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INNOVATIVE SUSTAINABLE PRACTICES THROUGH GREEN LOGISTICS IN SHIPPING INDUSTRY – AN EVIDENTIAL PERSPECTIVE

Mr. Sujan Baburajan, Department of Management, Dr. G.R.Damodaran College of Science, Coimbatore, Tamilnadu, India

Dr.S.Brindha, HOD & Associate Professor, Department of Management Dr. G.R.Damodaran College of Science, Coimbatore, Tamilnadu, India

ABSTRACT

The shipping industry, a significant contributor to global CO2 emissions, is under increasing pressure to transition towards more sustainable practices. The feasibility of using green logistics vessels as a solution to this challenge is yet to be addressed. The environmental, economic, and operational aspects of green logistics vessels along with the potential reduction in greenhouse gas emissions, and the cost-effectiveness compared to traditional vessels, are the same as the operational implications of this transition. The research includes a comparative analysis of the performance of green logistics vessels and conventional vessels, considering factors such as fuel efficiency, cargo capacity, and maintenance costs. It explores the regulatory and policy environment, identifying potential incentives and barriers to the adoption of green vessels. A comprehensive evaluation of the feasibility of introducing green logistics vessels in the shipping industry offers valuable insights for stakeholders and policymakers. It serves as a guide for future decision-making and strategic planning in the pursuit of a more sustainable shipping industry.

Keywords: Green Logistics, sustainable shipping industry, Traditional Vessels.

I. INTRODUCTION

In the era of globalization and rapid technological advancement, the logistics industry plays a pivotal role in connecting different parts of the world. The introduction of green logistics is a step towards mitigating these environmental concerns while ensuring the efficiency and effectiveness of logistics operations.

Green logistics consists of using more eco-friendly and sustainable processes to reduce the environmental impact of logistics. This approach covers the entire life cycle of the product: Manufacturing, storage, transport, marketing, use and disposal. Moreover, this shift towards green logistics is not merely altruistic; it also yields tangible economic benefits. By embracing eco-friendly practices such as optimizing routes and investing in cleaner technologies, shipping companies can enhance operational efficiency and reduce costs associated with fuel consumption and regulatory compliance. This not only improves their bottom line but also fosters long-term resilience and competitiveness in an increasingly environmentally conscious market.

Green shipping otherwise known as sustainable logistics encompasses a variety of methodologies used to lessen the environmental impact caused by the maritime industry. It entails using green technologies, implementing sustainable practices, and adhering to stringent legal requirements. The primary goal is to reduce the emission of GHG, energy conservation ecological supervision and the preservation of maritime biodiversity. The International Maritime Organization has set a goal to reduce greenhouse gas emissions from

ships by at least 50% by 2050 compared to 2008. Since the International Maritime Organization announced greenhouse emissions in 2008.

II. GREEN LOGISTICS

Green logistics addresses environmentally friendly practices in the transportation, warehousing, and distribution of goods. It aims to reduce energy consumption, emissions, and waste while optimizing operational efficiency.

- Transportation Optimization: Utilizing eco-friendly transportation modes (e.g., rail, sea, electric vehicles) and optimizing delivery routes to minimize fuel consumption and emissions.
- Vehicle Efficiency: Adopting fuel-efficient vehicles, hybrid or electric trucks, and implementing driver training programs to promote eco-driving behaviours.
- Packaging Optimization: Using lightweight, recyclable, or biodegradable packaging materials to minimize waste generation and environmental impact during transportation.
- Warehousing Practices: Implementing energy-efficient lighting, HVAC systems, and recycling programs in warehouses to reduce energy consumption and waste.
- Reverse Logistics: Managing product returns, refurbishment, and recycling processes efficiently to minimize waste and maximize resource recovery.

III. GREEN SUPPLY CHAIN MANAGEMENT

Extends the principles of green logistics to the entire supply chain, including suppliers, manufacturers, distributors, and retailers. It involves integrating sustainability considerations into sourcing, production, inventory management, and distribution processes.

- Supplier Engagement: Collaborating with suppliers to promote sustainable practices, such as sourcing from eco-friendly suppliers, reducing packaging waste, and minimizing transportation emissions.
- Product Design: Designing products for sustainability by using recycled materials, reducing packaging size, and designing products for disassembly and recyclability.
- Lifecycle Assessment: Conducting lifecycle assessments to evaluate the environmental impact of products throughout their lifecycle and identify opportunities for improvement.
- Inventory Optimization: Implementing just-in-time inventory practices, demand forecasting, and inventory management systems to minimize excess inventory, reduce storage space requirements, and lower carbon emissions.
- Collaborative Partnerships: Forming partnerships and alliances with other organizations, industry associations, and non-profits to share best practices, resources, and expertise in sustainable supply chain management.
- Regulatory Compliance: Ensuring compliance with environmental regulations and standards related to product safety, emissions, waste management, and sustainable sourcing.
- Continuous Improvement: Implementing performance monitoring, benchmarking, and reporting mechanisms to track progress, identify areas for improvement, and drive continuous sustainability initiatives.

IV. GREEN LOGISTICS IN APPLICATION

MOL(MITSUIO.S.K.LINES) :

The veritably first shipping company named MOL(MITSUIO.S.K.LINES) took action to make as world's first solar cold-blooded auto carrier in September 2009. The EMERALD ACE was launched in 2012.

CMA CGM GROUP :

CMA CGM is the world’s first maritime shipping company to choose LNG to power its ultra-large containerships. This major corner in the construction of the world's first LNG-powered ultra-large containership was reached the moment at the Shanghai Jiangnan- Changxing Shipyard, at an event attended by Rodolphe Saadé, Chairman and Chief Executive Officer of the CMA CGM Group, French and Chinese officers, business leaders and CMA CGM Group guests.

In 2017, Rodolphe Saadé blazoned his decision to order a series of nine 23,000-TEU containerships that would be the world’s first ever to be powered by thawed natural gas. Clean energy, LNG helps to reduce, the emigration of Sulphur oxides and fine patches by 99, Nitrogen oxide emigration by over 85, and Carbon dioxide emigrations by around 20.

These new vessels joined the Group's line in 2020 on the French Asia Line(Asia- Northern Europe).

OCEAN NETWORK EXPRESS(ONE) :

Ocean Network Express(ONE) was innovated in 2016 as a common adventure between Nippon Yusen Kaisha(NYK), MitsuiO.S.K. Lines(MOL), and K-Line. ONE is a major player in the global vessel shipping assiduity. These vessels have a nominal capacity of further than 13,700 TEU and are to be delivered in 2025. This investment embodies ONE's Midterm Strategy blazoned in March, to guard a sustainable force chain for the future and emphasize ONE's green strategy and decarbonization plan. As ONE envisions being a global leader in the consummation of environmentally sustainable shipping, we place great significance on measuring and tracking our environmental footmark to achieve our net-zero GHG emigration target in 2050. In line with our emigration reduction targets, we seek to minimize the impacts of our operations and apply enterprise to work towards our carbon reduction targets. Our sweats to reduce emigration from our line through functional and energy effectiveness advancements have yielded a 14 reduction in emigration intensity from 2018 to 2022. settlers in the maritime assiduity since 1927.

HÖEGH AUTO LINERS :

Höegh Autoliners is a leading global provider of ocean transportation services within the Roll-on Roll-off(RoRo) member. The company operate a global network of deep ocean trades with Pure Car and Truck Carrier(PCTC) vessels. The company offer our guests safe and secure deep ocean transportation of RoRo weight similar to buses, high and heavy ministry and breakbulk. Each time, the company transports around 1,6 million auto original units(CEU) as well as other rolling and static weights. The future is looking both green and bright for Höegh Autoliners with the launch of the new sunup class vessels. The sunup class will be the largest and most environmentally friendly auto carriers ever erected. Designed to carry up to 9,100 buses, the multi-fuel and zero carbon ready. Pure Car and Truck Carrier(PCTC) vessels will be the first in the PCTC member to be suitable to operate on zero carbon ammonia.

V. SIGNIFICANCE OF THE STUDY

The study is significant as it explores the feasibility of introducing green logistics vessels, a critical step towards sustainable and eco-friendly maritime transport. This topic is of paramount importance considering the increasing concerns about environmental degradation and climate change. The introduction of green logistics vessels can significantly reduce the carbon footprint of maritime transport, contributing to global efforts to combat climate change. It will assess the economic viability of green logistics vessels, including the costs associated with their implementation and operation, and the potential return on investment. It reflects in evaluating the technical aspects of green vessels, such as the availability of technology resources and expertise needed for their successful implementation. The study will consider the legal implications of introducing green logistics vessels, including compliance with international maritime laws and regulations. It identifies potential risks and challenges associated with the introduction of green logistics vessels and proposes strategies to mitigate them.

VI. REVIEW OF LITERATURE

According to Taechee Lee and Hyunjeong Nam, the study aims to define green shipping and eco-friendly vessels and identify the regulations and current request situation regarding eco-friendly vessels in major countries similar as Europe, the United States, Japan, China and South Korea within the frame of shipping companies, dockyards, anchorages, and programs. This abstract study defines and analyzes the current request situation of green shipping grounded on the former literature as well as the cases of each stakeholder in major countries. As a result, this study identifies six major problems and proposes countermeasures to enhance strategic plans in medication for green shipping in South Korea. The countermeasures are 1) the establishment of a shipping–shipbuilding cooperative network, 2) information sharing and common cost reduction for shipping and shipbuilding assiduity, 3) investment in R&D in eco-friendly vessels by shipbuilding assiduity, 4) expanded support for LNG-fueled boat.

In the study by Pierre Cariou, Francesco Parola, and Theo Notteboom, the International Maritime Organization(IMO) agreed in 2018 on a reduction of total hothouse gas(GHG) emigrations from transnational shipping, which should lower the total periodic CO2 emigrations by at least 50 by 2050 compared to 2008. Although expansive studies live on the impact of transnational shipping on a global scale, many tools and empirical papers are available to assess the progress made so far in the shift towards carbon-clean maritime force chains. The paper identifies the crucial factors affecting CO2 emigrations by vessel

vessels grounded on extant literature and business perceptivity and measures how important has been formerly achieved in the once decade by offering multi-trade comparisons of the situations in 2007 and 2016.

As demonstrated by Buirma, M.; Vleugel, J.; Pruyn, J.; Doedée, V.; Schott; The maritime sector is required by the International Maritime Organization (IMO) to limit its CO2 emissions by −40% (IMO2030) and −70% (IMO2050). "Which technical, economic, and emissions-related conditions predominantly determine the feasibility of a conceptual supply chain of liquid CO2 that is captured from the exhaust gases of LNG-powered offshore vessels?" was the research question this article attempted to address. The collected CO2 is shipped to land and used by a last-mile client. The research used a system engineering methodology. After defining the problem, needs were analyzed in terms of technology, emissions, economy, and operations. A case study with actual vessel deployment, modelling, and assessment were then included in the design process. While there are financial and technological risks associated with any design, one of the main advantages of the suggested approach over others may be the sale of CO2 that has been captured. The major finding is that by matching the offshore transportation distance with the ability to store CO2 on board and the available means of transport to the final user, emission and financial targets (payback time) may be reached. According to experts from the ship's owner, the capture, storage, and offloading processes should only slightly affect the availability and routine operations of the vessel.

As mentioned by Haakon Lindstad, Bjørn E. Asbjørnslett, and Jan Tore Pedersen; The environmental consequences of international trade and transport have gained importance as a result of the current climate debate. Products are increasingly being produced in one part of the world, transported to another country and then redistributed to their final country of consumption. Since more than 80% of world trade tonnage measured in metric tons is carried by seagoing vessels, maritime transport will continue to be a core part of most supply chains while rail and road mainly are used for hinterland transport and to and from ports. This chapter presents a methodology for assessing the environmental impact of maritime transport and transport in general, with a specific focus on greenhouse gas emissions. The first section gives an introduction to why Green Maritime Logistics and Sustainability are important topics, while the second offers a framework for measuring greenhouse gas emissions (GHG) for transport systems. The third section presents a model for measuring seaborne transport and its greenhouse gas emissions, and in the fourth section, we compare greenhouse gas emissions from different modes of transportation.

As indicated by George Mallouppas, Elias Ar. Yfantis; To help the shipping industry meet the deep decarbonization targets set by the International Maritime Organization (IMO) by 2050, this review study looks at potential technology and methods. According to market surveys by Shell and Deloitte, there is a growing interest in deep decarbonization among key players. However, considering that the maritime industry contributes only around 3% of greenhouse gas (GHG) emissions, deep decarbonization will necessitate financial incentives and policies at the international and regional levels. The review paper addresses techno-economic issues and/or advantages of technology that will assist the shipping industry in meeting the IMO's targets. It is based on research publications and grey literature. The review discusses the most recent research on renewable energy sources (wind, solar, biofuels), alternative fuels (nuclear, hydrogen, ammonia, methanol), and the development of technologies (fuel cells, internal combustion engines) and operational and technical methods (slow steaming, cleaning and coating, waste heat recovery, hull and propeller design) to minimize fuel consumption for both new and old ships. The significant technological transformation required to meet the IMO's 2050 targets will be facilitated by financial incentives, societal pressure, and local, regional, and global legislative and regulatory changes.

On the authority of Alan C. McKinnon; A very energy-intensive industry, logistics is growing quickly, primarily due to globalization. This chapter evaluates its proportion of the world's energy consumption and greenhouse gas emissions and speculates on how these figures might evolve in the ensuing four decades. It then goes into the various strategies for lowering the energy used in logistical processes and the associated emissions. This is carried out within a structure centred on a set of seven crucial factors. Companies and governments should be able to separate the rising demand for logistics from the related energy needs and externalities by adjusting these criteria. The factors include the economy's freight intensity, the distribution of freight traffic among modes, the use of vehicle capacity, the proportion of emissions to energy consumption, as well as the energy efficiency of logistics activities, which include transportation and warehousing. There is little chance that energy consumption and carbon emissions in this industry will decline significantly in absolute terms over the next few decades, even though reductions in these parameters will somewhat counterbalance the underlying expansion in demand for logistical services.

VII. MOTIVE OF THE COMPANIES TOWARDS GREEN LOGISTICS

MOL (Mitsui O.S.K. Lines): MOL Stands as one of the world's largest shipping companies, with a 140-year history built on a relentless pursuit of safety and innovation. Specializing in bulk carriers, PCC vessels, LNG, and tankers, MOL's commitment to safe operations has been a cornerstone since its inception. Since launching the first car carrier in 1965 to support Japan's auto export boom, MOL has been a pioneer in automobile transport, continually enhancing safety and reliability across its fleet of 100 vessels. The MOL Auto Carrier Express (MOL ACE) brand reflects this legacy of innovation and environmental responsibility.

Embracing green logistics since 2012, MOL prioritizes environmentally sustainable practices to reduce carbon emissions, minimize waste, and optimize routes. This commitment not only aligns with corporate social responsibility but also drives cost savings and enhances the company's environmental reputation. Looking forward, MOL aims to achieve net-zero emissions by 2050, emphasizing sustainable strategies that reduce waste, fuel consumption, and greenhouse gas emissions. Leveraging advancements in technology, including AI for predictive analytics, MOL continues to lead the industry towards a more sustainable future, where environmental stewardship and profitability go hand in hand.

CMA CGM Group: CMA CGM is at the forefront of sustainable shipping practices, with its ACT with CMA CGM Plus program offering a suite of solutions to support decarbonization efforts. The Mass Balance Concept enables the attribution of various energy sources to different shipments, ensuring accurate carbon footprint accounting. Environmental Services like Biofuel Plus and Carbon Offset further demonstrate the company's commitment to reducing emissions. Setting ambitious targets, CMA CGM aims to be carbon neutral by 2050, with specific actions including using 10% alternative fuels by 2023 and operating LNG-powered vessels to reduce greenhouse gas emissions. The company has already optimized operations, cutting CO2 emissions per container and nautical miles by 50% since 2008.

Investing in R&D, digitalization, and collaboration with partners like Maersk, and CMA CGM is driving innovation in the maritime industry towards greener solutions. Plans to operate a fleet of "e-methane ready" ships and partnerships for R&D on alternative fuels underscore the company's commitment to leading the transition to a sustainable shipping future.

Höegh Autoliners: Höegh Autoliners is dedicated to facilitating green shipping for its customers, exemplified by its ACT with CMA CGM Plus program, which offers sustainable transport solutions. The company invests in biofuel technology and has ordered ammonia-ready dual-fuel vessels to reduce its carbon footprint significantly. Höegh Autoliners' commitment to sustainability is evident in its partnership with VARO Energy, aiming to reduce carbon emissions by 70% by 2050 compared to 2008 levels. By joining initiatives like the UNGC and the First Movers Coalition, Höegh Autoliners demonstrates its commitment to sustainable business practices and a net-zero carbon economy. The strategic use of biofuels and collaboration with partners like VARO Energy underscores the company's efforts to lead the transition to greener shipping.

While biofuels offer a promising avenue for emission reduction, Höegh Autoliners also explores other sustainable practices, including renewable energy sources, optimized shipping routes, and eco-friendly packaging. As sustainability becomes a priority for individuals and businesses, Höegh Autoliners' commitment to green logistics positions it as a leader in the industry, offering both environmentally friendly solutions and quality service.

ONE (Ocean Network Express): Ocean Network Express (ONE), established in 2016 through a joint venture between Nippon Yusen Kaisha (NYK), Mitsui O.S.K. Lines (MOL), and K Line, emerged as a significant player in global container shipping. With a fleet expansion plan including modern very large container ships (VLCS) and a commitment to environmental sustainability, ONE is positioned as a leader in the industry. With a focus on measuring and reducing its environmental footprint, ONE aims to achieve net-zero greenhouse gas emissions by 2050. Operational and fuel efficiency improvements have already led to a 14% reduction in emissions intensity from 2018 to 2022. The establishment of a Green Strategy Department underscores the company's commitment to environmental conservation.

Collaborating with other shipping lines through initiatives like the Global Centre for Maritime Decarbonization, ONE is actively engaged in industry-wide efforts to support decarbonization. Furthermore, the company's investment in methanol dual fuel container shipments represents a significant step towards

achieving its decarbonization goals. Despite not handling internal packaging, ONE remains focused on its core mission of providing efficient and sustainable container shipping services, positioning itself as a key contributor to the global supply chain and environmental conservation efforts.

VII. CONCLUSION

The integration of green logistics into the shipping industry signifies a transformative change that transcends mere business practices. It embodies a profound commitment to environmental stewardship, demonstrating the industry's recognition of its role in mitigating climate change and reducing its ecological footprint. By prioritizing sustainability, the shipping sector not only fulfils its corporate social responsibility but also contributes significantly to global efforts aimed at preserving the planet for future generations.

Moreover, this shift towards green logistics is not merely altruistic; it also yields tangible economic benefits. By embracing eco-friendly practices such as optimizing routes and investing in cleaner technologies, shipping companies can enhance operational efficiency and reduce costs associated with fuel consumption and regulatory compliance. This not only improves their bottom line but also fosters long-term resilience and competitiveness in an increasingly environmentally conscious market. The integration of green logistics into the shipping industry represents a holistic approach that reconciles environmental concerns with economic imperatives. It underscores the industry's adaptability and capacity for innovation, positioning it as a driving force for positive change in the global transportation landscape. As such, this pivotal shift towards sustainability serves as a beacon of hope for a more prosperous and environmentally sustainable future.

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