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ROUGH SEA AHEAD: CHALLENGES FOR THE SHIPPING INDUSTRY

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ABSTRACT
There were fewer obstacles to marine shipping in the past than there are now. The marine sector, like all others, must evolve to meet the requirements of the contemporary world and operate in a sustainable manner. Constant advances in technology and growing concern for the environment drive today's shipping industry. Therefore, protecting the marine environment through the implementation of innovative solutions is one of the primary challenges of maritime transport. However, it is difficult to simultaneously improve the environment and the economy. That's why it's crucial to work towards a marine transport future where everyone benefits from its growth. This article presents an overview of the important elements to consider in developing sustainable shipping, including available and prospective technology solutions, logistical operations, and regulatory regulations employed in lowering shipping gas emissions. Additionally, novel strategies for complying with the ever-tightening environmental regulations are discussed.

Keywords: Shipping, sustainable, Technology, logistical, environment, Marine.

I. INTRODUCTION

the economic activity of transporting products and people through navigable waterways. Passenger operations were formerly a significant part of the shipping business, but they have been severely constrained by the rise of the airline sector. However, the dramatic increase in certain types of cargo, such as petroleum, has more than made up for the decline in passenger traffic. Transportation of manufactured products has expanded fast since World War II, even though raw commodities such as mineral ores, coal, timber, grain, and other foodstuffs provide a large and still expanding amount of freight.

Indian shipping volume has increased dramatically since independence. With a total of 1204 vessels and 10.31 million GRT as of the end of 2014, India's commercial fleet strength has increased by 54 times since independence. The maritime industry's outlays and investments have steadily grown above projections. The government and various commercial and public organizations have made several efforts to boost shipping in the nation. In the years that followed, emerging nations expanded at varying rates in an effort to boost their economies. Most Asian countries are at or near the top of the list. The expansion of infrastructure like highways, airports, and seaports has been crucial to the growth of developing nations' economies, and this focus has increased as international commerce has expanded and trade barriers have been lowered. All of these factors, together with the ability to store goods and transport massive quantities, have put the shipping sector in a highly favorable position. Over time, other facets of shipping, like containerization, multi-modal transport services, advances in marine engineering technology, and so on, evolved as well.

Transportation of goods throughout the globe has increased. The increase in global maritime commerce from 2015 to 2016 was 2.6%, which is higher than the 1.86% growth seen in 2015 but still lower than the 3% average seen over the preceding four decades. Japan, Greece, and Germany have the largest dwt fleets, with Japan at the top. With around 1200 ships and 17.5 million dwt, India placed 17th, accounting for 1.4% of the world's dwt. Even though China's import demand remained robust in 2016, it was partially offset by slower growth in the import demand of other developing regions. The shipping sector was hit hard by the worldwide recession that began in 2008. Demand for ships and boats was impacted during this time period due to the recession since it is a derived demand for commodities. One of the main indications of global economic activity is the change in the Baltic Dry Index (BDI), which is simply a daily weighted average of the costs of shipping raw materials. The need to transport raw materials is a leading indicator of global manufacturing activity that is tracked by the BDI index. Dry bulk goods, including iron ore, coal, and grains, are transported throughout the globe at a cost reflected by the BDI. Wet cargoes (such crude oil transported by tankers) and container business (used mostly to transport manufactured items) are not included in the index.

Economic, environmental, and social factors must all work together in harmony for marine transport and logistics to be considered sustainable. Sustainability is the result of the systems' interactions and overlaps (Figure 1). On the one side, the transportation system affects how everything else works. On the other hand, it is assigned duties based on the requirements of other systems.

There is no denying the numerous detrimental repercussions of marine transport and logistics that are not sustainable. Numerous studies in the scientific community have established this. Pollutant gases are released while maneuvering, cargo activities, and waiting at berth or anchorage. The biggest effects of shipping emissions, however, are not the production of smog or the lack of clean air in ports. According to research, ships cause 24,000 premature deaths annually in East Asia.

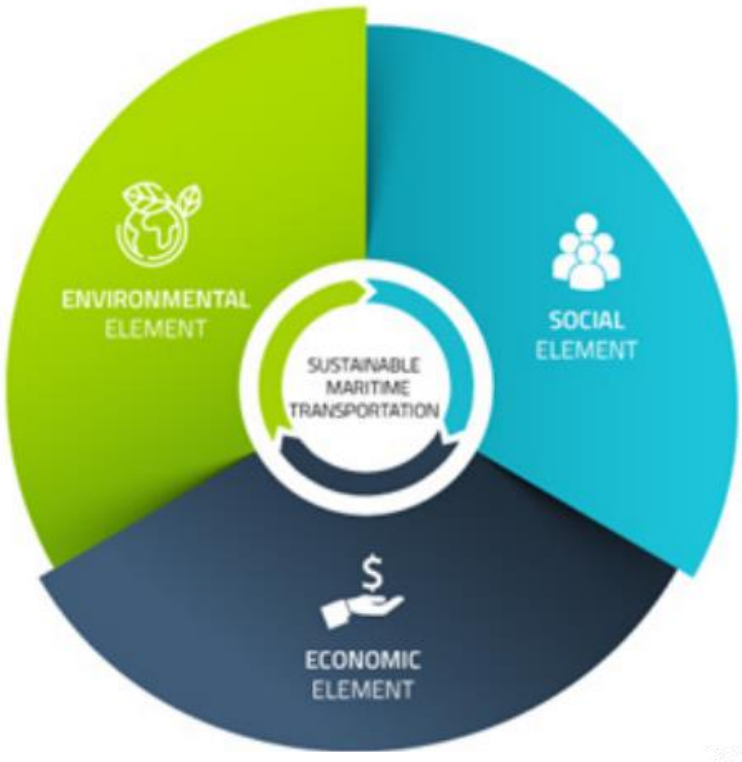

Figure 1: Interaction of sustainable maritime transport elements

II.ENVIRONMENTAL CHALLENGES

A. Climate change and its impact on the shipping industry

With the aid of CLD, we will be able to see how the marine sector is affected by climate change. We will begin by discussing individual loops of cause-effect interactions, and then we will merge all of the loops into a comprehensive whole.

Sea level rise due to climate change is expected to affect many of the world's main coastal zones, as described in earlier chapters. As the ocean rises, it will flood the coastal areas and potentially wash away the topsoil. Shoaly, sandy, and silty shores are the most susceptible to erosion from sea level rise, as determined by Kont et al. (1997). According to Vellinga, a 100-500m eroding of a sandy beach is possible due to a one meter increase in sea level. Sea level rise also contributes to back water effect (BWE), another factor in coastal soil erosion. As seas rise, the morphological activity of coastal rivers will increase, leading to more tidal flow along the shore. Riverbank erosion, especially around the shore, will worsen as river levels rise. Rising sea levels will hasten the process of salt intrusion along the shore, leading to the devastation of the mangrove forests there. Mangroves prevent soil erosion by acting as a natural buffer along the shore.

As the planet warms due to climate change, the polar ice cap and glacial mountains will melt, creating a reinforcing loop. The Arctic is warming at double the pace of the rest of the planet, and by 2100, 95 percent of the Alpine glacier mass may have vanished. As the polar ice melts, it will open up new shipping routes. If the current warming trend continues, by 2050 or later, there will be no more summer sea ice in the Canadian Arctic. Slowly but surely, the Arctic is losing summer.

B. Regulations and policies to address environmental concerns

Maritime law has always concerned itself with the protection of both the ship's cargo and its personnel. Environmental protection regulations are relatively new to marine issues, but they are gaining in importance. This article looks at how environmental laws have altered shipping practices both at sea and on land. It's obvious that the ocean-going shipping-port complex poses a danger to the environment and human health, and there are several initiatives underway to address this issue. The risk is that the regulatory framework will be disjointed, confusing, and ultimately detrimental to the shipping industry's need for consistency and predictability. The release of oil into the ocean was the first major issue with marine ecology to get attention. After the Torrey Canyon oil spill in 1967 demonstrated the massive environmental damage that could result from an accident involving a single large oil tanker, efforts to conclude an international agreement to control ocean oil pollution gained widespread attention around the world. Atmospheric pollution swiftly moved to the top of a growing list of marine environmental challenges, including, for example, the dumping of rubbish at sea and the migration of invasive species in ballast water. The "bunker" burned by oceangoing cargo ships is the highly contaminated residual oil that is left over after the refining process is complete, and it contributes significantly to air pollution. Particulate matter (PM), sulfur oxides (SOx), and nitrogen oxides (NOx) are the primary pollutants produced by bunker fuel, and they pose a threat to human health. Historically, regulation has been light since these ships operate in international seas and are registered in countries with weaker environmental or safety regulations ("flags of convenience"). In recent years, concerns about greenhouse gas (GHG) emissions from ships have grown. More than 20% of all greenhouse gas emissions from transportation are caused by international shipping.

C. Innovative technologies for greener shipping

The seas are essential to life on Earth because they cover more than 70 percent of the world. More than 90% of transactions are conducted by waterborne transit, and we are increasingly travelling into more dangerous regions of the ocean, at deeper and deeper depths, in search of resources to fuel global economic expansion. Over the past few decades, the shipping industry has worked tirelessly to meet rising environmental standards by improving operational strategies and creating new technologies, such as those related to more fuel-efficient engines, more advanced propulsion systems, and more aerodynamically efficient vessels. Fuel consumption and associated CO2 emissions have been significantly reduced on a capacity basis (tonne-mile) because to past and present technical advances. However, in recent years there has been a surge in public interest on global warming issues, and conversations about the need to conserve energy and cut CO2 emissions have become commonplace. It is projected that in the following decades, more work will be put into developing methods and technologies that will continue to provide social and economic value without harming the environment. In order to prosper, we must keep expanding our capacity for knowledge, creativity, and building new infrastructure. While ensuring maritime safety, it is important to take into account factors like environmental regulations, economic considerations, and the needs of the human element.

Lloyd's Register has a long-standing and crucial position within the maritime industry's regulatory framework, assuring safety and sustainability via the strategic deployment of technological assets. However, questions on the roles of technology, regulation, and classification-based assurance are raised by the varying and growing technological requirements implied by environmental expectations. In the future, conscience and principle will continue to drive the so-called "constraint" of Regulation. However, as new environmental regulations are implemented, it is expected that provisions for alternatives based on risk and equivalence will coexist with prescriptive requirements for specific features of a ship. As environmental demands rise and technology advances at a dizzying pace, so too could the importance of Classification's function in protecting assurance and implementing technological applications on green ship designs. As a result, it may become important to facilitate the development of sustainable technologies within the framework of first gaining a basic knowledge of their application and then putting them into practice via the use of practical technical or operational measures. In this speech, we'll go over some of the most recent advancements in Society innovation projects, highlight some recent legislative changes, and present potential technical implementation alternatives. This lends credence to the idea that Strategic Research might be a watershed moment in meeting the future-oriented societal and economic expectations placed on the marine sector by the international community.

III. ECONOMIC CHALLENGES

A. Global economic uncertainty and its impact on shipping demand

Recent international events have shown the detrimental effects of uncertainty on international commerce. The era of instability that began with the trade conflict between China and the United States was exacerbated by the subsequent COVID19 epidemic. Both small businesses and national economies felt the effects of this unpredictability. Consumption adjustments in response to environmental uncertainty and supply chain disruptions have had far-reaching effects on the global economy. The

service industry, the backbone of the global economy, has been hit particularly hard. The marine industry performs crucial functions for the global economy. It takes on a great deal of responsibilities across the supply chain, from planning to execution. It plays a crucial role in both the pre-production transfer of raw materials and the post-production delivery of finished goods to consumers. The variety of vessels in use today is a direct result of the wide range of cargo carried. Transportation markets for dry bulk freight, liquid bulk cargo, containers, and gas have developed as a consequence of this segmentation. The demand structure of the cargoes and the necessary technological equipment set each market segment apart. Generally speaking, sea transportation allows for the cheap and efficient delivery of extremely big tonnage commodities across great distances. It paves the path for economically viable international commerce. In addition, consumers might get a good deal on items from faraway marketplaces. As a result of these characteristics, the seaway transports around 90% of the commodities in terms of weight. Because of its integral role in the global economy, the shipping industry has a derived demand structure. That is to say, there has to be a need for the goods being sent before there can be interest in the service of shipping them. As such, everything that influences international commerce also impacts marine transit.

B. Fluctuations in fuel prices and their impact on shipping costs

Supply and demand factors in the worldwide market as a whole and, more specifically, in the major refining hubs of Singapore, Northwest Europe, and the US Gulf Coast determine the price of crude oil. The price of crude oil is the single most significant element in determining the price of petroleum products before taxes are added. After four years of steady increases, oil prices peaked in July 2008 and have since dropped to below $50 per barrel. The global financial crises and economic stagnation have pushed down energy usage, and short-term market speculative fluctuations have also had a role. Many analysts, including the International Energy Agency (IEA), have predicted that the current low oil price could be temporary. The IEA predicted in its World Energy Outlook 2008 (2008) that oil would trade at an average of more than $100 per barrel between now and 2015. While market imbalances could temporarily cause prices to fall back, it is becoming increasingly apparent that the era of cheap oil is over, as stated by the IEA in its World Energy Outlook 2008, indicating widespread acceptance of the scarcity of energy supplies and the concept of a peak in oil production.

In addition to rising demand from rapidly developing countries like China and India, supply shortages due to geopolitical tensions and short-term market speculative movements contributed to the oil price rise seen between 2003 and July 2008. Also contributing to the rise in oil prices are political unrest in the Gulf region, Nigeria, and Venezuela, as well as a decline in oil production from OECD countries. In addition, major oil exporting nations have had robust economic expansion, while simultaneously subsidizing domestic oil consumption to the point that it has limited the amount of oil available for export to the global market.

C. Competition and consolidation in the shipping industry

Market consolidation over the last two years has reshaped the global container shipping sector, with container lines merging, shipping alliances shifting, and shipping corporations expanding into port operations. Further mergers are possible, which begs the questions of what this means for market concentration and whether or not certain routes in the industry are becoming monopolized. The

industry's consolidation attempts in 2016–2018 show how businesses are adjusting to the challenging market circumstances that have persisted since the global financial crisis of 2008. Low freight rates, declining profitability, and bad financial returns have plagued the container shipping industry for a long time. Consolidation in the container sector is not without its critics. Container lines should anticipate savings, improved capacity management, and increased efficiency as a result of consolidation and alliance membership. If container lines are able to save money on a certain route, then they may pass those savings along to shippers in the form of cheaper prices and better services. However, if on a particular route consolidation leads to less competition, limited supply, market power abuse, and higher rates and prices, then shippers, trade, and ports will feel the negative effects. Because of these shifts, the consolidation of the container shipping industry must be tracked and evaluated on a regular basis.

There have been several changes leading to considerable market consolidation in the worldwide container shipping business since 2016. This industry accounts for over 60% of the value of seaborne commerce trade.1 Multiple mergers and acquisitions were finalized by container lines, and larger strategic shipping alliances were formed so that container lines could work together on strategic matters. The market became more concentrated because of these mergers and acquisitions, according to the United Nations Conference on Trade and Development. with only a few major container shipping companies serving the world. In January of this year, the world's 15 largest container shipping companies controlled slightly over 70% of total container ship capacity. By June of the following year, six months after the mergers were finalized, the top 10 owned about 70% of the available capacity. The average number of service providers per nation fell by 38% between 2004 and 2018. The essential question, therefore, is whether the container shipping sector is trending toward oligopolistic markets, especially in light of the prospect for more consolidation in the future.

IV. OPERATIONAL CHALLENGES

A. Safety concerns and accidents at sea

The World Wildlife Fund has commissioned the first independent research to investigate the aggregate data around maritime disasters. Factors that have caused or been linked to maritime mishaps during the last 15 years are summarized below. Many large-scale spills of mineral oil have occurred at sea during this time. The significant environmental effect and evident linkages to poor vessel management and maintenance have led to changes in maritime rules as a result of incidents like this. The effects of these disasters on the ocean are discussed, along with the areas of most concern and the variables that contribute to maritime catastrophes. It examines the questions of flag nations' roles and obligations in ensuring the security of ships and enforcing compliance with international norms. The potential for environmental damage is proportional to the kind and quantity of hazardous materials, such as oil, being carried and the vulnerability of the coastal region at risk in the event of an accident. maritime catastrophes, which are typically the topic of dramatic media coverage, often elicit a strong reaction from civil society and politicians, suggesting a direct connection between environmental preservation and maritime safety. Vessels that are poorly maintained and managed are more likely to result in injuries, sinkings, and other negative impacts on the maritime and coastal environment.

The sinking of the Prestige in 2002 and the recent tragedies with the Hebei Spirit and the MV. Rena demonstrate the need of determining what causes maritime mishaps. The role of negligent flag states

in particular has been brought back into the focus by these and other recent occurrences. Unless preventative measures are put in place to address recognized risk factors, the likelihood of accidents and the potential degree of damage will again grow as the worldwide fleet continues to expand fast and starts to operate frequently in increasingly unsafe places. Small-scale mishaps in fragile ecosystems like the Great Barrier Reef may have far-reaching effects on the natural world. Extreme weather phenomena, such as storm surge, wind, and wave patterns, are predicted to increase as a result of climate change. The chances of foundering—that is, sinking because of storms, leaks, or other damage that wasn't caused by a collision—are anticipated to increase as a result of the current weather pattern. The lack of a recent "major" accident also poses a risk of complacency, and although recorded accident numbers might tell us a lot, they do not account for various types of near misses.

B. Piracy and security risks

It is crucial to address the root causes of accidents in order to reduce the frequency of events even more. This is especially important because the global fleet size is expected to rise dramatically over the next decades, and owners and operators may be tempted to cut shortcuts in light of the current economic climate. This means that there will be a greater number of vessels operating in hazardous environments, such as the Arctic, and resource-rich places, such as the west coast of Canada, in the future. Future maritime mishaps may be prevented in part by giving careful thought to these potentially dangerous spots. Even though the data shows that flag states with poor performance are still a factor, in that they do not adhere to basic international regulation, other factors also strongly contribute to accidents. When all of the following occur simultaneously, the likelihood of a disaster on the high seas increases dramatically:

- Key hotspot locations - Coral Triangle, Southeast Asia; Eastern Mediterranean and Black Seas; North Sea; British Isles; and Irish Sea
- Vessels over 10 years old
- Poorly performing flag states
- Being a general cargo or fishing vessel

The administrative difficulties of the shipping business, including port and flag state management, flag registration, and ratification of International Maritime Organization (IMO) treaties, lie underneath these requirements. The slowing down of the worldwide application of such increasing standards is a direct result of the poor performance of flag states, who tend not to desire regulation and hence do not become party to conventions. The drive to reduce turnaround times in ports and the usage of the bare minimum amount of officers and crew necessary to run a vessel may have negative effects on safety, such as leaving crew members overworked and exhausted.

C. Challenges in crew management and recruitment

Key stakeholders in the global shipping industry continue to worry about the shortage of seafarers, especially officers. This means that ships' skeleton crews may have to put in longer hours in order to make ends meet, and they may also be getting fewer days off. These kinds of practices may have an effect on productivity and, more crucially, can lead to situations where marine safety is compromised. The logistics and marine industries, like any other, benefit immensely from having a trained labor force. Also, today's shipping companies have to deal with a complex environment when it comes to managing

their crew. The persistent disparity between the supply and demand for seafarers has contributed to a volatile seafarer labor market. The increased compensation required to entice senior and experienced sailors is only one of the unintended consequences of a labor market in which demand exceeds supply. According to, shipping companies may become lax in their human resource policies due to the scarcity of qualified mariners and the inherent uncertainty of the profession. Such actions directly hinder the global maritime industry's ability to attract and retain qualified seamen in the long term. The present difficulties in recruiting and retaining qualified seafarers are examined via a case study of VOSCO (Vietnam Ocean Shipping Joint Stock Company) in this article. There are a total of six parts, including this introduction. The second part of the study gives context for the issues discussed in the first, discussing (i) the scarcity of seafarers worldwide and (ii) the shortfall in Vietnam. To aid in the creation of the case study research technique in part four, the existing recruiting and possible retention processes are discussed in section three. The next two parts first go through the study's empirical results, and then provide suggestions for how Vietnamese shipping firms and seafarer employers might better attract and retain maritime workers.

V. TECHNOLOGICAL CHALLENGES

A. Automation and digitalization in the shipping industry

Recent years have seen major ports throughout the globe incorporate new technology to actualize "Smart Ports," with the goals of increasing international competitiveness, lessening environmental impact, and bettering the working environment for port employees. As a result of the advancement of high-speed communication infrastructures like the fifth-generation mobile communication system (5G), smart ports are now anticipated to reap the benefits of the Internet of Things (IoT), Artificial Intelligence (AI), and Big Data, as well as more targeted initiatives, in particular the Physical Internet (PI). Using digital technologies to their full potential, like the ones outlined above, presents significant opportunity for company innovation but also necessitates significant structural changes. In particular, 5G networks allow for the digitization of ports by providing low latency, high capacity, and higher bandwidth; these characteristics make it possible to gather and intelligently handle massive volumes of data exchanged across an Internet of Things (IoT) information network architecture. The broad use of linked, environmentally friendly logistics systems and apps is one of the primary PI goals that 5G is helping to advance.

Connected wireless devices, smart sensors, actuators, data centers, and other IoT-based systems facilitate the exchange of data necessary to establish a smart port. Emerging marine logistics services and applications are shaped by the smart port's architecture, which is built on the continuous connection of ships, cargoes, waterway and shore-based facilities using 5G and IoT technology. Automation of port operations, including vessel management, container terminal operations, and yard automation, significantly improves efficiency, security, and safety, and contributes to the attainment of the highly priority sustainable development objectives.

B. Cybersecurity risks and challenges

About 80% of all merchandise traded between countries is transported by sea. Cyberattacks are a growing threat to marine operations, and this is a problem as a result of the increasing communication involved in international commerce. A cyberattack in 2017 cost the world's biggest container shipping

firm, Maersk, an estimated $200-$300 million. at 2018, a cyberattack occurred at the COSCO facility at the Port of Long Beach. Economic loss isn't the only thing these cyberattacks have cost the marine sector; they've also breached personal or business data, damaged firm reputations, etc. Losses in monetary value, intellectual property, and consumer faith as a consequence of cyber attacks are impossible to put a price on. However, to the authors' knowledge, there is scant scholarly work devoted to maritime cybersecurity. In the context of shipping, cyber risk is defined as the vulnerability of an organization's information technology assets to events or conditions that could compromise their ability to maintain operational safety and security.

Risk management is essential for the safe and secure operation of ships in the marine sector. Cyber risk management is becoming more important in the marine sector as it becomes increasingly dependent on digital, integrated, automated, and network-based technologies. Traditional risk management has concentrated on physical domain operations. The maritime business is lagging far behind other sectors when it comes to cybersecurity research, especially when compared to the military, the financial sector, and the aviation industry. In light of the above, the authors have concluded that maritime cybersecurity is an urgent issue.

C. Technological advances in shipping logistics and supply chain management

Logistics companies are revamping their organizational structures and working relationships to better facilitate the sharing of information, expertise, and data as well as the coordination, decision-making, and planning required to meet customer demands. Björklund and Forslund (2018) argue that in today's information and knowledge-based economy, companies can't survive without developing strategies to increase their capacity to innovate with new technologies. New technologies like artificial intelligence (AI), the internet of things (IoT), and big data are attracting new digital tools that link internal operations and support real-time engagement of the workforce, collaboration among suppliers, and results-oriented consumer experience. Integrating and growing operations with a digital open platform is made possible by cutting-edge online and mobile apps and software that allow for the management of data from several sources. In supply chain logistics, software solutions may be implemented to allow for channel ordering in the supplier's system, as stated by Bajec (2012). Different features for digital planning, digital logistics, and order fulfillment can be found in various software packages. The logistics of a company's supply chain may be improved with the use of software that provides real-time logical systems to facilitate the smooth movement of data and goods through the supply chain. Tools like vendor managed inventory (VMI) and full order transfer to third-party service providers are only two examples of the software cited by Bajec (2012). Solutions for integration into corporate resource planning systems might emerge from software that focuses on individual and atomic supply chain operations. Customer relationship management, cross-dock distribution, and transhipment procedures are among the other software solutions and methodologies described by Bajec (2012). While a centralized asset-recovery program and cutting-edge technological applications facilitate returns, front-end web portals give customers greater insight into the process. Client-driven architecture centered on data collection and analysis is the outcome of the distinctive web application characteristics offered by online and mobile apps. These programs provide access to data on clients, facilitate the exchange of information about new available solutions, and aid in the discovery of potential partners.

Environmental sustainability innovations in supply chain logistics

Supply chain logistics discussions increasingly center on how environmental management and logistical services may be better integrated. Ho and Lin (2008) classify innovations in terms of their technical, organizational, and environmental components. When logistics firms encourage and enable their staff to take positive environmental action, the company as a whole benefits. Improvements in environmental performance, waste management, and financial savings may be realized via green solutions, which in turn boosts workplace efficiency and encourages greater teamwork. In an effort to lessen their carbon footprint, businesses are evaluating innovative technologies that provide customers with real-time insights into how their fleets are doing. Improvements in routing, fuel efficiency, speed, and idling time are tracked and monitored in real time. Solutions related to transportation include, according to Lieb and Lieb (2010), the introduction of an Eco-Transport Program for the use of environmentally friendly methods that promote consolidation of shipments, the instruction of reduced vehicle speed on the organization's fleet in order to reduce fuel consumption and emissions, and the installation of solar panels to supply power as an ancillary service. Marchet et al. (2013) propose carpooling as a way to reduce fuel use, as well as imposing speed limits on work cars. The utilization of renewable energy sources (such as solar panels), energy-efficient material handling equipment, and water systems (such as the implementation of "gray water" systems) are three more major projects involving warehouse energy efficiency.

VI. CONCLUSION

A. Summary of the challenges facing the shipping industry

Humanity's understanding of how harmful emissions are to the planet is expanding. These days, transportation has to be quick, affordable, and ecologically and socially beneficial. This is why the marine industry is embracing novel approaches to cut down on harmful gas emissions. Maritime transportation must expand gradually while also attending to the demands of its current and potential clientele if it wants to maintain and expand its customer base. When thinking about the environment, this might be very challenging. Green shipping technologies are expensive, but they are essential. Customers may suffer as a result of higher prices for services like marine transport and shipping, which might lead to a decline in business. For this reason, it is crucial to strike a balance between ecological preservation and economic development. Sustainable development has become a catchphrase often used by shipping corporations and environmental groups. The marine industry is becoming more engaged in initiatives that will allow for maritime transit to be used in a sustainable, ecologically friendly, socially just, and commercially productive way.

B. Implications for the future of the shipping industry

The maritime industries face fierce and increasing global competition. As a result, Norwegian marine businesses rely on the ongoing innovation of both their goods and their manufacturing processes. Knowledge and new technologies provide the foundation for the growth of Norway's marine clusters. Research in this area is particularly robust, and the use of green, energy-efficient shipping has helped it forge connections with other top sectors of the Norwegian economy. The present article still has certain gaps in its research. While the author looked at how value added from ocean transport affected CO2 emissions, they neglected to account for the other way in which pollution from the air could affect the

maritime economy. The shipping business must conform to stringent laws, and this includes those pertaining to the environment. Therefore, surveys and causality analysis can be used in future studies to better understand this connection. Another drawback is that the research does not take into account sustainability frameworks for specific ports, which would be advised to apply and conduct comparisons of the efficacy of port logistics businesses, owing to a lack of indicators and trustworthy data of port performance. That's why it's important to track ports' progress in sustainability. These restrictions on the current study do, however, provide novel directions for follow-up studies.

C. Recommendations for addressing these challenges

According to studies, maritime transportation encounters several difficulties on a regular basis. At the moment, India seems to have one of the world's largest economies. Therefore, India's future prosperity depends on a robust maritime sector. The shipping business has several obstacles that prevent it from expanding, but they may be addressed via the implementation of sound strategies and the backing of supportive governments. The success of the Indian shipping industry depends on how well enterprises seize the possibilities that exist despite the difficulties. Given India's robust transport sector, it's safe to assume that the maritime industry there will undergo significant changes in the years ahead. All of the problems that plague it now will be overcome, and the maritime sector will emerge as the transportation sector's undisputed leader.

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