



Iryna Zaporozhets,
Antonina Trushliakova,
Mykola Fateev,
Sergii Gurskyi

DEVELOPMENT OF PROJECT MANAGEMENT MECHANISMS FOR THE CONSTRUCTION AND OPERATION OF TRANSPORT SHIPS ON INLAND WATERWAYS OF UKRAINE IN POST-WAR RECONSTRUCTION

The object of research is the process of project management of transport ships on the inland waterways of Ukraine. The subject of the research is a set of theoretical, methodological and applied aspects of the formation of project management mechanisms in the shipbuilding cluster system. The article solves the problem of restoring the competitiveness of inland waterway transport in Ukraine. The essence and features of cluster systems are revealed. Mechanisms for organizing a shipbuilding cluster for the construction of transport ships on the inland waterways of Ukraine are proposed. A feature of cluster systems is the participation of business structures, government bodies and scientific centers in them. It is proposed to organize in the cluster structure: a logistics center that will ensure the implementation of logistics tools; a dual form of training that will facilitate the transition to a qualitatively new level of training of workers and specialists for the industry; a project office that implements project management functions within a single information system and provides communication between projects. The results obtained are a tool for ensuring the competitiveness of enterprises in the shipbuilding industry. The cluster system is a functionally distributed logistics network that will develop both in the domestic and international transport markets. Modern logistics tools allow to build an effective system of material support for enterprises that are part of the cluster. The range of functions that the logistics center implements requires constant analysis at all stages of the life cycle of building a cluster. The proposed structure of cluster integration of enterprises in the shipbuilding industry will allow to link the project structure and the organizational structure of project portfolio management into a single comprehensive information tool in specialized project management software.

Keywords: project management, cluster system, shipbuilding cluster, water transport, dual education, logistics providers.

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1. Introduction

The development of inland waterway transport fully complies with the terms of the Association Agreement between Ukraine and the European Union, ratified by the Law of Ukraine dated 16.09.2014 No. 1678-VII. The Agreement provides for cooperation in the field of transport management and infrastructure modernization, the development of sectoral strategies based on the national transport policy for river transport [1]. The inland waterways of Ukraine are an element of the network of strategic transport corridors that unite the countries of the European Union and other neighbors into a single economic space [2]. The trans-European transport infrastructure is vital for the economic stability, resilience and security of the European Union, as it is adapted for dual military and civilian use. The integration of the inland waterways of Ukraine into the TEN-T affects our ability to defend ourselves, restore the economy and confidently move towards victory [3].

National University of Shipbuilding named after Admiral Markov (NUC) promotes the development of the shipbuilding industry and other scientific and industrial sectors of the maritime complex of Ukraine, cooperates in the sections of Cluster 3 "Science and Research",

Cluster 4 "Green Order and Sustainable Connection" of integration with the European Union [4].

Modern studies of models and mechanisms of formation and development of production and corporate structures, including economic clusters, are disclosed in papers [5, 6]. In [7], the structure of the cluster system and the feasibility of its creation are substantiated. In [8], the mechanisms of management of the activities of enterprises of the maritime complex are disclosed. However, the features of management of strategic alliances in the form of economic cluster systems for Ukrainian shipbuilding and ship repair enterprises in the post-war reconstruction of the industry are not disclosed. The relevance of integration processes in the project of creating a cluster system is the solution of a complex problem in which different fields of knowledge intersect; various elements are synthesized – economic, technological, social and ethical. As a result of the dynamic combination of these elements, the boundaries, subject area, and structure of the project for the creation and development of a cluster system are formed.

One of the main factors of the cluster's stability is the scientific and educational potential. Modern literature does not reveal the mechanisms of interaction between science and the education system in the shipbuilding cluster system. At the same time, the current task in creating a shipbuilding

cluster is the development of science and education, both on the basis of a partnership between educational and scientific institutions and employers, which could contribute to the formation of competitive advantages.

The concepts and practical methods of integrated logistics management are outlined in [9]. The principles of organization and design of logistics systems are disclosed in [10]. However, the principles of logistics management are absent in shipbuilding cluster projects. The cluster for the construction and operation of transport ships is a functionally distributed logistics network that is developing both in the Ukrainian and European markets; therefore it requires development taking into account the characteristics of the region and constant monitoring.

In parallel, project management information systems are being developed that allow receiving, storing and using information about projects and their environment for decision-making. Today, there are a significant number of project management software tools of various scales [11]. Research [12] indicates the need for a strategy for the development of artificial intelligence in Ukraine. In works [13, 14], methods of an artificial intelligence system are proposed. It should be noted the complexity of applying artificial intelligence tools to the project management system of modern enterprises, as well as the dynamics of changes in the field of digital technologies.

The conducted analysis of research and publications demonstrates the achievements of scientists and specialists: in the creation of projects of the cluster system and its elements, the problems of integration of education, science and production, functional areas of production logistics are solved. At the same time, there are no studies on the development of principles of organization of the project for the construction and operation of transport ships on the inland waterways of Ukraine to restore the competitiveness of the transport industry.

There is a need for developments that will ensure the restoration of a strategically important transport industry, namely inland waterway transport to ensure the competitiveness of the logistics component of Ukraine.

The object of research is the processes of project management of transport ships on the inland waterways of Ukraine.

The subject of research is a set of theoretical, methodological and applied aspects of the formation of project management mechanisms in the shipbuilding cluster system.

The aim of research is to develop project management mechanisms for the construction and operation of transport ships on the inland waterways of Ukraine in post-war reconstruction.

To achieve the aim, the following objectives were solved:

1. To develop a model of organization of a shipbuilding cluster system.
2. To develop principles of organization of sustainable functioning of scientific and educational centers.
3. To develop a mechanism of material and technical support of projects.
4. To develop a structure of an information system and artificial intelligence systems, which experimentally confirms the feasibility of creating a cluster system.

2. Materials and Methods

The conducted research is based on the use of:

- methods of analysis and synthesis (when studying the life cycle of a ship, the organizational structure of project-oriented enterprises with a matrix organizational structure, developing the functions of a project management office, forming the principles of human resources);

- project management methodologies (for analyzing the elements of project management of shipbuilding enterprises, for forming a project logistics system);
- object-oriented programming methods (for developing the principles of a cluster information system – SAP, for managing projects and programs – MS Project Standard, artificial intelligence systems – Long chain in building agents, integrated accounting system for processing budgets of all levels – SAP).

3. Results and Discussion

3.1. Development of a model for organizing a shipbuilding cluster system

The security situation in Ukraine and on its sea and inland waterways is an integral part of development and integration into the trans-European network. The development of the transport industry and increasing its efficiency is a factor in the country's competitiveness. For many years, the transport industry has been a priority area of Ukraine's cooperation with international partners. The geographical position of Ukraine is of strategic importance and is a key priority with international partners. The transport system has significant potential for increasing the efficiency of regional competitiveness. The post-war restoration of Ukraine's inland waterways will contribute to the activation of economic processes and the reconstruction of the country.

In accordance with [3], the National Transport Strategy of Ukraine for the period up to 2030 has been developed, which states that transport is the most important sector of the national economy, which ensures the development of trade and economic growth. The transport strategy covers all types of transport and defines the conceptual directions for the formation and implementation of state policy to ensure the stable functioning of the transport industry. The main provisions implemented in the transport strategy:

- ensuring timely delivery of goods;
- improving the transport industry management system;
- increasing the capacity of the transport network;
- integrating the transport system of Ukraine with European and global transport systems.

According to the Register of Ships, as of the end of 2025, there were more than 130 thousand civilian ships on inland waterways in Ukraine. Accordingly, the fishing industry fleet is 597; the tugboat fleet is 120 ships. Table 1 shows the structure of ships, it should be noted that despite the aging of the inland waterway fleet, its renewal, except for the company LLC SP "Nibulon", has not been carried out. Over the past fifteen years, six tugboats have been purchased, one of which is Ukrainian-made (the "Kranship" company – "Captain Merkulov" tugboat), the others were built abroad.

Table 1

Status of ships on inland waterways of Ukraine

Classification of ship types	2025	Type and purpose of the ship	Year of construction of the ship	Hull materials	Engine power (hp)	Owners
Civil ships	Over 130 thousand	Pontoons, Tourist, Pedestrian, Motorboats, Hydrofoil boats, Yachts, Sailing boats, Jet skis	1966–2011	Steel, Plastic, Rubber	Up to 310 hp	Individuals and legal entities
Fishing ships	597	Fishing, Longboat, Motorboat	1948–2018	Steel, Glass-plastic, Duralumin	Up to 300 hp	Individuals and legal entities
River tugboats	120	Most tugboats are from 30 to 70 years old, 11 tugboats are 30 years old, 6 tugboats built in the last 15 years, 16 tugboats – Nibulon Shipyard LLC				Nibulon LLC, Sapsan Transship LLC, Service Trans Bulk LLC, and others

For example, the tugboat fleet built by LLC SP Nibulon is 100% Ukrainian. The ships are designed by Ukrainian design bureaus, built at Ukrainian shipyards (Nibulon Shipyard), made of Ukrainian steel, sail under the Ukrainian flag, and are repaired and serviced by Ukrainian ship repair companies.

In these conditions, the role of the formation of a project management structure for the construction and operation of transport ships to provide inland waterways of Ukraine is increasing, which can be presented as follows.

The life cycle of a transport ship includes processes that are implemented at different stages from the contract for the construction of a ship to its disposal (Fig. 1):

- analysis of the state of the shipbuilding market, determination and assessment of demand;
- development of a draft design of the ship (preliminary design);
- development of design and estimate documentation for the construction of the ship;
- design and technological development of the ship design;
- comprehensive preparation of production for the construction of the ship (human resources, financial, material, technological, organizational);
- construction of the ship and transfer to the customer;
- ship operation, technical maintenance;
- ship disposal.

Under the current conditions of post-war recovery of competitiveness, an attractive strategy for shipbuilding enterprises in Ukraine is the creation of a cluster system that will unite enterprises that implement processes at all stages of the life cycle of a transport ship.

The project of creating a cluster system for the construction and operation of transport ships for the inland waterways of Ukraine is a complex problem, it intertwines different fields of knowledge, synthesizes various elements – economic, technological, social and ethical. The dynamic combination of these elements forms the boundaries, subject area and structure of the project for the creation and development of a cluster system. The scheme of functional decomposition of the operational activities of the shipbuilding cluster system (SCS) can be presented in the following form, Table 2.

An effective tool for forming the structure of a cluster system is the method of expert assessments. Using the synergy of clusters, enterprises develop through effective cooperation in the use of knowledge, financial resources, technologies, means of production, etc. Shipbuilding enterprises of the region perform the role of a focal firm of the cluster system (functions F4–F10). To perform work on the analysis of

shipbuilding market segments, it is advisable to organize a consulting firm in the cluster structure (function F1). Within the framework of cluster systems, there is an opportunity to mobilize the advantages of a powerful corporate structure while maintaining the national isolation of its participants. A feature of cluster economic systems is the participation of business structures, government agencies and research centers in them.

Cluster systems are able to ensure unification in the production process, create competition in the cooperation of logistics chains; these are growth points and stimulants of technical progress. Therefore, the cluster development of the national economy and individual regions is one of the characteristic features of a modern innovative economy.

The Shipping Register of Ukraine [15] is an inspection body that participates in the implementation of national and international rules and standards in accordance with the powers of the Flag Administration. The Register monitors the life cycle of a transport ship from construction to its disposal (functions F2–F10). Solving problems in projects for the construction and operation of transport ships involves long-term interaction of the Shipping Register of Ukraine with local authorities, industry enterprises, and scientific and educational institutions within the cluster. This information is necessary for the formation of a cluster management database, as it unites all interested participants in the cluster system to ensure the post-war restoration of competitive positions on the inland waterways of Ukraine.

Regional authorities, with the effective functioning of the cluster, are interested in ensuring employment growth and, as a result, in reducing social tension in the region. In this case, a significant factor is the real possibility of activating small and medium-sized businesses and implementing socially significant regional programs.

For scientific and educational structures in the cluster system, favorable conditions are created for the implementation of scientific research; the market for educational services is activated (functions F11–F12). Admiral Makarov National Shipbuilding University, design organizations of Ukraine, which successfully compete in global shipbuilding markets, have scientific potential for solving problems of design, technology and organization of construction of transport ships (function F2).

The competitiveness of the shipbuilding cluster system is determined by the following factors:

- the total cost of design and construction of the ship;
- the terms of completion of work on the construction of the ship;
- product quality;
- the required level of technical maturity of the cluster participants.

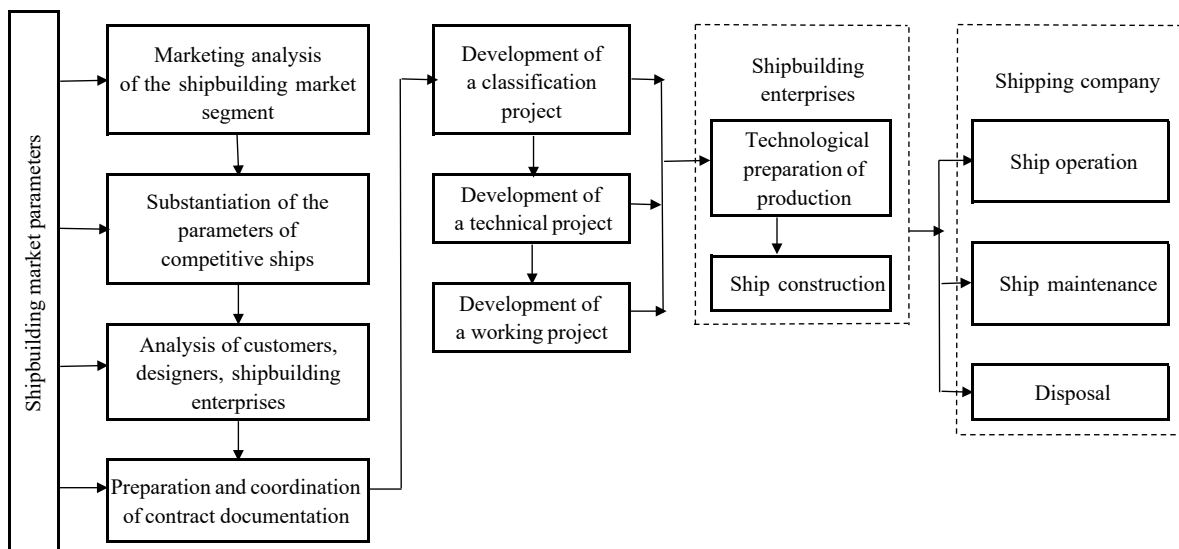


Fig. 1. Stages of the life cycle of a transport ship

Table 2
Functional decomposition of the operational activities of the shipbuilding cluster system

Function No.	Operational function
F1	Marketing research of the transport ship market
F2	Development of ship classification projects
F3	Identification of production enterprises for project implementation and preparation of a contract for ship construction
F4	Development of a working project taking into account the characteristics of the production enterprise
F5	Technological preparation of production
F6	Project logistics
F7	Manufacture of parts, assemblies, sections of the ship hull
F8	Assembly of blocks at the production site
F9	Launching of the ship hull and completion
F10	Delivery of the ship to the customer
F11	Continuous development of production processes and enterprise management systems
F12	Research and development work, continuous improvement of technologies and production organization

Based on the analysis of competitiveness factors, a strategic concept and structure of the cluster system are developed, which is based on the existing competitive advantages of the cluster participants in terms of operational and management functions. Each cluster participant performs a number of functions Φ_ψ ($\psi = 1..12$). In turn, each function is implemented through a list of works $W_{i\psi}$ ($i = 1, n; \psi = 1..12$), where n is the number of works to implement the function. Each work is characterized by the cost of the necessary resources $C_{i\psi}$ and the duration of execution. Thus, the total cost of design and construction of the main order S_p is determined by the expression

$$S_p = \sum_{\psi=1}^{12} \sum_{i=1}^n C_{i\psi}. \tag{1}$$

Based on the analysis of the network model of the mock-up project, it is possible to determine the share of costs required to implement the functions of each participant in the cluster system and use this information in the decision-making process when preparing a contract for the design and construction of a ship.

To manage a cluster system, it is advisable to form a network model of the design and construction of a ship in two stages:

1. Development of fragments of the network model of work within the functions implemented by each participant in the cluster system with resource alignment within each participant (Fig. 2).
2. Integration of fragments of the network model and resource alignment within the cluster with subsequent adjustment of the fragment models.

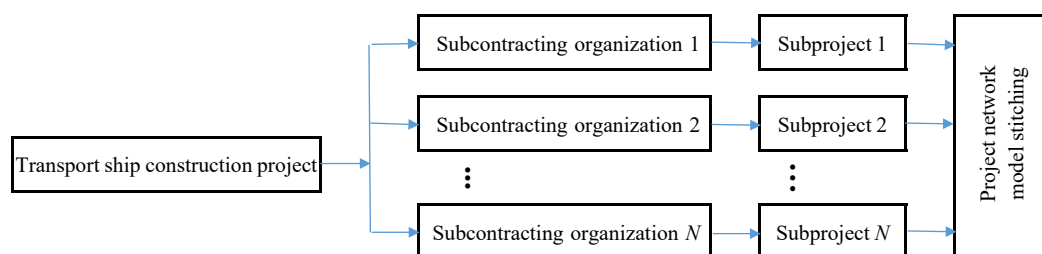


Fig. 2. Fragment of the network model of project work

The resulting model allows to form the expenditure part of the cluster budget for the project. The expenditure part of the budget of each cluster participant is determined by the parameters of the work that implements the functions of this participant. These tasks are effectively implemented in MS Project [11].

To plan the revenue part of the budget, it is advisable to use a balance sheet model. The balance sheet model allows to solve the following tasks, with the help of which the cluster system management processes are implemented:

- forecasting the availability and flow of funds for the project;
- checking the financial implementation of the project;
- analyzing the feasibility of taking out loans;
- determining the terms and volumes of the necessary loans;
- monitoring and adjusting the project financial plan taking into account its actual implementation.

In general, the balance sheet model is a functional $B(t)$

$$B(t) = P(t) - R(t), \tag{2}$$

where $P(t)$ – the integral value of project revenues; $R(t)$ – the integral value of project costs.

A sufficient condition for the financial implementation of the project is the non-negligibility of the functional $B(t)$ during the period of implementation of the shipbuilding project.

3.2. Development of principles for organizing the functioning of scientific and educational centers

In modern society, where professional work and other areas of life are constantly changing, there is a change in the criteria for assessing educational outcomes. The competitiveness of a specialist in the labor market is determined by competence, which is considered as a set of skills, level of qualification, ability to social adaptation outside the educational institution, initiative and readiness for professional risk. Graduates of educational institutions who do not have sufficiently formed professional competencies and experience of practical activity are not in demand in the labor market. The solution to this problem lies in the development of mechanisms for effective interaction between educational institutions and employers.

An important factor in ensuring the entry of the Ukrainian shipbuilding industry into a single European transport network is the training of new-type specialists who are able to respond promptly to technological, organizational and social changes. In this regard, vocational education institutions of all levels must ensure that graduates have professional competencies capable of ensuring the innovative development of all elements of the chain of creating competitive ship equipment.

The experience of finding ways to ensure the effectiveness of vocational education institutions shows that the development of the vocational education system in modern conditions involves a combination of theoretical training in educational institutions with practical training at enterprises. This form of combining theoretical training with practical training is defined as dual training.

The provisions of the Law "On Higher Education" [16] define broad opportunities for the modernization of the vocational education system of Ukraine, providing for effective interaction between all levels of the vocational education system, science and production. The dual system of training specialists requires the development of appropriate curricula and organizational schemes for the interaction of interested participants. The practical component makes up almost two-thirds of the training time, and the theoretical part, respectively, one-third in the preparation of working professions. In the curricula of bachelors and masters, the balance of time between theoretical and practical training is determined by the list of approved professional competencies of graduates of a specific specialty.

The dual form of professional training of working professions and specialists for the shipbuilding industry is effectively implemented in the cluster structure. The National Qualifications Framework [17] provides for eight qualification levels, each of which is determined by a certain set of competencies that are typical for the qualification level. Using the provisions of the National Qualifications Framework will ensure the establishment of interaction between educational institutions and employers. At the same time, graduates will be provided with a high level of their competitiveness in the labor market.

The unconditional advantages of the dual training system include:

1. Enterprises – cluster participants receive trained specialists who do not require psychological and professional adaptation, confidently navigate within the framework of their functional responsibilities.
2. Vocational education institutions are given the opportunity to participate in solving production problems, due to which the subject matter and content of diploma theses are predominantly research and applied in nature.
3. The combination of theoretical training with work at enterprises creates both material motivation for students and interest in career growth.

3.3. Development of mechanisms for logistical support of projects

Up to 60% of all organizational resources of the enterprise are involved in a shipbuilding project. Project activities have priority over functional activities. In general, logistical support of projects includes two groups of processes:

1. Procurement of materials and equipment.
2. Inventory management, resource distribution and supply to production sites.

To ensure the sustainable functioning of the cluster system, it is proposed to organize a logistics center in its structure, which will ensure the implementation of logistics tools and reliable logistics service. The logistics center (LC) in the structure of the cluster for the construction and operation of transport ships is proposed to establish the following functions:

1. Management of the cluster's corporate information system.
2. Development of network models of ship design and construction for each project.
3. Development of logistical support plans for each project.
4. Integration of logistics plans for the entire cluster order portfolio.
5. Management of procurement of materials, equipment and components.

6. Management of inventories of logistics resources.
7. Management of supply of materials and components to production sites.

To implement the above functions as a logistics center in the cluster structure, it is advisable to organize an independent integrator company, Fig. 3. According to the classification of logistics concepts, such a company belongs to the 4PL (4 Party Logistics) class of logistics providers. Its main function is to perform logistics operations within the cluster with an emphasis on ensuring the efficiency of the entire supply chain.

To implement the above logistics service, it is necessary to use modern network computer technologies. An important task of the logistics center of the cluster is the formation of a single information space for the purpose of sharing information resources at all stages of the design and construction of the ship.

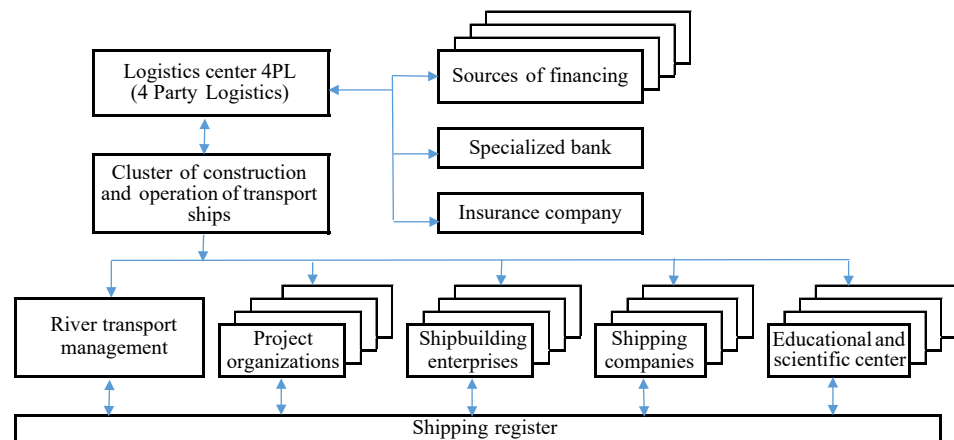


Fig. 3. Logistics center in the cluster structure

3.4. Development of the structure of the information system and artificial intelligence systems

The corporate information system of the cluster is divided into parts:

- information model of the ship – formed at the stages of design and technological preparation of production. These works are performed in design organizations and technological services of construction plants. An important task of the logistics center is to ensure the integrity and consistency of the elements of the model, as well as the organization of controlled access to each section of the model;
- information system of the cluster management is an organizational and technological complex of methodological, technical, software and information tools aimed at maintaining stable organizational ties of cluster participants. With the introduction of data exchange standards between systems, the spread of network and WEB technologies, new opportunities have opened up for the development of mechanisms to support cluster management processes.

It is necessary to note the peculiarity of budget and planning mechanisms in the cluster management system. Planning of production resources is implemented among project management systems. These systems provide for the possibility of processing a number of projects, as well as procedures for calculating financial needs. Fragmented resource and financial planning allows to build a system of budgets of enterprises – participants of the cluster. On the basis of resource and financial planning, phasing of resource needs by time is implemented – basic information for performing the main task of the logistics center – timely provision of production areas with materials and components.

A project management office is a balanced organizational and technological complex of software, technical and information tools and instruments aimed at implementing, supporting and improving the efficiency of project management processes, Fig. 4. The functions of a project management office are performed within a single information system and are based on proven in-house standards.

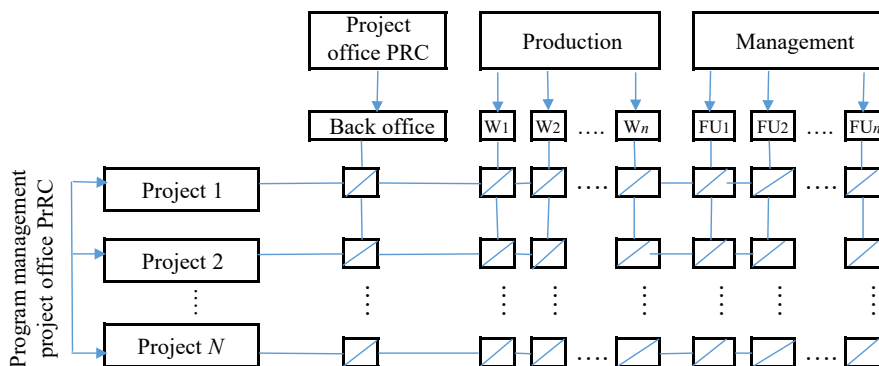


Fig. 4. Project office in the structure of the shipbuilding cluster

The project management office ensures effective communication between projects and the performance assessment systems adopted at the enterprise. Let's present the structure and functions of the project office of the enterprise in the form of a developing system that includes several maturity levels. The proposed maturity levels are based on the classification model of corporate project management systems recommended by the PMBOK standard [18] and taking into account the specifics of production.

Level 1 – the processes of forming the project office as a structural unit of the enterprise: development of regulations regulating the activities of the project office, analysis of information on the structure of the project portfolio, formalization of project management processes.

Level 2 involves expanding the influence of the project office by increasing the range of tasks to be solved.

Level 3 of the project management office is recommended to have a predictive and analytical function, within which project statistics are maintained, analytical reports are generated and regulatory assessments are made for project planning. This also includes a register of typical risks associated with a high degree of uncertainty in ship repair operations.

An important task of the third stage of the development of the project management office is the development of regulations for information support of the Agile methodology. Cooperation of the project management office with cross-functional teams will allow for prompt adjustment of project plans, redistribution of resources within the project portfolio.

The use of an information model of the ship, which is formed at the stages of design and technological preparation of production within the framework of the 6D-design methodology, will ensure a reduction in the complexity of developing ship repair projects and an increase in their quality.

By its nature, 6D-design allows planning for the next stages of the ship's life cycle, it is a monitoring system during the operation of the ship, predicting the degree of wear of ship elements over time. The project management office will ensure the preparation of documentation for scheduled inspections and tests of key components, repair and replacement of equipment, pipelines, and mechanisms.

The MS Project Standard package allows to build effective interfaces for obtaining parameters of hull structures, characteristics of ship mechanisms and equipment, as well as recommendations for repair technology, embedded in the ship information model, Fig. 5.

Level 4 involves the active participation of the project management office in the strategic management of the project portfolio. To do this, certain prerequisites for the development of portfolio management must be formed in the enterprise management system, such as a formalized strategy, metrics for assessing projects for compliance with the strategy, and a certain culture of making management decisions.

In December 2020, the Cabinet of Ministers of Ukraine No. 1556-r approved the Concept for the Development of Artificial Intelli-

gence [19], which defines priority areas in the field of scientific and technical research: education, vocational training, economics, cybersecurity, information security, public administration, etc. The use of AI systems corresponds to the hierarchy of building a cluster system for the design and construction of transport ships and has coverage at all stages of the project life cycle. AI technologies allow to strengthen and expand the functions of the head of the project management office, for example:

To analyze historical data of shipbuilding and ship repair projects, where regular problems in projects of this type are revealed:

- to automate current tasks: work planning, resource allocation, tracking the progress of the project implementation using the mastered volume method, calendar monitoring of works and work packages performed by the enterprise or contractors, cost tracking, documentation analysis, creation of current reports [20];
- to integrate AI systems technologies with the life cycle of the ship from design, operation to its disposal. Analytical data based on AI systems will allow to track regularities in the data of the ship project. Project office managers and the Shipping Register of Ukraine will be able to track regularities of each stage of the ship's life cycle and predict risks;
- AI in the resource management system will allow to optimize the allocation of resources according to the project tasks, which will ensure effective interaction of the logistics center with the project management office. AI systems technologies will help optimize project cost norms and meet deadlines;
- AI systems in the project portfolio are recommended to solve balance sheet model management tasks in real time, track the budget for the project and the order portfolio as a whole, which will allow timely management decisions to be made;
- AI systems in team formation are recommended to implement chatbots that are used to streamline information exchange, task coordination, data management, planning, and report generation. Long chain integration in building AI agents for a shipbuilding cluster system is possible at the functional and management levels, Fig. 6.

Integrating Long chain systems in building agents with the project management office will allow transferring routine tasks to the information environment, and will enable all project participants in the cluster system to focus on strategic goals.

In order to assess the effectiveness of the elements of the cluster system, it is advisable to use a system of balanced indicators, Table 3. This system involves the selection and justification of a nomenclature of indicators that reflect all aspects of the system's activities, both financial and non-financial [21, 22].

In the process of developing a system of balanced indicators of individual cluster participants and responsibility centers of different levels (cascading indicators), explicit (calculated) and implicit causal relationships between key performance indicators are determined.

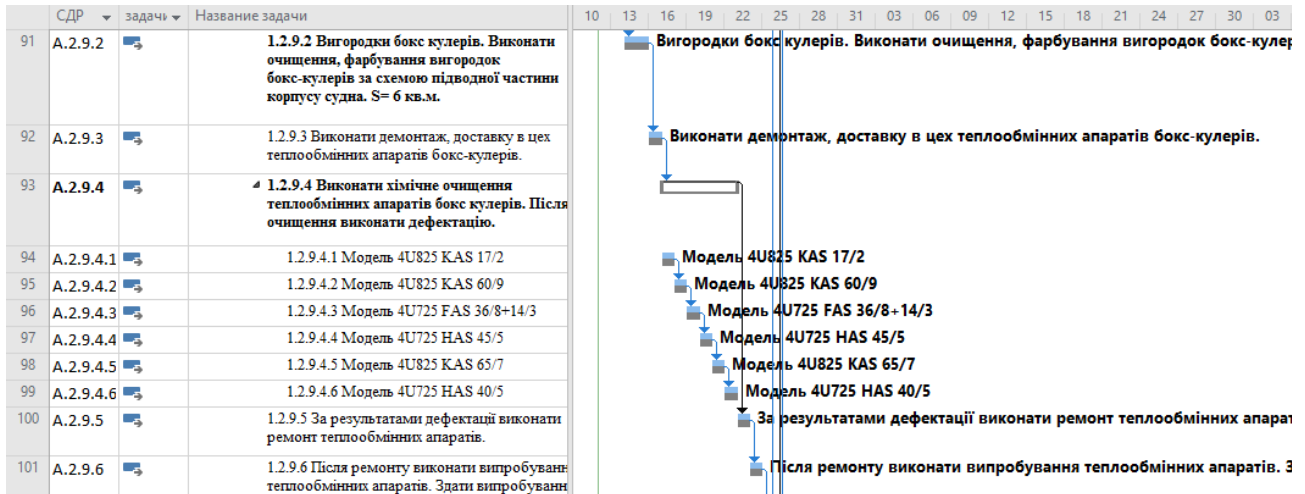


Fig. 5. Fragment of project implementation in the MS Project system

```

40 def model_call(state:AgentState) -> AgentState:
41     system_prompt = SystemMessage(content=
42         "You are my AI assistant, please answer my query to the best of your ability."
43     )
44     response = model.invoke([system_prompt] + state["messages"])
45     return {"messages": [response]}
46
47
48 def should_continue(state: AgentState):
49     messages = state["messages"]
50     last_message = messages[-1]
51     if not last_message.tool_calls:
52         return "end"
53     else:
54         return "continue"
55
56
57 graph = StateGraph(AgentState)
58 graph.add_node("our_agent", model_call)
59
60
61 tool_node = ToolNode(tools=tools)
62 graph.add_node("tools", tool_node)
63
64 graph.set_entry_point("our_agent")
65
66 graph.add_conditional_edges(
67     "our_agent",
68     should_continue,
69     {
70         "continue": "tools",
71         "end": END,

```

Fig. 6. Long chain in building agents (AI)

The mechanisms developed in the work are a scientific and methodological basis for creating tools for managing projects for the construction and operation of transport ships on the inland waterways of Ukraine. They are proposed to be implemented in a project-oriented shipbuilding cluster system, which includes enterprises of the industry, state administration bodies, and scientific institutions.

3.5. Limitations and directions of research development

The results obtained demonstrate the feasibility of developing mechanisms for managing projects for the construction and operation of transport ships on the inland waterways of Ukraine. These research and development results are recommended to be used in projects for the post-war reconstruction of the industry to restore the maritime complex of Ukraine. Shipbuilding as a transport industry is a complex organizational and technical system with a project-oriented nature of production. Ukrainian enterprises compete in global markets. World shipbuilding markets are introducing the shipbuilding 4.0 methodology, which is based on advanced technologies. The shipbuilding 4.0 methodology has clear goals of reducing costs and duration of ship construction, improving the quality of the final product to achieve sustainable competitiveness. In the process of developing organizational mechanisms in the shipbuilding cluster management system, the concept of project management using information technologies and artificial intelligence systems was implemented. The practical value of the results lies in the possibility of using organizational

Nomenclature of balanced indicators of the shipbuilding cluster system

Table 3

Strategic goals	Performance indicators
Ensuring financial sustainability of individual participants and the cluster system as a whole	– Minimization of deviations from the budget of expenses. – Return on investment
Increasing customer loyalty	– Customer loyalty index
Improving the operational activities of cluster participants	– Minimization of deviations from the terms established by the integrated network model. – Index of implementation of plans for improving the quality of technological processes and management
Improving staff skills and abilities	– Increasing the number of employees who meet the qualification requirements. – Index of implementation of the personnel training plan

mechanisms in the process of creating a shipbuilding cluster system to restore competitive logistics positions on the inland waterways of Ukraine and beyond. The limitation of this research is associated with a number of environmental factors, namely: assessment of the fixed assets of the enterprise, human resources, both production and engineering, construction of a logistics system in the southern region of Ukraine. Prospects for further research are the development of information and communication technologies, the formation of global value chains for the transport industry of Ukraine and ensuring its competitiveness in the trans-European transport system.

4. Conclusions

1. Based on the analysis of the life cycle of a transport ship, a project for creating a cluster system for the construction and operation of transport ships for inland waterways of Ukraine is proposed. The formation of a cluster integration of the construction and operation of ships is an effective mechanism for state support of the inland waterway transport system of Ukraine, an effective platform for implementing the provisions of the Law of Ukraine on Public-Private Partnership. The organization and functioning of the cluster will positively affect the search for consensus with all participants in the river transport market. Cluster integration creates conditions for attracting private investment in river transport.

2. The principles of formation of mechanisms of personnel potential in the system of training of specialists have been developed. The implementation of dual education in the structure of the regional cluster of shipbuilding and ship repair will contribute to the transition to a qualitatively new level of training of qualified workers and specialists for the shipbuilding industry of Ukraine. At the same time, a system of social partnership is developing, which has a positive impact on ensuring the competitiveness of domestic shipbuilding enterprises in international markets.

3. The formation of a logistics center in the cluster system is substantiated. For the sustainable functioning of the shipbuilding cluster system, it is proposed to organize a logistics center in its structure, which will ensure the implementation of logistics tools and reliable logistics service. The nomenclature of functions assigned to the logistics center is subject to constant analysis and adjustment at different stages of the project life cycle.

4. The structure of the cluster information system and the artificial intelligence system in the management of projects for the construction and operation of transport ships is proposed. Systematic integration of processes that will allow building a single production space to restore the internal potential of the industry requires significant efforts and the involvement of modern management technologies, including in information systems. The information base forms the logistics service of the industry for domestic enterprises and partners of the European Union. The cluster system project will allow potential partners to build a logistics chain and form a personnel policy in accordance with European requirements for the quality of training. The result of the interaction of all participants in the cluster system is the unification of enterprises in the industry with European partners, to accelerate the post-war reconstruction of the trans-European network.

Conflict of interest

The authors declare that they have no conflict of interest in relation to this research, whether financial, personal, authorship or otherwise, that could affect the research and its results presented in this paper.

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Data availability

The manuscript has no associated data.

Use of artificial intelligence

The authors confirm that they did not use artificial intelligence technologies when creating the presented paper.

Authors' contributions

Iryna Zaporozhets: Conceptualization, Methodology, Validation, Formal analysis, Investigation, Resources, Data curation, Writing – original draft, Writing – review and editing, Visualization;
Antonina Trushliakova: Conceptualization, Methodology, Validation, Formal analysis, Investigation, Resources, Data curation, Visualization;
Mykola Fateev: Conceptualization, Methodology, Validation, Formal analysis, Investigation, Resources, Data curation, Visualization;
Sergii Gurskyi: Conceptualization, Methodology, Validation, Formal analysis, Investigation, Resources, Data curation, Visualization.

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✉ **Iryna Zaporozhets**, Candidate of Technical Sciences, Associate Professor, Department of Management, Admiral Makarov National University of Shipbuilding, Mykolaiv, Ukraine, e-mail: iryna.zaporozhets@nuos.edu.ua, ORCID: <https://orcid.org/0000-0003-4015-5958>

Antonina Trushliakova, Candidate of Economic Sciences, Associate Professor, Department of Management, Admiral Makarov National University of Shipbuilding, Mykolaiv, Ukraine, ORCID: <https://orcid.org/0000-0003-1958-3472>

Mykola Fateev, Candidate of Technical Sciences, Professor, Department of Management, Admiral Makarov National University of Shipbuilding, Mykolaiv, Ukraine, ORCID: <https://orcid.org/0000-0002-2663-6440>

Sergii Gurskyi, CEO, State Enterprises "Classification Society Ukrainian Register of Shipping"; PhD Student, Admiral Makarov National University of Shipbuilding, Mykolaiv, Ukraine, ORCID: <https://orcid.org/0009-0002-2186-8004>

 ✉ *Corresponding author*