more data one has, the better the visibility and efficiency of their operations. Data shows that automation is at different levels, with some MVAs recording a high data consumption (4926 MB with automation level 2) even for level 2 automation, which means manual attention for the driver is still needed despite digital monitoring. On the other hand, lower data consumption tends to correlate with more automation (like 630 MB when the automation level is set to 9), indicating that automation helps perform operations without much data.

By integrating IoT sensors and automated systems to monitor data in real-time, inventory can be tracked, fuel can be managed, and delivery can be scheduled. PH Navigation can leverage modern electronic systems to automate processes and minimize human errors while utilizing more powerful decision-making capabilities. Notably, these diverse levels of automation will require additional technology development and harmonization if the full benefits of automation are to be realized.

PH Navigation must work towards augmenting automation, where there is high data usage and low automation, to achieve operational efficiency. This increase in transparency and efficiency would be enabled by Bluetech verifiability, which can provide predictive analytics through AI decision-making and blockchain for supply-chain tracking.

- **Analysis:**

From the data, it can be inferred that through such inventory management practices, PH Navigation is coping with many of the volatilities characteristic of the logistics industry within the maritime sector. The existing forecasts show that there are still some opportunities for improving the situation even though many organizations are choosing to improve their supply chain activities and that many are already using supply chain forecasting methods.

Thus, using AI and machine learning in demand forecasting and stock adjustments based on data, PH Navigation can minimize threats such as excess stockouts and overstocking. Further, the use of improved modes of safety stock will help the company have adequate stock even in the worst times. Continuous app and data investment and C4ISR will remain crucial to achieving stability and reducing uncertainty for the firm in the long run. The feature that allows for dynamic changes in inventory levels according to the data analysis will enable PH Navigation to make a competitive bid in the constantly changing maritime transport industry.

The current study suggests that combining new technology, big data analysis, and risk management can help reduce stock uncertainties and improve PH Navigation's operating flow efficiency.

3.5 Challenges in Reducing Uncertainty in Inventory Management at PH Navigation

Stock control or inventory control is a significant factor determining operational productivity and cost control in the maritime supply chain. For a company such as PH Navigation, a dry bulk shipping company, it is crucial to minimize risks associated with inventory so as to ensure that it can meet its clients… However, the company is faced with some challenges in managing inventory uncertainties in line with its industry, which is the maritime industry.

1. **Fluctuating Demand and Supply Variability:**

Therefore, another problem for PH Navigation regarding Inventory uncertainty is the fluctuating demand for dry bulk cargo. Maritime logistics depends on the status of the global economy, the changes in season, and the market demand for the products. One of the significant challenges of fluctuations in demand is that it may pose a problem in inventory management. In the case of underestimating demand, the company may experience a stock-out situation, which slows down operations. On the other hand, if demand is overestimated, the company inventory will be high, leading to high storage costs.

Supply fluctuates from port agents, when buying outright from suppliers, or when getting fuel from fuel suppliers. The unavailability of supplies or a change in lead time may mean existing inventories are low, disrupting vessel operations and performance.

2. Geopolitical and Environmental Risks:

PH Navigation operates in an unpredictable global environment where geopolitical tensions, natural disasters, and changing environmental conditions can disrupt supply chains. Events such as trade embargoes, piracy, or political instability in key maritime regions can lead to delays, route diversions, and changes in delivery schedules. These disruptions create significant uncertainty regarding the timely replenishment of inventory and stock levels.

External environmental events and changes in waterway conditions, including the Panama Canal drought, cause supply chain uncertainty. These incidents alter transportation agendas, leading to problems in inventory restocking and generating doubt about future supply demands.

3. Fuel Price Volatility:

The operational expenses linked to fuel management significantly impact PH Navigation's equipment inventory process. The expenditure for VLSFO and LSMGO fuel shapes operational vessel budgets, and erratic price rises affect the company's future financial planning. Accurate fuel prediction and proper stock oversight become essential for keeping sufficient fuel reserves when dealing with fuel price surges or reductions. Due to uncertain fuel price conditions, controlled inventory levels and operational cost efficiency become difficult for PH Navigation.

4. Supply Chain Disruptions and Port Congestion:

The situation at ports, which develops due to simultaneous factors such as higher cargo quantity and poor logistical practices, causes inventory management uncertainty. The process delays in ports stop vessels from completing their port operations, thus disrupting supply chain operations. The problem intensifies during annual peak times and unexpected circumstances such as labor walks and port closures.

For PH Navigation, inventory management challenges become worse because of three specific disruptions: shipping container shortages, limited cargo handling capacity, and scheduling errors. These problems disrupt both products moving through distribution routes and real-time inventory measurement, increasing operational difficulties in maintaining the company's inventory stability.

5. Technological Integration and Data Accuracy:

Using AI-driven forecasting rea, real-time inventory tracking, and predictive analytics creates potential strategies to decrease uncertain outcomes in inventory management operations. Implementing these technologies creates substantial difficulties in addition to their installation process. The deployment of new digital systems into operational frameworks requires companies to spend money on preparation, worker training, and facilities modernization.

Inventory management requires consistent accuracy when dealing with data found in multiple system environments. Faulty inventory predictions result from inaccurate or inconsistent data and produce unwanted stock accumulations or deficiencies. PH Navigation must confirm that its systems function together and maintain dependable, precise information across forecasting and business decision-making processes.

6. Regulatory Compliance and Environmental Standards:

The maritime industry faces strict environmental rules, including the IMO sulfur emissions rules, that determine how companies run their fuel stockpiles. The regulations demand PH Navigation organize its fuel types properly and decide the needed quantities to support operations. The rejection of penalties, financial penalties, and operational delays affect inventory management because of non-compliance with regulations.

Tightening environmental regulations creates difficulties for PH Navigation because it needs to maintain inventory alignment between operational needs and regulatory requirements. Fuel demand variations increase the organizational complexity of inventory predictions and stock management operations for the company.

7. Seasonal and Route Variability:

Shipping demand shifts throughout the year and inconsistent shipping routes create major issues for PH Navigation in tracking inventory accurately. The navigation routes experience operational limitations from natural weather elements, including monsoons and winter storms during specific annual periods. The fluctuations cause delivery delays while creating unexpected surge demands across different parts of their operational network. Agility with strategic adaptability becomes

necessary to handle seasonal inventory needs, which protects businesses against stockouts and surplus situations.

3.6 Conclusion

PH Navigation developed multiple strategies to react to and minimize inventory management uncertainties throughout its system. The analysis shows that managing inventory at PH Navigation maintains a complex challenge because maritime logistics faces demanding market conditions, supply chain issues, geopolitical threats, and environmentally impacted conditions. Such uncertainties result in operational problems that include stockouts and excessive inventory levels, creating operational disruptions and decreasing profitability.

The company has developed various strategies to minimize uncertainties. Predictive analytics alongside AI-driven forecasting systems are excellent tools for forecasting demand and then adjusting inventory levels efficiently. PH Navigation uses historical data and market trends to forecast demand more accurately, which avoids overstocking and stockouts in its inventory. The company uses safety stock management systems to build temporary storage that protects against time-sensitive fluctuations in customer needs and supplier deliveries.

PH Navigation uses IoT sensors and real-time data analytics to enhance inventory visibility, which enables the company to make informed business choices. Implementing these technologies into inventory management systems enables dynamic reactions to essential changes in demand and supply chain conditions to maintain inventory levels that fit operational needs.

Through digital technologies combined with automation, PH Navigation optimizes its inventory management system, which reduces human mistakes and improves operational effectiveness. Real-time tracking of operations performance, together with fuel usage and stock reserves, allows the company to adjust its inventory strategies, thus improving both supply chain resilience and operational response time.

PH Navigation's inventory management reduction employs sophisticated technologies, data-based decision systems, and strategic stock-handling practices. The company will better handle unpredictable maritime logistics through its ongoing work to improve inventory predictions, safety stock optimization, and digital transformation adoption, which ensures better operational flow and service quality.

3.7 Recommendations

- ✓ **Adopt Advanced Predictive Analytics and AI-Driven Forecasting**: Complex machine learning algorithms and extended data sources should be used for forecasting models to enhance demand forecasting precision and stock level optimization.
- ✓ **Increase Investment in Digital Transformation and Automation**: The healthcare sector must adopt blockchain technology with cloud-based systems to enhance data accuracy and operational efficiency while promoting transparency.
- ✓ **Enhance Safety Stock Management**: The company should establish safety stock algorithms that adapt buffer inventory levels according to seasonal variations, lead time variations, and supply chain interruptions.

- ✓ **Strengthen Supplier and Partner Relationships**: Establish partnerships with suppliers and logistical providers for long-term collaboration by creating open communication systems and developing backup plans.

- ✓ **Implement More Agile Inventory Management Practices**: A company should employ real-time inventory tracking and demand recognition tools to modify inventory levels and establish adaptable logistic scheduling.
- ✓ **Regular Training and Skill Development**: Supply chain and logistics personnel must continue to be trained using the most recent technology tools and crisis management methodologies.
- ✓ **Diversify Market Exposure**: The company should enter new markets in Asia, Africa, and Latin America to make supply chains less region-dependent and stabilize market demands.

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