Building a Sustainable Future of the Maritime Industry

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Abstract. Maritime transport accounts for over 80% of global cargo shipments and offers numerous advantages. The main challenges facing maritime transport worldwide include increased operational costs of vessels, reduced emissions of pollutants from ships into the environment, and a significant number of maritime accidents and disasters due to improper or untimely actions by crews or shore services.

The research aims to formulate measures for building a sustainable future for the maritime industry in the context of sustainable development in a BANI world.

The methodological basis of the research included a systemic approach, engineering paradigm methods of analysis and synthesis, longitudinal analysis, selective surveys.

To build a sustainable future for the maritime industry in the context of sustainable development, it is not enough to modernize or implement innovations in the maritime sector alone, separate from other participants in the cargo transportation process from sender to receiver. The future of the maritime industry depends on all participants in the cargo transportation process, their strategic partnerships, which, when combined, can generate a synergy effect.

It is proposed to systematically introduce innovations throughout the value creation chain, which should be aimed at the dynamic balanced development of production, mining, processing enterprises providing finished products or valuable minerals for transportation, maritime education institutions, shipbuilding, machinery and equipment manufacturing, IT sphere, ship repair, suppliers of ship fuel, lubricants, spare parts, food, water, other transport companies, seaports, shipping companies, trade service organizations, market infrastructure, based on comprehensive analysis and forecasting of demand and consumer behavior.

Systematized directions of innovative development for the main links in the value chain - maritime transport, maritime education institutions, and seaports.

The research results confirmed the hypothesis regarding the use of the value creation chain, which will allow taking into account the needs and expectations of consumers in shaping the competitive advantages of maritime transport, reducing emissions of harmful substances from ships, reducing transportation costs, and increasing the income of maritime industry organizations.

The formulated proposals are recommended to be applied by maritime industry businesses to reduce the environmental impact on the environment, optimize costs, and improve the quality of transportation services for consumers.

Keywords: maritime transport, maritime education, seaports, innovative development**.**

1. Introduction

Maritime transport carries over 80% of the world's cargo and offers numerous advantages [1]. However, it faces significant challenges globally, including increased operational costs of vessels, reduced emissions from ships into the environment, and a high number of maritime accidents and disasters due to improper or untimely actions by crews or coastal authorities. Addressing these issues necessitates the exploration of new ideas for overcoming these challenges and further developing the maritime industry.

Research on the development of maritime transport, the infrastructure expansion of seaports, and logistics solutions has been conducted by scholars such as G. Ye. Bielaieva, O.G. Pustovit [2], O.M. Kibik, O.P. Podtserkovnyi, Yu.Z. Drapailo [3], M. Matvienko [4], and others. However, ensuring the safe and economic functioning of maritime transport within the context of sustainable development requires more than just innovations on ships and in shipping companies. It involves building strong competitive advantages for all participants in the cargo transportation process.

The aim of this research is to formulate measures for building a sustainable future for the maritime industry in the context of sustainable development in the BANI world.

2. Building of the Maritime Industry Value Chain

The concept of sustainable development is focused on satisfying the needs not only of the current generation but also of future generations. This is made possible by balancing three components of sustainable development: economic, social, and environmental. On August 25, 2023, the United Nations General Assembly declared the period from 2024 to 2033 as the International Decade of Science for Sustainable Development.

Our new reality is characterized by unpredictable and rare events with significant and unforeseen consequences. We are currently living in a BANI world, which stands for Brittle, Anxious, Nonlinear, and Incomprehensible) [5].

Success in a BANI world can only be achieved through innovation. To build a sustainable future for the maritime industry, for its safe and economical functioning, it is not sufficient to modernize or introduce innovations only within the maritime sector, isolated from other cargo transportation participants. The efficiency of maritime transport operation depends on all participants in the cargo transportation process, their strategic partnerships, which, when combined, can create a synergistic effect.

Building a sustainable future for the maritime industry depends on the harmonious functioning of the following participants (taking into account requirements and innovations in

the political, legal, scientific, technical, sociocultural, and other factors of the macro-environment):

- Suppliers providing production factors (cargo from production, extraction, processing, and other enterprises with goods for transportation, fuel and lubricants, spare parts, food for crews, ship repair, the quality of educational services for crew members, etc.);
- Other transport companies (road, rail, air) and companies (banks, insurance companies, etc.);
- Shipping companies;
- Seaports;
- Distribution channels that transport the product to the consumer.
- Consumers of the product, using it to meet specific needs.

The BANI world demands the continuous reengineering of all business processes in organizations and boosting innovation in all links of the value chain since inefficient distribution channels or changes in consumers not considered by producers can lead to a lack of demand for products, and consequently, cargo transport will have no goods to carry. Similarly, maritime transport, if it does not consider changes occurring in previous links in the value chain (cargo flows, equipment at berths in seaports, the energy resource market situation, shortage of maritime professionals), will not be able to achieve its goals effectively and will not be competitive.

Let's delve into more detail about the key participants in the value chain: maritime transport, seaports, and institutions of higher maritime education (due to space limitations).

3. Trends in the Innovative Development of Maritime Transport in the World

Trends in the Innovative Development of Maritime Transport Worldwide, which will contribute to environmental improvement of maritime vessels, include:

- Increasing the linear dimensions of container ships to enhance vessel efficiency, cruise ships for quality tourist service.
- Utilizing fuel-efficient and environmentally friendly maritime vessels to reduce sulfur, nitrogen, and carbon content in bunkers.
- Using LNG as ship fuel to reduce harmful emissions from vessels.

Applying alternative energy sources (ammonia, hydrogen, biofuels, methanol, solar, wind, water) to reduce emissions of harmful substances from vessels [6].

- Container shipping: to accelerate unloading in the future, specially designed waterproof reservoirs will be used, which will be dumped overboard at anchor, and then tugs will deliver them to the pier.
- Prospective construction of underwater vessels.
- Implementation of intelligent transportation systems, transforming vessels into data processing centers.
- Enhancing maritime transport safety through the introduction of unmanned vessel management and more.

4. Formation of Maritime Officers Soft Skills in Higher Education Institutions

High-tech maritime vessels present new challenges in terms of maritime transport professionals' competencies. The development of a sustainable society places demands on the modern individual and maritime officers for employment and living: the ability to adapt in turbulent conditions and cope with any non-standard work situations.

Prerequisites for employment include competencies that enable seafarers to quickly understand what is happening in the work environment and respond immediately to new problems.

Maritime education must proactively shape hard and soft skills that align with the requirements of sustainable development and employer expectations, involving a mass customization of education.

In particular, requirements for the preparation of a new generation of maritime professionals are changing, emphasizing the need for soft skills that help individuals realize themselves as individuals, find employment, and a place in life and society.

Research identifies various groups of soft skills. However, the work of maritime vessel crews has significant peculiarities—it takes place in conditions of social isolation, beyond usual and direct contact with a wide social environment.

A harmonious atmosphere on board the vessel, created by the teamwork, contributes to the preservation of the health and lives of seafarers, successful work, and in critical situations, helps prevent panic and ensures the safety of cargo, the vessel, and the crew.

To determine the main soft skills that need to be developed during lectures, practiced in practical classes, and training sessions, selective observation was conducted.

Based on the results of selective surveys of 46 maritime officers enrolled in a master's program, with experience working at sea for more than two contracts, and studying at the Faculty of Navigation, the following soft skills were identified as necessary for a maritime

career: resilience (95.1% of respondents), attentiveness (87.8%), teamwork skills (85.4%), communication skills (80.5%), responsibility (73.2%), and leadership qualities (58.5%).

5. Directions of Seaports Innovative Development

The efficiency of maritime transport operation depends on the functioning of maritime ports, their level of technological and technical equipment, compliance with modern international requirements, and trends in management systems and infrastructure development. Efficient processing of worldwide maritime vessels, prevention of maritime accidents, and demand for the development of intelligent maritime ports exist. Port technology will simplify shipping by optimizing and accelerating various port processes. Additionally, it will have a positive impact on the environment (reducing greenhouse gas emissions due to shorter vessel stays in port waters and other modes of transport within the port area) and vessel safety [7].

Research into the directions of innovative development of leading ports worldwide has identified the latest trends in the port industry: digitization of logistics flows and data processing, the use of drones, automation of management processes, increasing port capacity, and more. These trends will contribute to environmental improvement, reduce the number of human errors, and thus enhance the efficiency of maritime ports' activities.

The proliferation of digitization in maritime ports will be facilitated by the implementation of the Internet of Things (IoT), robotics, artificial intelligence, unmanned vehicles and equipment, blockchain technology, as well as developments in the field of cyber security, 3D modeling, and 3D printing, among others [7].

6. Conclusion

To build a sustainable future for the maritime industry in the context of sustainable development, it is proposed to systematically introduce positive changes throughout the value chain. These changes should be aimed at the dynamic balanced development of manufacturing, extraction, processing enterprises that provide finished products or valuable minerals for transportation, maritime education institutions, shipbuilding, machinery, and instrument manufacturing, IT sphere, ship repair, suppliers of ship fuel, lubricants, spare parts, food, water, and other transport companies, maritime ports, shipping companies, trade service organizations, market infrastructure, based on comprehensive analysis and forecasting of demand and consumer behavior.

Systematized directions for innovative development for the main links of the value chain have been outlined, including maritime transport, maritime education institutions, and maritime ports.

The research results confirmed the hypothesis regarding the use of the value chain, which will allow for taking into account the needs and expectations of consumers when forming competitive advantages in maritime transport, reducing emissions of harmful substances from maritime vessels, reducing costs for cargo delivery, and increasing the revenues of maritime industry business organizations.

The proposed recommendations are recommended for implementation by maritime industry businesses to reduce environmental impact, optimize costs, and improve the quality of transportation services for consumers.

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