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# APPLICATION OF THE SYSTEM APPROACH TO THE DEVELOPMENT OF THE PROJECT OF A SAFETY MANAGEMENT SYSTEM FOR NAVIGATION IN UKRAINE

*Представлено системний підхід до розробки проекту системи управління безпекою судноплавства (УБС) в Україні і до її методологічної бази забезпечення транспортної безпеки. Визначені значущі і пріоритетні чинники для економічних і геополітичних інтересів України. Розглянуто умови для формулювання і постановки завдань управління безпекою судноплавства і створені основи розробки моделей і методів вирішення цих завдань.*

**Ключові слова:** системний підхід, проект системи, управління безпекою судноплавства, фактори безпеки.

## 1. Introduction

The national transport strategy of Ukraine for the period up to 2030 determines the content of the state policy in the field of ensuring the transport safety of navigation, the program for its implementation and sets in motion the implementation mechanism [1].

The marine transport industry of Ukraine has an extensive network of navigable routes, sea ports and river terminals, developed infrastructure and interacts with other types of transport in Ukraine. This creates the necessary prerequisites for meeting the population's needs for transport services and business development.

Maritime transport is an important part of the economy, provides services for both domestic and export/import and transit transport of goods and passengers. Maritime transport is an integral part of the overall state economic policy and ensuring the country's defense capability.

The level of transport safety of navigation depends, in the main, on the interaction of negative (threat) and positive factors of influence in the following areas of manifestation [2]:

- technical and technological;
- organizational and managerial;
- ecological;
- antiterrorist (protection from acts of unlawful interference in transport activities).

Provision of technical and technological factor of transport safety of navigation covers the following issues:

- technical condition of transport infrastructures, transport facilities, vehicles;
- technical safety regulations throughout the life cycle (design, production, operation and disposal) of objects of technical and technological transport safety;
- scientific and technical development and improvement of objects of technical and technological transport safety.

Provision of organizational and management factor of the transport safety of shipping covers the following issues:

- monitoring the level of transport security, control and supervision in the field of transport activities;

- organization of the system (structure and functions) of the permanent state administration (public-private partnership) in the field of ensuring transport security;
- advance and sufficient resource support (personnel, scientific and technical issues, financing);
- categorization of transport safety objects by the degree of vulnerability;
- licensing and certification.

Provision of the environmental safety factor of shipping covers issues [3]:

- assessment of environmental damage and measures to prevent it;
- monitoring of the two components of the environmental hazard of maritime transport – operational and emergency;
- control over compliance by all ships and ports with the requirements of the international MARPOL Convention 73/78 in respect of environmental protection.

Provision of the protection of maritime traffic from illegal acts (terrorism) covers issues [4]:

- development of a set of legal, organizational, operational, administrative, regime, military and technical measures providing for the establishment and functioning of coordination bodies and operational headquarters of various levels, maritime security units;
- organizational support for the protection of ships and port facilities, inspection of crew members of ships, maintenance personnel, passengers, hand luggage, baggage, cargo, technical supplies and food stock.

The safety of navigation should be ensured, first of all, by rigorous execution and observance of the relevant norms of international law and Ukrainian legislation by participants in the transportation and other activities in the water areas.

In this paper, first of all, the project of a safety management system for navigation (NMS) in Ukraine is being considered. The relevance of this study is also connected with the definition of significant and priority factors for Ukraine's economic and geopolitical interests.

## 2. The object of research and its technological audit

The object of research is the activity to manage the safety of navigation in maritime and river transport. The central body of executive power carrying out this activity is the State Service of Ukraine for Transport Safety (Ukrtransafety) [5].

Ukrtransafety guided by the Constitution and laws of Ukraine, decrees of the President of Ukraine and resolutions of the Verkhovna Rada of Ukraine, adopted in accordance with the Constitution and laws of Ukraine, acts of the Cabinet of Ministers of Ukraine, other acts of legislation.

The main tasks of Ukrtransafety are:

1) implementation of the state policy on security issues in land transport and security in maritime and river transport;

2) submitting proposals to the Minister of Infrastructure for ensuring the formation of a state policy on security issues in land transport and security in maritime and river transport;

3) implementation of state supervision (control) of safety on land transport, maritime and river transport;

4) provision in administrative cases provided for by administrative services in the field of land, maritime and river transport.

The main shortcoming in the implementation of Ukrtransafety is the lack of comprehensive methodological support for formation of the level of transport security, depending on the impact of technical and technological, organizational and management, environmental and anti-terrorist factors of impact. The principal scheme of the effect of factors on maritime and river transport is shown in Fig. 1.

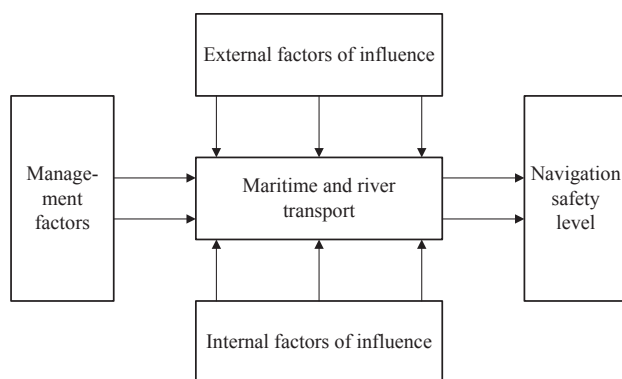


Fig. 1. Schematic diagram of the impact of factors

For the system solution of the problem of ensuring the safety of maritime and river navigation, the implementation of a specialized management system is required. A safety management system for shipping is understood as a complex organizational and technical system that performs the functions of analyzing the state, control and security of both individual functional elements and processes and the system as a whole.

## 3. The aim and objectives of research

The aim of research is application of a systematic approach to development of the project for the creation of this system.

To achieve this aim, it is necessary to solve the following tasks:

1. To analyze the current state of the level and ensure the transport safety of navigation.

2. To identify the problems and directions of ensuring the transport safety of navigation.

3. To develop a systemic methodology for managing the security of shipping security.

## 4. Research of existing solutions of the problem

Since 1959, the International Maritime Organization (IMO) is the only specialized agency of the United Nations engaged exclusively in maritime navigation. IMO creates a forum for cooperation between Governments in the field of national regulations and practices relating to all types of navigation in international trade. This facilitates the adoption of comprehensive multilateral treaties for a wide range of technical measures and, in particular, the adoption of the highest practical standards aimed at improving the safety and efficiency of shipping in international trade [6].

IMO's achievements in its field of competence since 1959 have included the adoption of approximately 50 international conventions and protocols and more than 800 codes, recommendations and guidelines relating to these international instruments.

It is the responsibility of IMO to fully consider all technical, as well as operational, areas of competence affecting safety at sea, including technical development, namely:

- designing and equipping of ships;
- fire protection;
- safety of navigation;
- radio communication;
- search and rescue;
- training and certification of seafarers;
- cargo transportation;
- State Flag implementation;
- control of the port state;
- increase of safety on ships and in ports;
- facilitation of international maritime navigation.

The International Convention for the Safety of Life at Sea [7] (SOLAS), in its consistently published forms, is perhaps the most important of all international agreements on the safety of merchant ships.

Each ship that makes an international voyage and is subject to this normative document [7] must comply with its requirements. Otherwise, it may be delayed, and for some positions ISPS (Code) [7] and not allowed to the port. The current version of the document is known as SOLAS-74.

The main purpose of this normative document is to establish minimum standards that meet the safety requirements for the construction, equipment and operation of ships.

Flag States should ensure that ships that fly their flag comply with SOLAS requirements. To prove their implementation, the Convention provides for a number of certificates. Such documents (usually referred to as «conventional») are issued either by the Flag Administration itself or on its behalf («under the authority of the Administration») – if there is an appropriate instruction.

The monitoring conditions also allow Contracting Governments to inspect ships flying the flags of other states,

especially if there are clear grounds for doubt that the vessel and/or its equipment do not materially comply with the requirements of the Convention. This procedure is called «Port State Control» (PSC).

The current text of the SOLAS Convention includes Articles that set out general obligations, procedures for introducing changes, etc., and is accompanied by an Annex divided into 12 chapters defining the requirements for the safe operation of ships.

The International Safety Management Code (ISM) was adopted on November 4, 1993 at the 18th Session of the IMO Assembly [8].

The main conclusion from the results of the studies was the lack of a system for managing the safe operation of ships and preventing pollution, as well as the inadequate preparedness of crews for actions in emergency situations. The practical result of the conducted studies was the development and implementation of various national and international recommendations as well as normative documents that are mandatory for implementation.

The objectives of the Code are to ensure safety at sea, to prevent accidents or loss of life and to avoid harm to the environment, in particular the marine environment, and property. The objectives of the Code are followed by the requirements for shipping security management companies, including:

- 1) ensuring the safe operation of ships and a safe environment for humans;
- 2) assessment of all identified risks associated with ships, personnel and the environment and the organization of appropriate protection against them;
- 3) continuous improvement of the skills of onshore and shipboard personnel for safety management, including readiness for emergency situations related to both safety and environmental protection.

The safety management system should provide:

- 1) compliance with mandatory rules and regulations;
- 2) application of codes, guidelines and standards recommended by the Organization, Administrations, classification societies and marine industry organizations.

The requirements of this Code may apply to all ships. Every company should develop, use and maintain a Safety Management System (SMS) which includes the following functional requirements:

- 1) policy on safety and environmental protection;
- 2) instructions and procedures to ensure safe operation of ships and protection of the environment, in accordance with relevant international law and legislation of the flag State;
- 3) scope of authority and the link between the personnel on shore and the ship, and within them;
- 4) procedures for the transmission of reports of accidents and cases of non-compliance with the provisions of this Code;
- 5) procedures for preparing for emergencies and actions in emergency situations;
- 6) procedures for conducting internal audits and procedures for reviewing management.

It is noted in [9] that in recent years the marine industry has faced numerous changes and problems. Most of them have created new requirements for knowledge levels and staff understanding of the problems that are working on the ground, especially for those at the management level. The safety of maritime activities is one of the areas

associated with the complication of the maritime profession and the need for new knowledge. A very important aspect of the training process for training seafarers is to raise staff awareness of the new challenges of the time. To this end, educational institutions involved in training are required to develop and offer qualified courses that cover the most recent requirements.

The Maritime University in Constanta (Romania) and the Maritime Academy in Varna (Bulgaria) decided to develop a master's program dedicated to raising the awareness of maritime personnel in security matters. This program was developed with the support of IAMU and The Nippon Foundation in Japan. This document presents the aims and objectives of the MARSAs project – raising awareness of the safety of maritime personnel and ways to implement them through the developed training materials and evaluation methods. The program includes such topics as maritime safety, navigation safety, risk-based safety, security knowledge in piracy zones, special operations of ships.

The paper [10] deals with the US National Maritime Security Strategy. It brings together all programs and initiatives in the field of maritime safety of the federal government into integrated and integrated national events with the participation of relevant departments, sectors and other areas.

In addition to this Strategy, the Departments developed eight supporting plans to address specific threats and problems of the marine environment. Although the plans address various aspects of maritime security, they are inter-related and reinforce each other. Supporting plans include:

- national plan to raise awareness of the marine domain;
- a global plan for the integration of maritime intelligence;
- temporary response plan for sea operational threats;
- international advocacy and coordination strategy;
- marine infrastructure restoration plan;
- security plan for the maritime transport system (the plan is based on the call for recommendations on improving the national and international regulatory framework for the maritime region);
- security plan for maritime trade (the plan is based on a comprehensive security plan for the marine supply chain);
- internal plan (the plan is based on an internal information and propaganda plan that does not include federal materials to assist in the development and implementation of maritime security systems).

In [11], the structure of safety of the maritime transport system was developed and the task of ensuring its safe functioning was formulated. The principles and categories of ensuring safety of navigation and risks of losses are grounded.

The conducted research has shown that the main reasons for the increase in accidents in the marine fleet are economic, technical, information and human factors. When developing measures to ensure the safety of navigation in order to improve the information and technological support of the ship's on-board equipment and assist the boatmaster in making managerial decisions, it is necessary to take into account the psychological state of a person, especially in extreme situations.

The analysis of the main problems and tasks of ensuring safety in the field of navigation allows to formulate a general definition and principles of safety at sea. The paper

provides a definition of the safety of elements of the marine transport system. It is important to note the formulated safety assessment criteria based on the application of risk indicators.

The structure of safety of the maritime transport system is introduced and the task of ensuring its safe functioning is formulated. To solve the problem, the concept of a safety management system for navigation is introduced as an integrated organizational and technical system. The tasks of the system include analysis of the state, control and security of both individual functional elements and processes of the system, and the system as a whole.

The expediency of division of indicators into direct and indirect, absolute and relative is shown. The conclusion is substantiated that the solution of two problems is necessary for determining the quantitative indicators of the safety of navigation:

- development of safety models for various elements of the system and taking into account a variety of situations;
- determination of the probabilistic characteristics of the particular events included in the security model.

In [12], the scientific and organizational problems related to the practical implementation of the Law of Ukraine «On the seaports of Ukraine» from the point of view of ensuring the safety of ship maintenance in ports are considered, in particular, it is proposed to insure certain risks. In [13] the question of possible insurance of the risk of damage to the berthing facilities as a result of their interaction with ships is being investigated.

In [14], the main document defining the requirements for development of the estuary port of Ust-Dunaisk (Ukraine) is the Memorandum of Understanding regarding the development of the Pan-European Transport Corridor VII (Danube). In accordance with the Memorandum of Understanding in the framework of the development of the port of Ust-Dunaisk, the following topics should be considered:

- the state of the port and corridor infrastructure;
- assessment of safety requirements for navigation;
- the overall concept of coordinated development of the port and corridor;
- the necessary conditions for the participation of international financial institutions and the private sector in the development of both the port and corridor (Romania);
- organizational, legal, economic and social problems.

In [15], problems of a choice of optimum ways on the control and diagnosing of a technical condition of the ship technics which are in the course of operation, maintenance service or repair are considered.

The paper [16] is devoted to the development of theoretical provisions and practical recommendations for improving the economic efficiency of the classification society through a more sophisticated risk management system based on risk management and insurance.

The paper [17] notes the role and importance of maritime transport safety, which is a very important, systemic concept affecting all elements of the marine industry. However, the management of safety and its introduction into the maritime industry is now more important than ever. The modern maritime industry has a number of codes, conventions and guidelines that establish the boundaries of safety and efficiency of navigation. Development of the marine industry has led to a significant development of technologies, structures, dimensions, propulsion and safety of ships. At the

same time, the development of new technologies in the marine industry has made changes in the education system. Despite the great breakthroughs in technology and security, the marine industry is still a relatively dangerous place to work. The present study presents the flow and analysis of the development of technologies, which are important milestones for navigation with respect to their contribution to maritime security. The paper also discusses important factors that adversely affect the safety of navigation.

The paper [18] is aimed at studying the effect of the marine safety management model on the organizational effectiveness of shipping companies. For this purpose, a survey was conducted in the collection of data from shipping companies around the world. The hypotheses of this study were tested using modeling methods. It was found that the proposed model has a direct positive impact on security, business sustainability and its effectiveness.

The analysis of the main problems and tasks of ensuring safety in the field of navigation made it possible to formulate:

- determination of the navigation safety, as activities related to the protection of life and health of crew members of ships and passengers, the safety of the vehicles themselves and the goods carried thereon;
- determination of a ship security management system, as a set of documented measures necessary for the effective implementation of maritime safety requirements on ships.

Ensuring the safety of navigation is achieved through the implementation of the state policy in the field of security, a system of organizational, economic, technical and other measures on a planned basis, adequate to threats to the vital interests of the individual, society and the state.

For assessment of safety, specialized organizations with competence in the field of maritime and river transport safety and performing the following basic functions can be used [11]:

- assessment of the vulnerability (risks) of the infrastructure of sea and river transport and river transport;
- development of measures to ensure the safety of the infrastructure of maritime and river transport;
- certification of the infrastructure of maritime and river transport and transport services for compliance with maritime safety requirements;
- categorizing the infrastructure of maritime and river transport with the involvement of specialized organizations in the field of maritime safety;
- maintenance of the register of categorized infrastructure of maritime and river transport;
- approval of training programs in the field of maritime safety;
- introduction of proposals on accreditation of specialized organizations in the field of maritime safety to the state executive authority authorized in the field of maritime transport;
- organization of scientific, technical and logistic support for the safety of navigation.

The quality of the work of shipping companies and state control bodies for ensuring safety of navigation is estimated by the accident rate in the fleet.

A comprehensive risk assessment of emergencies is based on an analysis of the causes of their occurrence (failure of technical devices, personnel errors, external influences) and the consequences of accidents.

The analysis shows that the following indicators should be considered as the main criteria for the safety of navigation:

- values of concentrations of hazardous substances (environmental safety);
- level of accidents and injuries on the sea and river transport (functional safety);
- level of damage from accidents and incidents in maritime and river transport (functional safety);
- level of risk as an integral safety characteristic.

As a result of the analysis of published sources, it can be concluded that the use of the principles of system analysis to ensure safety in maritime transport systems, taking into account the safety indicators and the assessment of operational risks, will increase the safety of marine transport systems.

On the whole, the reviewed works represent a wide range of problems of maritime safety management. And all of them can serve as a basis for the further development of the management system for the safety of navigation in Ukraine.

**5. Methods of research**

The basis of the research methods is a systematic approach to ensuring the formation of a level of transport security, depending on the impact of technical and technological, organizational and management, environmental and anti-terrorist factors of impact. To solve the problem of ensuring maritime and river safety, the implementation of a specialized safety management system for shipping is required. The basis of the development of a safety management system for navigation, a system model is used, which has been tested in the theory and practice of project management (PM) [19].

**6. Research results**

Development of a safety management system for navigation (Fig. 2) contains three main blocks represented by structural decompositions of management entities, management objects and the management process.

*Subjects of management.* The subjects of management are active participants of the NMS (project) system, interacting in the development and adoption of management decisions in the process of its implementation. The subjects of management are: the customer (Ukrtransafety), the designer, the contractor, the executors, etc., the project manager, the project administrator, project representatives, functional project managers.

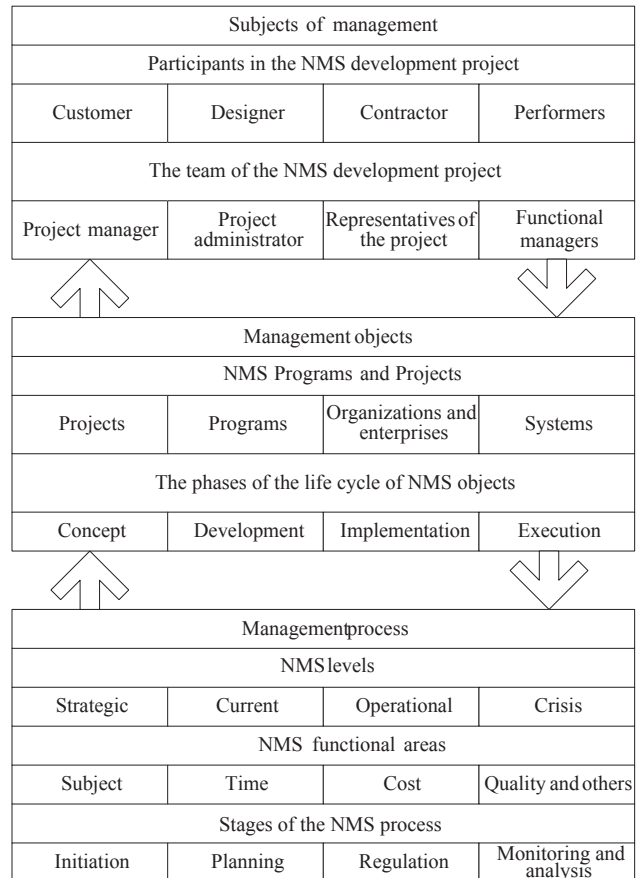
*Objects of management:*

- NMS systems and subsystems;
- a lot of projects, portfolios of projects and programs in Ukrtransafety units or companies (shipping, stevedoring, service, etc.);
- phases of the life cycle of the control object: concept, development, implementation, execution.

The process is governed by the development of the NMS system. This is the impact of the subjects of management on the objects of management through the decisions taken by the NMS. The grounds for classification of the NMS objectives are:

- stages of the management process, including: development of the concept of the NMS system, planning of NMS development, organization and monitoring of the NMS operations, analysis and regulation of NMS development, closure of the project and its parts;

- functional areas of management, including: subject area, time parameters, cost, quality, risks, personnel, communications, contracts, changes, etc.;
- temporary sections of management, including: the strategic level – covers the entire life cycle of the NMS system; annual level; quarterly level; operational level; crisis management level.



**Fig. 2.** Development of a safety management system for shipping

Based on the system model for NMS development, it is possible to integrate its various elements. By combining the model elements from top to bottom, it is possible to obtain a vertical integration of the subjects of management, management objects, and the management process by the selected elements of the system model.

This allows to define the tasks (processes) required for the customer, the designer, the project manager, etc. No less important are the tasks defined by different combinations of elements at each level of the system model – horizontal integration. Such integration can combine all elements or parts of elements (their combination). The greatest practical value and application have tasks defined by horizontal-vertical or mixed integration of the elements of the system model.

The proposed system model is a methodological tool for the generation and system design of an integrated WBS system that can be used at all stages of its development, including:

- conceptual design;
- design of functional and providing parts;
- design of the communication and documentation system;

– development of elements: models, methods, algorithms, programs and regulatory support (user guidance, corporate and system standards, methodologies, instructions).

Formation of the functional structure of the tasks of the system model allows the classification of tasks and procedures possible in the management of projects and safety programs of navigation. The proposed approach makes it possible to identify the composition of problem-oriented complexes of processes (tasks) of the NMS, to identify methods and tools for ensuring effective decision-making at all levels of the WBS system.

As a basis for defining and developing the tasks required for the NMS, it is proposed to use the Sectoral Safety Program for Navigation for 2014–2018 [20]. The main objective of the Program is ensuring the safe operation of sea, river transport and marine industry enterprises.

The main directions and tasks of the Program are as follows:

1. Combating acts of violence in maritime and river transport, including:

- improvement of the modern regulatory framework for maritime security;
- organization of protection of vessels and port facilities against unlawful interference;
- participation in the creation of stationary and mobile systems for detection of unidentified water bodies on approaches and within the water area of sea trading ports.

2. Environmental protection, including:

- construction and reconstruction of reception facilities in ports for reception, collection, processing and disposal of pollutants, including waters that contain garbage and waste. Presence in a sufficient quantity of means of neutralization and utilization of the oil spilled in the sea and collected;
- creation of a closed sewage collection system in the territory of ports, quays and other structures, and further transfer of these waters to reception facilities for their cleaning;
- ensuring compliance with the requirements of environmental legislation when carrying out reloading operations.

3. Ensuring the safety of navigation, including:

- improvement of the existing management system of the sphere of ensuring the safety of navigation in order to bring it in line with the requirements of international conventions;
- improvement of the system of state and technical supervision over compliance with the requirements of international treaties and legislation of Ukraine, safety rules for navigation on ships, shipping companies, sea and river ports, territorial sea and inland waterways of Ukraine;
- further modernization of coastal technical and information systems for navigation safety;
- improvement of the material and technical basis of practical and training of specialists in the sea and river fleet;
- ensuring the safe transport of dangerous goods by sea and river transport;
- improvement of the national search and rescue system at sea, etc.

Thus, the project presents a project to develop a safety management system for navigation (Fig. 2). This project is

aimed at creating an integrated organizational and technical system that performs the functions of analyzing the state, control and security of both individual functional elements and processes, and the system as a whole.

All components of the presented system require further research and detailing, taking into account the Sectoral Safety Program for Navigation.

## 7. SWOT analysis of research results

*Strengths.* Strengths of the NMS system include:

- target setting in establishing the level of transport security and the time limits for which they are to be achieved;

- norms (rules, requirements and standards) of transport security that must be established for all transport safety facilities, sections of transport infrastructures, transport process operations.

The standards of transport security include two groups:

- reliability of transport safety facilities;
- quality of the functioning of transport safety facilities.

The organization of a system of monitoring (identification) and assessing threats to transport security is an independent direction of ensuring transport security.

The categories of transport safety objects are assigned in accordance with the degree of their vulnerability to all types of transport security threats.

In determining specific requirements for ensuring the safety of transport facilities take into account:

- features of prevention and action in crisis situations;
- elimination (minimization) of the consequences of crisis situations;
- conditions of insurance, licensing and certification in transport activities.

The preparedness plan is formed at all levels of management in the field of transport security provision – from the vehicle crew, the transport facility personnel and business entities to the state authorities and local government.

The effectiveness of preventing accidents in transport should be ensured by the continuity of control and supervision, the promptness of identifying and responding to threats to transport security.

*Weaknesses.* Weaknesses of the NMS system include an inadequate mechanism of interaction between the state executive bodies responsible for ensuring transport security. The mechanism of interaction between civil and law enforcement agencies is most critical.

The work on navigational safety of navigation is aimed at improving the safety of navigation and preventing ship accidents, improving the state supervision of commercial navigation. However, limited resource opportunities, as well as dominant commercial interests, exacerbate the risk of accidents and incidents. Shipping companies do not pay enough attention to preventive work to reduce accidents, working in a highly competitive market for maritime transport services (lack of a stable cargo base, relatively low freight rates, a significant tax burden, complex customs procedures). The prerequisite for emergency situations (ES) is the minimization of the costs of shipping companies for the technical re-equipment and maintenance of the ship, its machines, mechanisms, devices and systems in the required technical condition. The age of the ships is one of the reasons for the increase in accidents.

The adopted national laws and programs have identified a number of serious structural transformations of the Ukrainian sea and river transport system [5, 21, 22]. However, there are no tools for analyzing the safety of transport systems, the structure and composition of the indicators, the evaluation criteria are not clear, and there are no clear modeling techniques.

*Opportunities.* The use of the principles of the system approach, taking into account the safety indicators, risk assessments and the functioning of the system as a whole, serves as a methodological basis for managing the transport safety of navigation and will improve the safety of sea and river transport systems.

The capabilities of the safety management system of navigation are determined by:

- the possibility of cooperation to ensure transport security with foreign states, their law enforcement agencies and special services, business entities, as well as with international organizations to coordinate efforts and interaction to reduce the risk and damage from transport crises;
- the possibility of creating favorable economic conditions and ensuring the security of the activities of economic entities in the conduct of international transport.

A necessary condition and legal basis for such cooperation is the harmonization of Ukrainian legislation in the field of transport security with the norms of international law and generally accepted international practice.

*Threats.* The processes of implementation of the proposed safety system for navigation occur, as a rule, in the presence of a certain measure of uncertainty determined by the following factors:

- incomplete knowledge of all parameters, circumstances, situations for choosing the optimal solution, as well as the inability to adequately and accurately account for all even accessible information and the presence of probabilistic characteristics of the behavior of the environment;
- the presence of a random factor, that is, the realization of factors that are difficult to predict even in a probabilistic realization;
- the presence of subjective factors of counteraction, when decision-making goes against the position of partners or non-coinciding interests.

## 8. Conclusions

1. Based on the analysis of the current state of the level and ensuring the transport safety of navigation, it is shown:

- increase in accidents, injuries, damage, increased transport costs, high wear and tear of technical equipment, especially rolling stock;
- the growing threat of acts of unlawful interference in the work of transport (terrorism), which makes it difficult for Ukraine's transport to enter the path of sustainable development, which ensures the necessary level of all types of transport security;
- insufficiently established mechanism of interaction between state executive bodies dealing with transport security. The mechanism of interaction between civil and law enforcement agencies is most critical;
- limited resource opportunities, as well as dominant commercial interests, which exacerbate the risk of accidents and incidents;

- lack of tools for analyzing the safety of transport systems, uncertainty in the structure and composition of indicators, lack of assessment of all identified risks associated with ships, personnel and the environment, lack of clear modeling techniques.

2. The problems and directions of ensuring the transport safety of navigation are defined, including:

- the lack of a single coordinating body at different stages of ensuring transport security;
- the state of the legislative framework is not adequate to existing security threats;
- insufficient level of transport safety of navigation;
- the main safety requirements for the objects of transport infrastructure of maritime and river transport are not defined;
- the criteria for assessing safety are not formulated.

3. A systemic methodology has been developed for managing the transport safety of navigation, including:

- the concept of a safety management system for navigation is introduced as an integrated organizational and technical system. This system performs the functions of analyzing the state, control and security of the functional elements and processes of the system;
- subjects of navigation safety management, including international organizations, governmental organizations, shipping companies, ports, service companies, as well as key participants in the development of NMS project;
- objects of safety management of navigation are represented, including systems, projects, programs, organizations and enterprises responsible for the implementation of safety of navigation;
- the processes of the development and operation of a safety management system for shipping are presented, including shipping security management levels, management functions and the development stages of a safety management system for navigation.

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#### ПРИМЕНЕНИЕ СИСТЕМНОГО ПОДХОДА К РАЗРАБОТКЕ ПРОЕКТА СИСТЕМЫ УПРАВЛЕНИЯ БЕЗОПАСНОСТЬЮ СУДОХОДСТВА В УКРАИНЕ

Представлен системный подход к разработке проекта системы управления безопасностью судоходства (УБС) в Украине и к ее методологической базе обеспечения транспортной безопасности. Определены значимые и приоритетные факторы для экономических и геополитических интересов Украины. Рассмотрены условия для формулирования и постановки задач управления безопасностью судоходства и созданы основы разработки моделей и методов решения этих задач.

**Ключевые слова:** системный подход, проект системы, управление безопасностью судоходства, факторы безопасности.

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