

## TRENDS IN THE FORMATION OF SYSTEMIC SECURITY OF THE MARITIME TRANSPORT INDUSTRY STATE

## ТЕНДЕНЦІЇ ФОРМУВАННЯ СИСТЕМНОЇ БЕЗПЕКИ СТАНУ МОРСЬКОЇ ТРАНСПОРТНОЇ ІНДУСТРІЇ

The article analyzes the features of the formation of systemic security of the state of the maritime transport industry. The development of the maritime transport industry, as a process conditioned by the dialectic of social history, requires a special quality of social regulators. In addition, attention is drawn to the system of conditions for stable positioning. The article substantiates the need for a system of restrictions that predetermine the directions of strategic management of the marine economic complex. Therefore, at the center of any development there is the principle of compliance with the standards and rules of maritime administration to achieve not only economic results but also systemic safety. The maritime transport industry, along with the standard commercial goals of development and operation provides some freight security of foreign economic relations of the country, which leads to the principle of combining business activities and state support of shipowners and other units of the maritime complex in creating special conditions. The set of international requirements for the safety of navigation is becoming one of the criteria for limitations for the sustainable positioning of the maritime industry.

**Key words:** maritime transport industry, institutional regulation, sustainable positioning, safety management, risk, navigation safety, safety criteria, maritime administration, "human factor".

В статті аналізуються особливості формування системної безпеки стану морської транспортної індустрії. Розвиток морської транспортної індустрії, як процес, обумовлений діалектикою суспільної історії, вимагає особливої якості соціальних регуляторів. Крім того звертається увага на систему умов стійкого позиціонування. Важливим чинником стійкого позиціонування вітчизняного морського транспорту в світовому торговельному мореплаванні на основі загальносистемних критеріїв ринкових відносин стає розробка національних норм операторської діяльності і прийняття проектних рішень. Кодекс торговельного мореплавання та інші акти, що регулюють зовнішньоекономічну діяльність флоту, повинні враховуватися системою стимулювання використання ресурсів з комерційних цілей і обмежень безпеки. У статті обґрунтовано необхідність в системі обмежень, які зумовлюють напрямки стратегічного управління морегосподарського комплексу при формуванні особливих умов діяльності. З цих позицій важливо вести збалансовану політику у формуванні структури власності. В свою чергу в статті приділяється увага адмініструванню в системі торгового мореплавання, що будується на реалізації стандартів і положень міжнародних і національних інституційних організацій. Вся система міжнародного адміністрування в торговому мореплаванні зосереджена на його безпеці і на досягненні досягнених правомірності діяльності судновласників і операторів в комплексі трудових відносин. Головною, кінцевою метою адміністрування є мінімізація негативних наслідків функціональної діяльності флоту і портів в реальних умовах розвитку глобальної транспортної індустрії. Сукупність міжнародних вимог з безпеки мореплавання стає одним з критеріальних обмежень сталого позиціонування морської індустрії.

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лектикой общественной истории, требует особого качества социальных регуляторов. Кроме того обращается внимание на систему условий устойчивого позиционирования. В статье обоснована необходимость в системе ограничений, которые определяют направления стратегического управления морехозяйственным комплексом. Поэтому в центре любого развития лежит принцип соответствия стандартам и правилам морского администрирования по достижению не только экономических результатов, но и системной безопасности. Морская транспортная индустрия наряду со стандартными коммерческими целями развития и функционирования обеспечивает определенную фрахтовую безопасность внешнеэкономических отношений страны обуславливает возникновение принципа сочетания предпринимательской деятельности и государственной поддержки судовладельцев и других подразделений морехозяйственного комплекса при формировании особых условий деятельности. Совокупность международных требований по безопасности мореплавания становится одним из критериальных ограничений устойчивого позиционирования морской индустрии.

**Ключевые слова:** морская транспортная индустрия, институциональное регулирование, устойчивое позиционирование, управление безопасностью, риск, безопасность мореплавания, критерии безопасности, морское администрирование, «человеческий фактор».

У статті аналізуються особливості формування системної безпеки стану морської транспортної індустрії. Розвиток морської транспортної індустрії, як процес, обумовлений діалектикою суспільної історії, вимагає особливої якості соціальних регуляторів. Крім того звертається увага на систему умов стійкого позиціонування. Важливим чинником стійкого позиціонування вітчизняного морського транспорту в світовому торговельному мореплаванні на основі загальносистемних критеріїв ринкових відносин стає розробка національних норм операторської діяльності і прийняття проектних рішень. Кодекс торговельного мореплавання та інші акти, що регулюють зовнішньоекономічну діяльність флоту, повинні враховуватися системою стимулювання використання ресурсів з комерційних цілей і обмежень безпеки. У статті обґрунтовано необхідність в системі обмежень, які зумовлюють напрямки стратегічного управління морегосподарського комплексу при формуванні особливих умов діяльності. З цих позицій важливо вести збалансовану політику у формуванні структури власності. В свою чергу в статті приділяється увага адмініструванню в системі торгового мореплавання, що будується на реалізації стандартів і положень міжнародних і національних інституційних організацій. Вся система міжнародного адміністрування в торговому мореплаванні зосереджена на його безпеці і на досягненні досягнених правомірності діяльності судновласників і операторів в комплексі трудових відносин. Головною, кінцевою метою адміністрування є мінімізація негативних наслідків функціональної діяльності флоту і портів в реальних умовах розвитку глобальної транспортної індустрії. Сукупність міжнародних вимог з безпеки мореплавання стає одним з критеріальних обмежень сталого позиціонування морської індустрії.

**Ключові слова:** морська транспортна індустрія, інституційне регулювання, стійке позиціонування, управління безпекою, ризик, безпека мореплавання, критерії безпеки, морське адміністрування, «людський фактор».

**Problem statement.** The development of the national maritime transport industry and the global maritime economy is a complex process involving many different actors. Various social norms are used to regulate emerging social relations; the development of the maritime industry, as a process conditioned by the dialectic of social history, requires a special

quality of social regulators. In this regard, institutional regulation at the national and international levels has proved to be an indispensable tool for ensuring both technical and socio-economic progress.

Nowadays, the amount of information provided to the seafarer is often excessive, which negatively affects his or her management decisions. Given the

time constraints in selecting and interpreting the most important information, as well as the fact that a person is unable to process so much information, the likelihood of situations leading to accidents and catastrophes is high.

An example of information overload is the situation when it is difficult for the captain's shift assistant in the area of heavy traffic to identify the most dangerous ship among the many marks on the screen of the radar station and to take priority action in dangerous situations, especially the limitations caused by physical and mental condition and human characteristics. Limited resources and lack of time to make decisions are complicated by high responsibility for their actions. The study of this problem led to the formation of models of causal dependence of crew members in the operation of the vessel, associated with increased danger and responsibility, among which the most famous is the Heinrich Pyramid (1931) and Reason's Swiss Cheese Model (1990). Despite progress in addressing the impact of the "human factor" on shipping safety, the issue is still far from being resolved. Maritime administration is concerned that the human element is a complex multidimensional problem that covers the full range of human activities at sea. The need to regulate the "human factor" is a particularly urgent and complex task of maritime administration.

**Literature review.** Problems and analysis of the development of maritime transport in Ukraine, as well as the role of maritime transport in the world economy and its formation are widely covered in the works [1–4]. The works by Nicolas Primachov are devoted to the management of the safety of navigation. However, despite the significant contribution of the authors of these studies to the study and analysis of navigation safety problems, the studies did not highlight the ways and prospects for the formation of systemic safety of the state of the maritime transport industry regarding the current situation. The presented works by the authors served as a fundamental basis for the analysis and substantiation of strategic priorities for the safe functioning of the Ukrainian maritime industry.

**Research objective.** The purpose of this article is to identify the problems of sustainable functioning of the global maritime trade market and the functional activities of the fleet, as well as the effective positioning of Ukraine's maritime transport in the world merchant shipping.

**Key results.** The Merchant Shipping Code and other acts regulating the foreign economic activity of the fleet must be taken into account by the system for stimulating the use of resources for commercial purposes and safety restrictions.

Resource use and safety management are closely related to the reservation of transport capacity according to sustainability criteria. The reserves of maritime transport companies should be formed on the principles of the adequacy of marginal costs and

equilibrium tariff rates. When forming a strategy for the sustainability of operator activities, one should bear in mind the development of intermodal transport communications, which do not allow inconsistencies between individual parts of the system.

It is important to provide for reserves for handling transit cargo flows in any strategy for the development of national maritime transport potential. As a basis for the formation of additional reserves in relation to standard needs, it is necessary to take into account Russia's need for handling cargo flows in the winter. It should be remembered that shipping conditions become more difficult for at least two months in the ports of the Baltic basin. An increase in transit cargo flows to the trade ports of Ukraine is possible precisely due to this time.

Thus, the share of the operator's activity risk in the competitive sustainability management system of a shipping company is minimized. The differentiation of the risk of managing the stability of the profitability of tanker, bulk, container and refrigerated fleets is known. Hence, given a severe limitation of investment resources and an increase in requirements for the safety of navigation, programs with a minimum capital intensity and maximum development capitalization should be selected. As an example of managing the value of a shipping company according to safety criteria, we can consider the BP Oil Shipping Company's tanker fleet replenishment program. The safest double bottom tankers are commissioned. The double bottom of the vessel is designed for 35 years of continuous use, and the deck for 50 years of intensive use. That is, the liquidity of tankers of this class does not decrease to the level of scraping costs.

The maritime transport industry, along with the standard commercial goals of development and operation, provides a certain freight security of the country's foreign economic relations. Therefore, traditionally, the principles of combining entrepreneurial activity and state support for ship-owners and other subdivisions of the maritime complex should be preserved when creating special conditions for activity. From these positions, it is important to pursue a balanced policy in the formation of the ship-owners structure.

The regularity of the functioning of the world maritime trade market is the increase in operating costs. This is due to the increased requirements for the quality of transport services and the safety of navigation. In liner shipping, the management of the transportation process is provided by the owner of the fixed capital or the management of the company. In the non-scheduled commercial shipping sector, the principle of chartering is widely used. As a result, the economic, legal and power relations between the owner of the fleet and the charterer are being formulated. On this basis, problems arise in assessing the value of the fleet and the dynamics of investment resources.

In this aspect, an important direction of the maritime safety service is the classification of ships by their condition. The European Union has established standards for the reconstruction of ships, the issuance of navigation certificates, repair and maintenance work. At the same time, strict control is established over the activities of such services. Therefore, the inspectorate of the European Maritime Safety Agency has unlimited access to the necessary documents. When violations are found, strict sanctions prescribed by the European Union norms are applied.

The safety of navigation stands out among the complex set of problems of the sustainable functioning of the global maritime trade market and the functional activities of the fleet. Both international maritime organizations, individual states and their unions are engaged in providing it. This is especially important in the European Union and the United States. The maritime industry of the latter, together with the Coast Guard, is developing a long-term accident prevention strategy taking into account the role of technical and human factors.

The most important factor in the operation of vessels is the safety of navigation and the protection of human life at sea during effectively solving the tasks. The most important component of the no accidents fleet operation is based on a systemic approach to the study of measures aimed at implementing the requirements of maritime administration in the field of maritime safety and prevention of environmental pollution. A systematic approach to the study of maritime safety, taking into account all the basic elements of safety on board, can help to reduce the level of accidents in shipping. In this case, the "human factor" is the most dynamic element, which should be given much attention.

One of the factors determining the economic costs of the development and operation of the fleet is the level of its safety. Marine accidents cause three types of losses: economic, human and environmental. Therefore, reducing the risk of accidents due to technical reasons and the role of the human factor determines the costs of creating transport potential and ensuring the efficiency of its work. It is necessary to take into account international provisions that provide for both the normalization of costs and the tasks of the ship owner to manage the financial stability of the company.

Administration in the merchant shipping system is based on the implementation of standards and regulations of international and national institutional organizations. The entire system of international administration in merchant shipping is focused on its safety and on the achievement of socio-economic standards for the work and rest of seafarers. Achieving the legitimacy of the activities of shipowners and operators in the complex of labor relations becomes fundamental.

The safety problems of navigation are aggravated every year and are caused by numerous factors leading to an increase in the number of accidents, inci-

dents with passenger and merchant vessels. In the last decade, one of the main factors in the increase in accidents, arrest and seizure of vessels was determined by the lack of system solutions for the information security of navigation, the insufficiency, unreliability and untimely provision of masters with the necessary information for the safe management of the vessel was established.

An analysis of the basics of information security has shown that security is a complex task. On the one hand of the information regime, information security presupposes, at least, ensuring its three components – availability, integrity and confidentiality of data. And with this in mind, the problem of information security should be considered comprehensively. On the other hand, information systems "permeate" all spheres of shipping activity and the influence of information on the development of the maritime complex is growing, therefore, ensuring information security also requires an integrated approach.

The following information systems and technologies are used to ensure the safety of navigation in shipping:

AIS is an Automatic Identification System that serves to transmit the vessel's identification data (including its cargo), information about its condition, current position and heading. It is also used to prevent collisions of vessels, monitor their condition; with its help, the owner can monitor the vessel. It provides communication between courts. The device works by transmitting ultrafast waves signals between vessels that float as repeaters and coastal AIS gateways and they are connected to the Internet. All vessels on international voyages, vessels of over 500 gross tonnage, and all passenger vessels must be equipped with AIS. The system works on marine search and rescue equipment.

ECDIS is Electronic Chart Display and Information System, which collects and uses AIS messages, data from radars, GPS and other ship sensors (from a gyrocompass) and compares them with embedded maps. It is used for navigation, automation of certain tasks of the navigator and increasing the navigational safety. Since 2019, ECDIS is mandatory installed on all ships. The system is usually connected to the ship's sensors and instruments by a workstation on which the ECDIS software is installed. The requirements of the International Maritime Organization (IMO) for an electronic system for displaying graphical data and information have become the basis for a new paradigm of navigation systems that have combined all modern navigation aids on one display and in one control structure.

VDR is Voyage Data Recorder, trip recorder, analogue of the "black box" used in aviation. The main tasks are to record important voyage information of the vessel, including both technical and heading data, as well as voice recordings from the captain's bridge, and to store it in case of an emergency.

TOS is Terminal Operating System. It is the IT infrastructure that serves the purpose of automating the processes taking place with cargo in the port – loading and unloading them, inventory and monitoring of movement through the port territory, optimization of storage and search for the containers needed at the moment, ensuring further transit. The most complex and heterogeneous item on the list, since in practice it can be both an integral product of a particular vendor, and a set of systems (including general purpose ones) that perform various tasks.

CTS is Container Tracking System. It is a system that allows to track the movement of containers using GPS and, less often, other data transmission channels. Most of the companies in this field also offer tracking devices for other areas, for example, personal trackers for tourists, solutions for vehicle tracking, etc.

EPIRB is Emergency Position Indicating Radio Beacon. It is a transmitter that sends a distress signal, the transmission of which, depending on the technology of execution, can be carried out via satellite, in the VHF band, or in combination.

Over the past decades, even before the IMO initiated the transition to innovative safety systems, an intensive introduction of modern technologies began in the design and construction of bridges. Currently, the main concepts are systems interconnection and redundancy, which provides crew members with much greater control over control and navigation competencies.

The IMO resolution has become a powerful stimulus to the study of the “human factor” in the activities of the maritime complex. In the psychological aspect, the “human factor” is a factor that determines the ability of the driver to receive and process navigation information. Many studies explore the ability of the navigator to act in extreme navigation situations and difficult sailing conditions. The stereotype of the “human factor” as a psychological component is formed. Unfortunately, the fact is often omitted that “the control system of a moving object (ship, vessel, aircraft) is a human-machine and consists of a regulator, which includes both the operator and the object of regulation, which is a moving object to the project as an engineering structure» [5, p. 1].

Omission introduces a number of significant problems in research of the fact that the driver as an element of the technical regulator. When studying the “human factor” in navigation, it is necessary to simultaneously take into account the psychophysiological state of the master, his or her personal characteristics, and the characteristics of the ship’s handling as an object of control.

The term “human factor” is perceived in the world as a negative phenomenon that threatens the effective development of shipping. However, without the human factor, progress is impossible. Scientific and

technological progress allows us to make more effective management decisions in shipping. Since the second half of the 20th century, the development of scientific and technological progress has been reflected in maritime shipping. With the creation of new transport and technological systems, international trade began to grow. Due to this, there was a need to speed up the delivery of goods.

The link between the development of scientific and technological progress and social development is inseparable, which makes it difficult to accurately predict. However, the pace of scientific and technological progress has increased significantly, the stage of implementation of scientific developments in shipping has decreased, and science itself is playing an increasingly important role in technical and organizational support for the effective development of the global maritime trade market. With the judicious implementation of scientific and technological progress, much can be improved and facilitated, but at the same time there are new problems.

The British scientist Alfred North Whitehead rightly remarked: “Civilization is moving forward by increasing the number of operations that we can carry out without thinking about them” [6, p. 16].

Modern scientific and technological progress has found wide application in the field of shipping. Despite the rapid increase in the level of shipping intensity, the effect of scale, sea ranges, which were previously considered impossible due to safety, navigation automated systems; the problem of accidents remains unresolved. The impact of the “human factor” on the level of accidents remains high.

The “human factor” in navigation is the willingness and ability of a seafarer to make management decisions based on their psychophysiological and professional qualities in conjunction with the data provided to him or her by modern technical means.

IMO Resolution A.772 “Fatigue factors in manning and safety” provided some clarity in the interpretation of the concept of “human factor”. It systematized the factors of ship and shore-based personnel that affect the state and maintenance of the security management system. In the share of the “human factor” is more than 70% of all maritime accidents, the figures are as follows: errors of shore personnel – 14%, cargo problems – 5%, miscalculations of pilots – 5%, design flaws – 10%, equipment failures – 8%, errors in the composition of ships – 27%, errors in the crew – 17%, others – 14%.

From the seafarer’s point of view, vessel traffic control is interpreted as an activity aimed at achieving a certain goal (transition from the port of loading to the port of unloading, disagreement with the ship, maneuvering against possible pirate attacks, etc.) with regard to the environment. It is very important to study the “human factor” in shipping, a macrostructural analysis of ship operation in terms of psychology.



**Conclusions.** Shipping is the safest and most environmentally friendly form of commercial transportation. Perhaps alone in a physical hazard industry, commitment to safety has long been a major issue in the maritime transport industry. Shipping was among the first five industries to adopt international administration safety standards. Due to its inherently international nature, the safety of navigation is regulated by various UN offices, in particular the International Maritime Organization (IMO), which has developed an integral system for regulating global maritime security.

The main, ultimate goal of the administration is to minimize the negative consequences of the functional activities of the fleet and ports in the real conditions of the global transport industry. The set of international requirements for maritime safety is becoming one of the criterion constraints on the sustainable positioning of the maritime industry. Therefore, the principle of compliance with standards and rules of maritime administration is at the heart of any development of the maritime complex to achieve not only economic results but also system security.

The direction of the state maritime policy should contribute to further strengthening the position of Ukraine as a maritime state, creating favorable conditions for achieving the goals and solving problems of developing the systemic security of the national maritime fleet.

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