UDC 005:338.28
DOI: 10.15587/2312-8372.2018.129208

Hrytsaienko M.

DEVELOPMENT OF THE INFORMATION PLATFORM MODEL FOR THE NEUTRALIZATION OF POTENTIALLY DANGEROUS UNDERWATER OBJECTS

Об'єктом дослідження є процеси управління створенням інформаційного забезпечення проектів знешкодження підводних потенційно небезпечних об'єктів. У таких проектах циркулюють складні інформаційні потоки на всіх фазах їх життєвого циклу, тому їх структурування та визначення складових є важливою частиною продукту проекту. Одним з найбільш проблемних місць є відсутність науково обґрунтованих рекомендацій щодо створення інформаційної платформи проектів знешкодження підводних потенційно небезпечних об'єктів, що ускладнює управління проектами як на стадії їх планування, так і на стадії виконання.

В ході дослідження на основі залучення успішних практик управління проектами створення складної техніки розроблено перелік організацій-учасників, залучених до проектів знешкодження підводних потенційно небезпечних об'єктів, та визначено основних споживачів інформації цих проектів. Це утворило науково-методологічне підґрунтя для розробки моделі інформаційної платформи проектів знешкодження підводних потенційно небезпечних об'єктів та для структуризації основних видів їх інформаційного забезпечення.

Модель інформаційної платформи управління проектами підводних потенційно небезпечних об'єктів запропонована у складі техніко-технологічної, організаційної та економічної інформаційних платформ. У сукупності вони утворюють інструментальну основу для розробки прикладного програмного забезпечення управління проектами очищення акваторій держави від підводних потенційно небезпечних об'єктів.

Створена у роботі наукова методологія розробки моделі інформаційної платформи спрощує планування інформаційної складової таких проектів, як завдання загальнодержавного значення.

У порівнянні з аналогічними відомими підходами до процесів управління складними проектами цей утворює повну множину стейкхолдерів проектів і забезпечує урахування інформаційних потреб всіх учасників проектів знешкодження підводних потенційно небезпечних об'єктів на акваторіях держави.

У цілому, запропонована модель інформаційної платформи управління проектами знешкодження підводних потенційно небезпечних об'єктів дає змогу спростити процеси планування інформаційного забезпечення таких проектів та підвищити загальну ефективність їх планування та реалізації.

Ключові слова: *управління проектами, підводні апарати, інформаційні моделі, засоби морської робототехніки, знешкодження підводних потенційно небезпечних об'єктів.*

1. Introduction

Among the main tasks, which determine the activities of the State Emergency Service of Ukraine (SES), a special place is occupied by tasks related to the neutralization of potentially dangerous underwater objects (PDUO) [1]. The urgency of resolving the tasks of PDUOs neutralizing is related to the possible significant negative impact of the result of the emergence of an emergency situation on the PDUO impact on socio-economic development and the state of enterprises, a particular region or the state as a whole. The main objects that need to be protected against the possible impact of the PDUO operation include objects of sea and river ports, hydroelectric power plants, offshore fixed platforms and pipelines, recreation areas and the like.

The existing problem of effective performance of tasks to neutralize PDUO is primarily related to the need to address issues of improving the existing system for planning and performing submarine operations [2].

One of the directions of the solution of this problem should be considered the introduction of the methods and models of the theory of project management into the SES divisions' activities [3]. In particular, the current task is the scientific task of developing models of information support for projects to neutralize PDUO as a theoretical basis for their timely and high-quality execution.

2. The object of research and its technological audit

The object of research is the processes of managing the creation of information support for PDUO neutralization projects. Such projects are of national importance and are characterized by a broad list of attracted general industrial enterprises, specialized organizations, scientific institutions and public authorities and local self-government. In such projects, complex information flows circulate in all phases of their life cycle – from initiation to completion. Thus, when planning and implementing projects for the PDUO neutralization, information is generated and circulated:

– on the underwater survey of certain water areas;

– on the formation of the expeditionary unit of the SES of Ukraine and its deployment in the offshore area and/or the coastal area for the implementation

ISSN 2226-3780

of a complex of works on the clearing the water areas from the APP;
– on the documentation of identified PDUOs;
– on the results of PDUO monitoring (inspection) from the moment of their detection and to the moment of neutralization;
– on the rationale and development of marine technologies for PDUO neutralization;
– on documenting the results of clearing the water area from PDUOs for the final report on the project;
– on completion of projects for cleaning the water area and transferring it for use to local authorities.

One of the most problematic tasks of managing PDUO neutralization projects is the lack of a single scientifically sound methodological basis for building an information field for such projects. Structuring the information circulating in such projects will allow to formalize the management process of the information component of project management and more fully meet the information needs of all participants in the projects of PDUO detection and neutralization.

3. The aim and objectives of research

The aim of research is development of a model information platform for project management for the PDUO neutralization as a theoretical basis for increasing the efficiency of their planning and implementation.

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

1. To identify a standard list of enterprises and organizations that are participants in PDUO neutralization projects and information consumers about these projects.

2. To develop the structure of the information platform model of the PDUO neutralization projects and synthesize information models of its components as the theoretical basis for their effective planning.

4. Research of existing solutions of the problem

Among the main stages of work on the project should be considered the stage of creating an information platform model that will provide the team and stakeholders of the project with the necessary information resources [4, 5]. Ultimately, this will effectively manage the formation of the project and its implementation.

The development of information platforms for projects includes the following known approaches and provisions:
– the main factor influencing the modeling of information platforms is the subject area of management [6];
– the processes of ensuring the reliability and availability of the created information, its use, distribution and archiving in the course of the formation and implementation of projects and programs take a special place in the modeling of information platforms [7];
– the features of the information field of projects and programs include the simultaneous presence of deterministic, probabilistic and strictly incomplete information [8], while in probabilistic information it is necessary to identify probabilistic-complete and probabilistically incomplete information;
– one of the important elements characterizing the effectiveness of the information platform in project management, it is necessary to consider the permissible level of information error, which is determined by the accepted aggregation approaches, measurement error, etc.;
– the permissible level of error for the same element of the project may differ significantly at different stages of the life cycle of the project.

At the present stage of development of information platforms and corresponding information and control systems, their development is carried out on the basis of a distributed hierarchical chain: interstate level, state level, the level of subordinated and regional systems, corporate information management systems [9]. At the same time, communication is organized through various communication channels, using graphoanalytical models that include geoinformation systems and integrated decision-making models [10].

In the formation of the information platform for the PDUO neutralization projects, their classification should be taken into account [11], which allows, on the basis of previously performed identification, to determine information needs in the technical and technological indicators of search facilities and detoxification technologies.

For certain coordinates of the PDUO location in the formation of the information platform of the project, the following should be used:
– information resources on meteorological and hydrological conditions in the work area [12];
– information arrays on the project environment [13], etc.

However, as the analysis shows, the existing information platforms for PDUO neutralization projects are not structured and complete in content and do not allow to solve the problems of information support of the project in a complex manner [14].

5. Methods of research

The development of the information platform for the management of PDUO neutralization projects is carried out on the basis of the system approach [15], the use of which allows identifying existing problems, creating an adequate research setting, synthesizing effective solutions to the task.

In accordance with the subject field of the study of the information platform formation of the PDUO neutralization projects, it is considered in the relationship between the structural and parametric objects of protection against PDUO and the technical indicators of the SES equipment. It is also obligatory to take into account the technologies used in underwater technical work, the organizational structure of the SES service, the meteorological and hydrological conditions in the area of PDUO neutralization projects and the like.

The research is based on the terminological definitions of the theory of project management, its main principles and provisions [3].

6. Research results

The author's experience in managing of PDUO neutralization projects indicates that the main participants in such projects should be considered (Fig. 1):
– government departments;
– bodies of local self-government;
– SES of Ukraine;
– main administrations of the SES of Ukraine;
– SES services and units;

– enterprises and organizations, which operation is associated with a potential threat from the PDUO operation;
– enterprises and organizations that are in the zone of potential threat from the PDUO action;
– state and public associations;
– mass media;
– meteorological service;
– research institutions;
– project team.

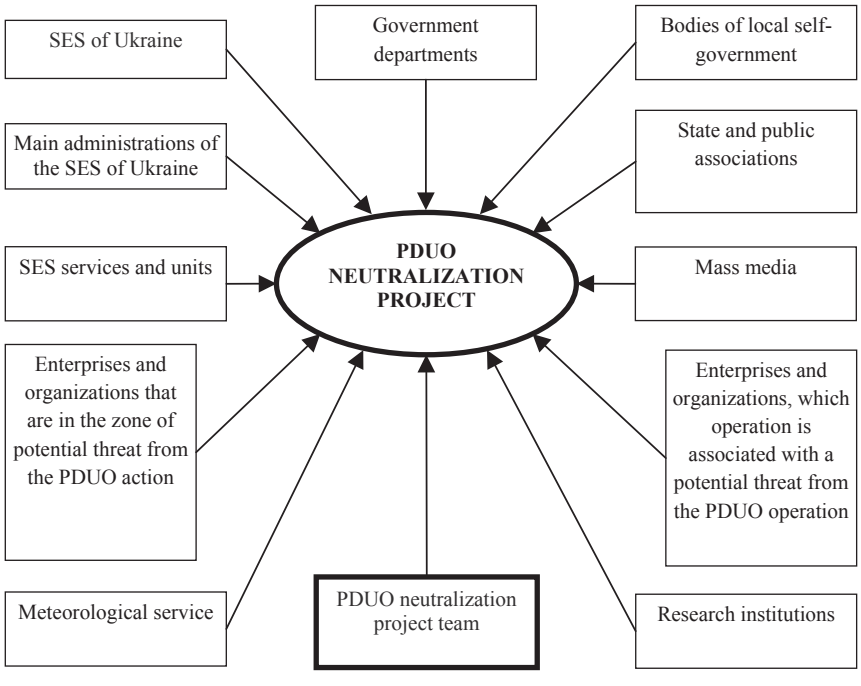

Fig. 1. The main participants in the PDUO neutralization projects

The presence in the structure of the main participants of the PDUO neutralization projects of state authorities and local self-government, SES of Ukraine, the main administrations of the SES of Ukraine, SES services and divisions is regulated at the legislative level. The main project participants are also enterprises and organizations that are in the zone of potential threats to PDUO and which functioning is associated with a potential threat from the PDUO action. This is due to the need for their participation in the planning and, if necessary, the implementation of certain stages of work on the PDUO neutralization. The meteorological service and scientific research institutions provide their participation in the draft resolution of issues of hydrometeorological information support, justification of organizational and technical solutions, and the like.

In accordance with the existing regulatory and legislative acts, as well as successful practices of completed projects, the structure of the information platform I^j for the j-th project is based on determining the following set of information needs I_i^j of project participants and programs [6]:

$$IP^j = I^j_{i=1,\dots 4} = I_1^j \cup I_2^j \cup I_3^j \cup I_4^j,$$

where I_1^j, I_2^j, I_3^j, I_4^j – the set of information needs of the project participants, necessary for the creation of the project product at different phases of its life cycle, respectively: at the phases of initiation, planning, implementation and completion of the project, respectively.

Information needs of the project participants are divided into three main groups, which form the corresponding information platforms of technical-technological (T), economic (E) and organizational (O) nature:

$$I_1^j = I_1^{j,T} \cup I_1^{j,E} \cup I_1^{j,O}; \quad I_2^j = I_2^{j,T} \cup I_2^{j,E} \cup I_2^{j,O};$$

$$I_3^j = I_3^{j,T} \cup I_3^{j,E} \cup I_3^{j,O}; \quad I_4^j = I_4^{j,T} \cup I_4^{j,E} \cup I_4^{j,O},$$

where $I_1^{j,T}$, $I_1^{j,E}$, $I_1^{j,O}$, $I_2^{j,T}$, $I_2^{j,E}$, $I_2^{j,O}$, $I_3^{j,T}$, $I_3^{j,E}$, $I_3^{j,O}$, $I_4^{j,T}$, $I_4^{j,E}$, $I_4^{j,O}$ – respectively, the set of information arrays of technical, technological, economic and organizational nature that are necessary for the initiation, design, implementation and completion of the PDUO neutralization project.

Next, let's consider the information needs of the participants in the PDUO neutralization projects for the initiation phase, as the needs structures for other phases are similar. According to [5], it is convenient to develop each of the information platforms in the form of an appropriate information model as the basis for the synthesis of applied information software for project management processes.

Such models include frames describing the structural and parametric characteristics of objects, as well as a number of models that allow to solve the tasks of managing the PDUO neutralization projects (Fig. 2).

The information model of the technical and technological platform «PDUO» $I_1^{j,PDO}$ contains information on the potentially dangerous underwater objects in accordance with their classification characteristics [16]:

$$I_1^{j,PDO} = (\{(x_{Mi}, y_{Mi})\}, i \in 1\dots n) \cup (\{T_{NMi}\}, i \in TN1) \cup$$
$$\cup (\{Q_{NMi}\}, i \in TF1) \cup (\{Q_{RMi}\}, i \in TFF1) \cup$$
$$\cup (\{V_{NMi}\}, i \in BT1) \cup (\{K_{MTi}\}, i \in TK1) \cup$$
$$\cup (\{K_{TXMi}\}, i \in XK1) \cup (\{O_{NMi}\}, i \in OK1) \cup$$
$$\cup (\{UP_{NMi}\}, i \in FY1) \cup (\{XS_{NMi}\}, i \in SV1) \cup$$
$$\cup (\{XT_{NMi}\}, i \in TN1) \cup (\{M_{NMi}\}, i \in MN1)),$$

where $\{(x_{Mi}, y_{Mi})\}$ – the coordinates of the location of each of the PDUOs; $TN1$, $TF1$, $TFF1$, $BT1$, $TK1$, $XK1$, $OK1$, $FY1$, $SV1$, $TN1$ – set characterizing PDUO, respectively:
– information level;
– territorial influence;
– origin;
– environmental impact;
– type of exposure;
– size of the impact;
– duration of the potential hazard;
– period of impact on the environment;
– constancy of the situation in space;
– position in space;

$MN1$ – set of models that provide the definition of indicators and characteristics of PDUO.

ISSN 2226-3780

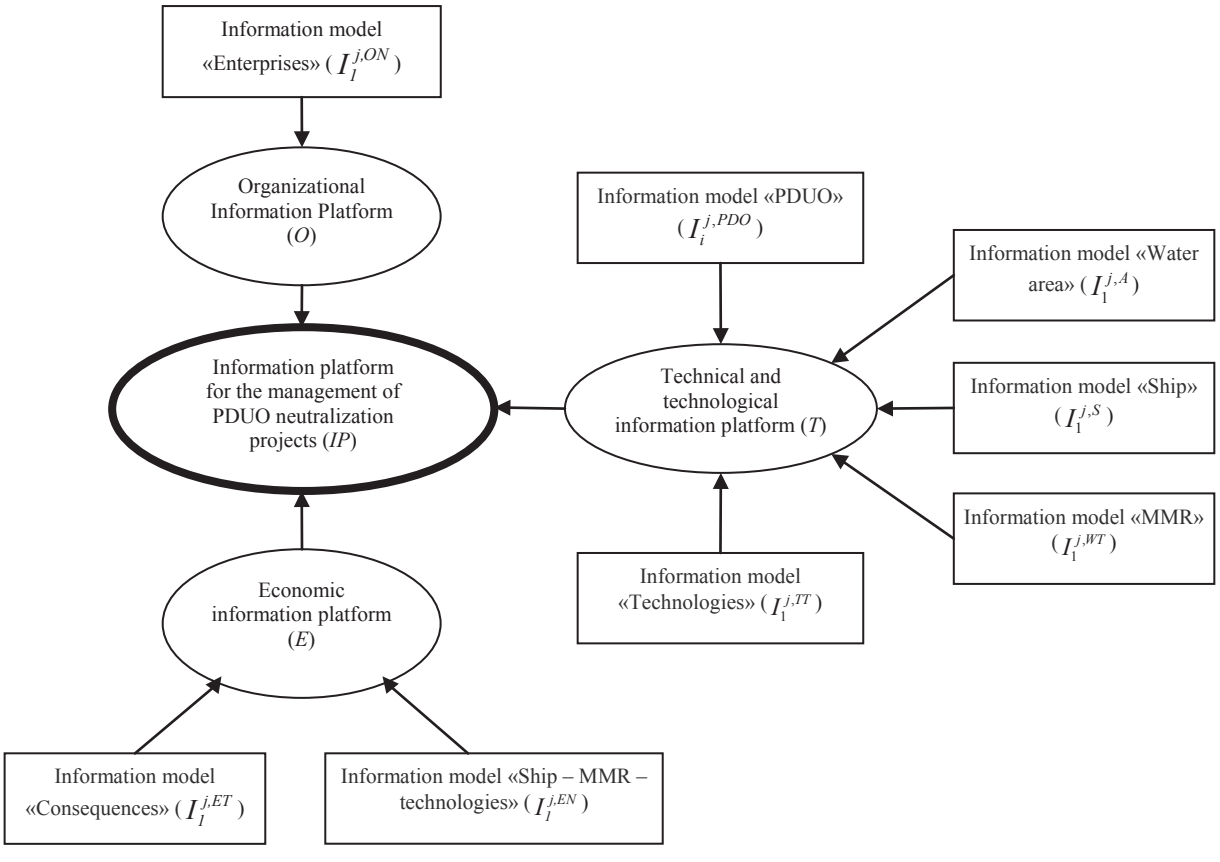

Fig. 2. The main components of the information platform for the management of PDUO neutralization projects

The main content of the information model of the technical-technological platform «Water area» is provided in accordance with [17]:

$$I_1^{j,A} = (((\{((x_1\ y_1),\ (x_1\ y_2),\ (x_2\ y_1),\ (x_2\ y_2))\ \})\cup$$
$$\cup(\{T_{Ni}\}, i \in TN)\cup(\{Q_{Ni}\}, i \in TF)\cup(\{Q_{Ri}\}, i \in TFF)\cup$$
$$\cup(\{V_{Ni}\}, i \in BT)\cup(((\{(x_{Si}, y_{Si})\}, i \in 1...n)(\{K_{Ti}\}, i \in TK)\cup$$
$$\cup(\{K_{TXi}\}, i \in XK)\cup(\{O_{Ni}\}, i \in OK)\cup(\{UP_{Ni}\}, i \in FY)\cup$$
$$\cup(\{XS_{Ni}\}, i \in SV)\cup(\{XT_{Ni}\}, i \in TN)\cup(\{Z_{Ni}\}, i \in XZ)\cup$$
$$\cup(\{TR_{Ni}\}, i \in XT)\cup(\{RA_{Ni}\}, i \in\ \ N)\cup(\{I_{Ai}\}, i \in A_{Ni})\cup$$
$$\cup(\{I_{Bi}\}, i \in B_{Ni})\cup(\{T_{NEi}\}, i \in ECON)\cup(\{M_{Ni}\}, i \in MN)),$$

where $((x_1y_1), (x_1y_2), (x_2y_1), (x_2y_2))$ – the coordinates of the research area (water area); *TN*, *TF*, *TFF*, *BT*, *TK*, *XK* – sets characterizing the general metrological and hydrological situation of the water area, temperature gradients by seasons, salinity of water in the water area, depths, coastal deviations and ice situation; *OK*, *FY*, *SV*, *TN*, *XZ*, *XT*, $\{(x_{Si}, y_{Si})\}$ – set of characteristics of coastal zones, objects located on the shores of the water area, structural and parametric characteristics of industrial facilities and organizations, the functioning of which is threatened by the consequences of the PDUO operation, the characteristics of the ship's canals, the characteristics of structures, structures, obstacles and their coordinates; *AN*, A_{Ni}, B_{Ni}, *ECON* – set of data of the state of the ship's channels, parametric and structural indicators, environmental indicators of industrial facilities located on the shores of the water area, buildings, structures, obstacles, respectively; *MN* – a set of models that provide definition of indicators and characteristics of the water area, as well as management of their development projects.

The information model of the technical-technological platform «Ship» $I_1^{j,S}$ provides four basic information elements [18]:

1) registration documents for the ship – the number in order, the date of registration, the validity period of the charter party, the name of the ship, the callsign of the ship, the IMO identification number;

2) the legal characteristics of the ship – the destination and type, the navigation area, the time and place of construction, the owner and his legal address, the shipowner or charterer and his legal address, the organization that performs technical supervision;

3) technical characteristics of the ship – the main dimensions (length, width, height of the side, draft in the summer load line), gross tonnage, main mechanisms (type, quantity, total capacity), main heat machine (type, quantity, power);

4) operational characteristics of the ship – cargo holds (type, number, total capacity), refrigerated holds (number, total capacity), hull material, number of decks, number of watertight bulkheads, passenger capacity, crew and the like.

The information model of the technical and technological platform «MMR» contains an information array of data generated in accordance with the classification features of the means of marine robotics (MMR), which are planned to be used to the PDUO neutralization. Usually, these are uninhabited underwater vehicles, towed hydroacoustic systems, unmanned surface and aerial vehicles, their technical equipment, etc. [19]:

$$I_1^{j,WT} = (\{TS_{Ti}\}, i \in TRS) \cup (\{TP_{Ti}\}, i \in TRP) \cup$$
$$\cup (\{TKS_{Ti}\}, i \in TKRS) \cup (\{TKP_{Ti}\}, i \in TKRP) \cup$$
$$\cup (\{TZS_{Ti}\}, i \in TZRS) \cup (\{TZP_{Ti}\}, i \in TZRP) \cup$$
$$\cup (\{TUG_{Ti}\}, i \in TRUG) \cup (\{RA_{Ti}\}, i \in AT) \cup$$
$$\cup (\{I_{Ai}\}, i \in A_{Ti}) \cup (\{I_{Bi}\}, i \in B_{Ti})),$$

where *TRS*, *TKRS*, *TZRS* – set of structural indicators of underwater vehicles, towed hydroacoustic systems, unmanned aerial vehicles, respectively; *TRP*, *TKRP*, *TZRP* – sets of parametric indicators, respectively; *TRUG* – set of characteristics of the storage areas of underwater vehicles, towed hydroacoustic systems, unmanned aerial vehicles; A_{Ti}, B_{Ti}, *AT* – set of data technical condition of underwater vehicles, towed hydroacoustic systems, unmanned aerial vehicles.

Information model of technical and technological platform «Technologies» $I_1^{j,TT}$ contains safety issues, technical and environmental characteristics of existing marine (in particular, underwater) technologies for searching, examining and neutralizing PDUO.

The information model of the economic information platform «Ship – MMR – Technologies», which reflects the economic characteristics and cost indicators of the technical and technological elements of the project can be represented by the following main arrays:

$$I_1^{j,EN} = (((\{SN_{Ni}\}, i \in IS) \cup (\{S\ \ T_{Ni}\}, i \in ST) \cup$$
$$\cup (\{SBBT_{Ni}\}, i \in SBT) \cup (\{SVT_{Ni}\}, i \in VS) \cup$$
$$\cup (\{SZT_{Ni}\}, i \in ZS) \cup (\{SM_{Ni}\}, i \in SMN)),$$

where *IS*, *ST*, *SBT*, *SBT*, *VS*, *ZS* – set of cost indicators of ships, underwater vehicles, towed hydroacoustic systems, unmanned aerial vehicles, technologies for underwater technical work and PDUO neutralization, respectively; *SMN* – set of models that provide the definition of cost parameters and characteristics of objects and technologies.

The main content of the information section of the economic information platform «Consequences» $I_1^{j,ET}$ provides the definition of cost indicators of possible losses in the event of an emergency:

$$I_1^{j,ET} = (((\{STS_{Ti}\}, i \in STRS) \cup (\{STKS_{Ti}\}, i \in STKRS) \cup$$
$$\cup (\{STIS_{Ti}\}, i \in STIRS) \cup (\{STSS_{Ti}\}, i \in STSRS) \cup$$
$$\cup (\{STPS_{Ti}\}, i \in STPRS) \cup (\{M_{Ti}\}, i \in SMT)),$$

where *STRS*, *STKRS*, *STZRS*, *STIRS* – set of value indicators of losses, which are potentially possible at the objects of the sea and river port infrastructure, civilian objects of life support systems, onshore bases of the armed forces; *STSRS*, *STPRS* – set of cost indicators of losses, potentially possible in the coastal recreation areas, the locations of underwater archaeological values from the occurrence of an emergency situation due to the PDUO operation; *SMT* – set of models that provide the definition of cost indicators, as well as project management. The information component of the organizational information platform «Enterprises» $I_1^{j,ON}$ of the platform for PDUO neutralization contains the following main sets of information arrays:

$$I_1^{j,ON} = (((\{ZT_{Ni}\}, i \in ZTN) \cup I_1^{j,OT} = (\{ZTS_{Ti}\}, i \in ZTRS) \cup$$
$$\cup I_1^{jOF} = (\{ZFS_{Fi}\}, i \in ZFRS) \cup I_1^{j,ONH} =$$
$$= (((\{ZDRM_{NNi}\}, i \in ZMRD) \cup (\{ZSM_{NNi}\}, i \in ZSMNH)),$$

where *ZTN*, *ZTRS*, *ZFRS*, *ZMRD* – set of regulatory and legislative acts and regulations governing the organization of work to PDUO neutralization, information on enterprises and organizations involved in projects, respectively; *ZSMNH* – set of models that provide access to the above arrays and their processing, as well as management models.

Similar to the given information model, information models of other elements of PDUO neutralization projects are developed taking into account their life cycles. The developed information models and platforms have been tested in the development and implementation of PDUO neutralization projects [2] and can serve as a basis for their initiation, planning and implementation.

7. SWOT analysis of research results

Strengths. The standard list of organizations participating in the PDUO neutralization projects and consumers of information on these projects is the base one and forms the full set of stakeholders of the projects. This simplifies the planning of projects for cleaning the water areas of the state from PDUO at the early stages of their preparation.

The proposed structure of the information platform model of the PDUO neutralization projects covers the main types of information support and can be used in the planning of water purification projects from the PDUO.

The developed models of technical, technological, organizational and economic platforms as components of the information platform for PDUO neutralization projects form the instrumental basis for the creation of applied software for the management of projects for cleaning the water areas of the state from the PDUO.

Weaknesses. The resulting models of information platforms increase the complexity of the work on planning projects for cleaning the water areas from PDUO in the early stages of their development.

Opportunities. Further research should be directed to the synthesis of internal structures of the obtained information platforms and the development of quantitative indicators of their effectiveness.

Threats. Due to the large list of stakeholders of the project, there is a threat of high time spent on identifying differences between participants and the associated increase in the duration of work of project managers.

8. Conclusions

1. A standard list of enterprises and organizations that are participants of such projects and consumers of information on these projects is defined. This allows to determine the structure of the model information platform for project management for the neutralization of potentially dangerous underwater objects in three information platforms: organizational, technical and technological and economic.

2. An organizational information platform is proposed as part of the information model of the enterprise and its information sets of regulatory and legislative acts and regulations are defined, as well as information on enterprises and organizations involved in the projects.

ISSN 2226-3780

The technical and information platform is proposed as part of five information models that contain information important for project management. It includes information on detected potentially dangerous underwater objects and the water area on which they are located, about ships and marine robotics that will be involved in the project. An information model is also being introduced, which includes information on offshore technologies for the neutralization of potentially dangerous underwater objects.

Together, the proposed model of an information platform for project management for the neutralization of potentially dangerous underwater objects makes it possible to simplify the planning of information support for such projects and increase the overall effectiveness of their planning and implementation.

References

1. Blintsov O. V., Hrytsaienko M. H. Controlled unmanned vehicles on the service of the marine business of Mykolaiv // Shipbuilding and marine infrastructure. 2014. No. 1 (1). P. 28–33.
2. Upravlinnia uspishnymy proektamy stvorennia skladnoi tekhniky: monograph / Babkin H. V. et al. Mykolaiv: Torubary V. V., 2017. 336 p.
3. Rukovodstvo k Svodu znaniy po upravleniyu proektami (Rukovodstvo PMBOK®). Project Management Institute, 2013. 586 p. URL: https://profobr27.ru/upload/medialibrary/nd2/pmbok.pdf
4. Ruonan S., Shirley G., Byron K. Information Technology Platforms: Conceptualisation and a Review of Emerging Research in IS Research: proceedings // Australasian Conference on Information Systems. Adelaide, 2015. P. 1–17.
5. Fox S. Thinking about SWOT analysis: monograph. Amazon Digital Services LLC, 2016. 27 p.
6. Kharytonov Yu. M. Upravlinnia proektamy i prohramamy rekonstruktsii munitsypalnykh system teplopostachannia: Abstract's thesis of Doctor of Technical Sciences. Mykolaiv: NUK, 2014. 60 p.
7. Dihe P., Denzer R., Schlobinski S. An Information Model for a Water Information Platform // Environmental Software Systems. Infrastructures, Services and Applications. 2015. P. 91–101. doi:10.1007/978-3-319-15994-2_8
8. Enblin T. A., Frommert M. Reconstruction of signals with unknown spectra in information field theory with parameter uncertainty // Physical Review D. 2011. Vol. 83, No. 10. doi:10.1103/physrevd.83.105014
9. Mekhanizmy upravleniya proektami i programmami regional'nogo i otraslevogo razvitiya: monograph / Burkov V. N. et al. Mykolaiv: Torubara O. S., 2010. 176 p.
10. Somers R. M. Advanced Geographic Information Systems. Vol. 2. GIS Project Planning and Implementation. Encyclopedia of Life Support Systems (EOLSS). Virginia, 2009. 308 p.
11. A Guide to Survey and Clearance of Underwater Explosive Ordnance. Geneva: International Centre for Humanitarian Demining (GICHD), 2016. 58 p.
12. Lindquist P. S. Regional Freight Information Resources for Market Opportunities in the Great Lakes Maritime Transportation System. The University of Toledo and the U.S. Department of Transportation, 2009. 15 p.
13. Soner O., Akyuz E., Celik M. A Maritime Research Concept through Establishing Ship Operational Problem Solution (Shipos) Centre via Information Technologies Integrated With or/Ms: proceedings // World Conference on Technology, Innovation and Entrepreneurship. Procedia – Social and Behavioral Sciences, 2015. P. 2796–2803.
14. Modeli, metody i algoritmicheskoe obespechenie proektov i programm razvitiya naukoemkikh proizvodstv: monograph / Voznyy A. M. et al. Mykolaiv: NUK, 2009. 194 p.
15. Antonov A. V. Sistemnyy analiz. Moscow: Vysshaya shkola, 2004. 454 p.
16. DoD Unmanned Systems Integrated Roadmap FY2013-2038. 153 p. URL: http://www.dtic.mil/dtic/tr/fulltext/u2/a592015.pdf
17. Kharytonov Yu. M., Hordieiev B. M., Berdynskykh B. V. Modeling of project management information platform of port infrastructure development // ScienceRise. 2017. Vol. 1, No. 2 (30). P. 39–47. doi:10.15587/2313-8416.2017.91279
18. Pro zatverdzhennia Poriadku vedennia Derzhavnoho sudnovoho reiestru Ukrainy i Sudnovoi knyhy Ukrainy: Resolution of the Cabinet of Ministers of Ukraine No. 1069 from September 26, 1997. URL: http://zakon0.rada.gov.ua/laws/show/1069-97-%D0%BF
19. Stvorennia universalnykh transportnykh suden i zasobiv okeanotekhniky: monograph / Ryzhkov S. S. et al.; ed. by Ryzhkov S. S. Mykolaiv: NUK, 2011. 340 p.

Hrytsaienko Maksym, *Head of the State Service, The State Emergency Service of Ukraine in the Mykolaiv Region, Ukraine, e-mail: post@firedept.mk.ua, ORCID: http://orcid.org/0000-0002-4436-9382*