

SYSTEM SUPPORT OF ECOLOGICAL SECURITY OF THE ECOSYSTEM BY CREATING A SYSTEM OF TIPS FOR MAKING INFORMATIONAL ECOLOGICAL DECISIONS

Mashkov O.A.¹, Mikheev V.S.², Nigorodova S.A.¹, Zhukauskas S.V.³

¹State Ecological Academy of Postgraduate Education and Management
35, Metropolitan Vasyl Lypkivskyi str., building 2, 03035, Kyiv

²State Space Agency of Ukraine
8, Moskovska str., 01010, Kyiv

³Ministry of Energy and Environmental Protection of Ukraine
30, Khreshchatyk str., 01601, Kyiv

mashkov_oleg_52@ukr.net, yd@nkau.gov.ua

The article considers the problems of creating a system of support for environmental information solutions as a system of environmental security of the state. It is determined that environmental safety consists of environmental audit, monitoring, forecast of the environmental situation, environmental management. Carrying out of these actions provides processing and transfer of the ecological information for formation of administrative decisions. The authors consistently consider the following issues: features of the application of a systematic approach to ensuring the environmental security of the state; classification of managerial ecological decisions; general characteristics and features of management information environmental decisions; the process of making environmental information decisions; technology of information solutions in ecosystems. The tasks to which management information decisions in the environmental safety management system are aimed, as well as the main systemic threats in the environmental sphere. It is offered to systematize managerial ecological decisions as a set of three branches of decisions: information, organizational and operational decisions. It is determined that in the process of preparing an environmental information solution by rational technology there is a need to clarify or adjust the results of the following stages: diagnosis of the environmental problem, the accumulation of information about the environmental problem; development of alternatives, evaluation of alternatives, decision making. The considered questions about ecological management decisions can be applied to creation of system of support of ecological decisions and modeling of ecological processes in environment and technogenic dangerous objects. Theoretical questions are aimed at preparing for the following practical actions: to set and formulate the task of analysis and synthesis of environmental management structures; to form the purposes of ecological management and to define object of ecological management; plan and make management decisions in ecological systems. The material is the basis for the practical activities of specialists as researchers and managers in the field of environmental safety with the use of aerospace technologies. *Key words:* aerospace technologies, ecological safety, ecological information, ecological problem, ecological threats, environment, process of making information ecological decisions, system of support of ecological information decisions, system of management of ecological safety, system approach, managerial decisions.

Системна підтримка екологічної безпеки екосистеми за допомогою створення системи підтримки прийняття інформаційних екологічних рішень. Машков О.А., Міхєєв В.С., Жукаускас С.В.

У статті розглянуто проблеми створення системи підтримки екологічних інформаційних рішень як системне забезпечення екологічної безпеки держави. Визначається, що екологічна безпека складається з екологічного аудиту, моніторингу, прогнозу розвитку екологічної ситуації, екологічного менеджменту. Проведення цих заходів передбачає обробку й передачу екологічної інформації для формування управлінських рішень. Автори послідовно розглядають такі питання: особливості застосування системного підходу до забезпечення екологічної безпеки держави; класифікацію управлінських екологічних рішень; загальну характеристику та особливості управлінських інформаційних екологічних рішень; процес прийняття інформаційних екологічних рішень; технологію інформаційних рішень в екосистемах. Визначено завдання, на які спрямовані управлінські інформаційні рішення в системі управління екологічною безпекою, а також основні системні загрози в екологічній сфері. Запропоновано систематизувати управлінські екологічні рішення як сукупність трьох гілок рішень: інформаційних, організаційних та оперативних. Визначається, що у процесі підготовки інформаційного екологічного рішення за раціональною технологією виникає необхідність уточнення або коригування результатів таких етапів, як діагноз екологічної проблеми, накопичення інформації про екологічну проблему, розроблення альтернативних варіантів, оцінка альтернативних варіантів, прийняття рішення. Розглянуті питання про екологічні управлінські рішення можуть бути застосовані для створення системи підтримки екологічних рішень та моделювання екологічних процесів у навколишньому природному середовищі й техногенно небезпечних об'єктах. Теоретичні питання спрямовані на підготовку до практичних дій, зокрема: ставити та формулювати завдання аналізу й синтезу екологічних управлінських структур; формувати цілі екологічного управління та визначати об'єкт екологічного управління; планувати та приймати управлінські рішення в екологічних системах. Матеріал є підґрунтям для практичної діяльності фахівців як дослідників та управлінців у галузі екологічної безпеки із застосуванням аерокосмічних технологій. *Ключові слова:* аерокосмічні технології, екологічна безпека, екологічна інформація, екологічна проблема, екологічні загрози, навколишнє природне середовище, процес прийняття інформаційних екологічних рішень, система підтримки екологічних інформаційних рішень, система управління екологічною безпекою, системний підхід, управлінські рішення.

Problem statement and its interrelation with important scientific and practical tasks. It is known that ensuring environmental security is a component of national security and determines the degree of protection of man, society and the state. An indicator of the effectiveness of the state's environmental policy is to minimize the impact of negative factors on human health and the state of the environment. Therefore, environmental security should be considered not only as one of the components of national security, but also as an integrator who is able, on the one hand, to consolidate society, and on the other – to ensure its progressive progress.

Ecological safety is a state and conditions of the environment in which ecological balance is ensured and protection of the environment is guaranteed: biosphere, atmosphere, hydrosphere, lithosphere, cosmosphere, species of fauna and flora, natural resources, preservation of human health and life.

According to Art. 50 of the Law of Ukraine "On Environmental Protection" ecological safety is a state of the environment when the prevention of deterioration of the ecological situation and human health is guaranteed. It is a set of actions, states and processes that do not directly or indirectly lead to vital losses (or threats of such losses) inflicted on the natural environment, individuals and humanity; a set of states, phenomena and actions that ensures the ecological balance on Earth and in any of its regions at a level to which humanity is physically, socio-economically, technologically and politically ready (can adapt without serious losses).

Environmental safety is determined in relation to the territories of the state, region, administrative regions and districts, settlements (cities and villages) or to economic facilities – oil and gas areas, industrial complexes, factories, factories and other objects of industry, transport, energy, chemistry, mining, communications, etc.

Ecological safety consists of ecological audit, monitoring, forecast of ecological situation development, ecological management. Carrying out of these actions provides processing and transfer of the information for formation of administrative decisions.

In the context of the above, there is a need for systematic consideration of issues of creating a system of support for environmental information solutions as a system of environmental security of the state.

Analysis of recent research and publications. The following publications are devoted to the issue of ensuring the ecological security of the state from the standpoint of a systemic approach [8; 9; 16; 17; 21]. The issues of ecological monitoring and ecological safety of regions and technogenic dangerous objects are considered in [6; 7; 10; 11; 22]. Information features of management decision support systems are defined in publications [5; 12; 15; 20]. Features of the use of aerospace technologies in environmental monitoring systems are considered in [13; 14; 18; 19; 23]. However, today there is no common understanding of technologies for obtaining environmental information decisions in the system of sup-

port for environmental decision-making. This prevents a more adequate definition of management decisions from a systemic standpoint and gives rise to different interpretations of it by both theorists and practitioners in making management decisions.

Unresolved parts of the overall problem. Usually, when considering the creation of a system of support for information environmental decisions as a system of environmental security of the state, the emphasis is mainly on certain technical aspects of creating the hardware of automated decision support systems. However, the issues of creating software (algorithmic software) need to be improved. Therefore, the issue of creating a system of support for environmental information solutions from the standpoint of a systematic approach should be considered relevant. According to this approach, "information environmental solutions" require detailed elaboration from the standpoint of a systems approach.

The purpose of the article. The purpose of the article is to consider "information environmental solutions" from the standpoint of system analysis and determination (justification) of management decisions in the direction of environmental safety.

Presentation of the main research material.

1. Features of application of the system approach to ensuring ecological safety of the state

Systematic provision of ecological security of the state involves determining the purpose of environmental safety management – the creation of appropriate conditions for society, the functioning of the technosphere, self-reproduction of the natural environment. System management decisions are aimed at performing the following tasks:

- assessment of the levels of risk of occurrence of certain emergencies in specific areas or individual objects (aims to further develop measures to reduce the risk to an acceptable level, development of scenarios for responding to emergencies in case of their occurrence);
- classification of high-risk objects according to their levels of risk, capacity and environment according to the degree of their danger;
- classification of natural phenomena according to the levels of their occurrence, the scale of localization in space and time and the zone of their location according to the degree of danger;
- classification of situations around objects of increased danger according to the level of the situational response regime (everyday, high alert, emergency, state of emergency);
- development of scenarios of preventive actions and actions to eliminate negative consequences in accordance with the levels of situational response at facilities and territories;
- development of regulatory framework for environmental safety management;
- development of economic mechanisms to prevent and compensate for losses from man-made and natural hazards;

– formation of material, financial and human reserves for situational response to scenarios of prevention and liquidation of emergency situations.

It should be borne in mind that the activity of units of the Ministry of Defense of Ukraine significantly affects the state of environmental security of the state. It is possible to outline the following main elements of ecological danger that create separate parts of the military-industrial complex: the lack of resource-saving technologies in the production of military products; the problem of waste disposal; atmospheric pollution; land degradation; pollution of water resources; the problem of ammunition disposal.

Disposal of ammunition became an urgent need for Ukraine, as it was to Ukraine that the arsenals of troops of the former USSR stationed in Central and Eastern Europe were exported. Given the large number of storage facilities for ammunition and explosives, the conditions of their storage and the state of providing these facilities with systems of automatic control and monitoring, monitoring and firefighting, the risk of fires and explosions on them remains quite high. Emergencies that have occurred at these facilities in the last three years, and were accompanied by heavy material damage and human casualties, draw attention to the problem of man-made and socio-political security in the Armed Forces of Ukraine.

According to the State Emergency Service of Ukraine, during the liquidation of the consequences of emergencies during 2015–2018 related to explosions at ammunition storage warehouses (bases) of the Ministry of Defense, in accordance with their powers, the following were carried out:

1) measures to extinguish fires caused by detonation of ammunition, in particular in 2015 in Svativ district of Luhansk region 6 fires were eliminated, in 2017 in Balaklia district of Kharkiv region – 19 fires, in Kalinov district of Vinnytsia region – 7 fires, SES aircraft carried out 36 discharges of water (288 tons). In 2018, 39 fires were eliminated in Ichnia district of Chernihiv region, 148 water discharges (836 tons) were made by SES aircraft, 272 refueling of fire tanks (2449 tons of water), 47 refueling of wheeled vehicles (244 tons of water) and daily replenishment of the fire reservoir were carried out by SES units. with a volume of 200 cubic meters;

2) assistance was provided to local executive bodies in carrying out measures to evacuate the population, in particular: in 2015 from Svativsky district of Luhansk region – more than 5 thousand people were evacuated, in 2017 from Kalinov district of Vinnytsia region – more than 30 thousand people, from Balakliysky district of Kharkiv region – about 20 thousand people, in 2018 from Ichnia district of Chernihiv region – more than 12,5 thousand people;

3) works on clearing the territory from explosive objects outside warehouses (arsenals) were carried out, first of all within settlements, in particular during liquidation of an emergency situation on the territory: warehouses of missile and artillery armament of the Ministry

of Defense of Ukraine (Svatove, Luhansk region) more than 4,800 hectares, more than 22 200 explosive devices neutralized; 65 arsenals of the Armed Forces of Ukraine (Balakliya, Kharkiv region) cleared the territory with a total area of 31 thousand hectares, neutralized more than 29 thousand explosive devices; 48 arsenals of the Armed Forces of Ukraine (Kalinov district of Vinnytsia region) cleared the territory with a total area of 30 400 hectares, neutralized about 4,000 explosive devices; In the 16-kilometer zone adjacent to the 6th arsenal of the Armed Forces of Ukraine in Ichnia district of Chernihiv region, all 39 settlements around the arsenal were inspected and cleared of ammunition, as well as the territory with a total area of 79,7 thousand hectares was cleared and more than 100 thousand were neutralized. explosive objects.

The main task in the near future is to replace technology and technical re-equipment of enterprises. This requires significant investment, which due to the decline in production and unfavorable investment climate in the short term is not very real.

At this stage, the way out should be considered the implementation of non-capital, self-sustaining modernization using a systematic environmental approach, which should include a set of technological, managerial and economic improvements and innovations aimed at improving the environmental performance of production.

The environmental management system in enterprises should become an integral part of the overall management system. Decisions on the greening of production should be made on the basis of the conclusions and recommendations of the environmental audit.

The main systemic threats in the environmental sphere are:

1) significant anthropogenic disturbance and man-caused congestion on the territory of Ukraine, increasing risks of emergencies of man-caused and natural nature, including those related to hostilities on the territory of Ukraine;

2) irrational, depleting use of natural resources, both non-renewable and renewable;

3) negative socio-environmental consequences of the Chornobyl disaster;

4) deterioration of the ecological condition of water basins, exacerbation of the problem of transboundary pollution and water quality;

5) aggravation of man-caused condition of hydraulic structures of the cascade of reservoirs on the Dnieper River;

6) ineffectiveness of measures to overcome the negative consequences and other environmentally hazardous activities;

7) increasing the impact of harmful genetic effects in populations of living organisms, including genetically modified organisms, and biotechnology;

8) obsolescence and insufficient efficiency of toxic and environmentally hazardous waste disposal com-

plexes. Due to the lack of clear delineation of functions between ministries and departments, their duplication, the system of institutional support for regulation and control over compliance with environmental safety requirements also needs to be significantly improved. Departmental dispersion and duplication of control functions reduces their effectiveness and creates additional obstacles in the activities of business entities. In accordance with world and European practice, as in previous years, further development of existing and introduction of new mechanisms for regulating environmental safety is expected, in particular:

- identification of hazardous activities as the main criterion in assessing the state of environmental safety;
- licensing of hazardous activities as a tool for regulating the level of safety when working with hazardous substances and processes;
- environmental risk insurance;
- implementation of environmental audit as one of the possible tools for assessing the level of danger;
- application of the concept of “risk” as an integral indicator of possible environmental threats. Ensuring environmental security is not only a necessary condition for ensuring the right of Ukrainian citizens to a safe environment for life and health, guaranteed by Article 50 of the Constitution of Ukraine, but also an integral condition for advancing the state towards integration into the European community.

Accumulation of waste has become one of the most important factors of environmental pollution, negative impact on all its components. Therefore, limiting the amount of waste generated, expanding the scope of its disposal, disposal and environmentally sound disposal and consistently reducing their accumulation should be one of the most important tasks. Nuclear power plants are one of the largest producers of radioactive waste. At the sites of nuclear power plants, their primary processing and temporary storage is carried out.

The main burden on the environment in the industrial sector is borne by the enterprises of chemical, metallurgical, mining and electric power industries. Potentially ecologically dangerous objects, sudden emergence of emergencies, which can cause significant ecological damage, make a significant share in the structure of Ukrainian industry.

When applying a systematic approach to the environmental safety of the state, it should be borne in mind that the objects that pose an environmental hazard include: nuclear energy and nuclear industry; biochemical, biotechnical and pharmaceutical production; collection, treatment, storage, burial, disposal and utilization of all types of industrial and household waste; oil production, petrochemistry and oil refining; extraction and processing of natural gas, construction of gas storage facilities; chemical industry, including the production of plant protection products, growth stimulants, mineral fertilizers; textile production; metallurgy (black and non-ferrous); coal, mining, extraction

and processing of peat, spropel; production, storage, utilization and destruction of ammunition of all types of explosives and rocket fuel; production of electricity and heat based on fossil fuels; building materials industry (production of cement, asphalt concrete, asbestos, glass); pulp and paper industry; woodworking industry; mechanical engineering and metalworking; construction of hydropower and hydraulic structures and reclamation systems, including tailings and slag accumulators; construction of airports, railway junctions and stations, bus stations, river and sea ports, railways and highways, subways; animal husbandry (livestock complexes more than 5 000 heads, poultry farms); food production (meat plants, dairies, sugar factories, distilleries); processing of products and processing of animal waste; construction of sewage systems and treatment facilities, etc.

On the territory of Ukraine there are 109 warehouses for centralized storage of chemical plant protection products and about 5 000 warehouses located in farms of various forms of ownership. As of January 1, 2014, there were 436 521 tons of unusable and prohibited for use in agriculture chemical plant protection products in Kyiv region. There are 183 warehouse buildings (out of the total number) in the Kyiv region, where pesticides were previously stored, among which 137 are in unsatisfactory condition, 30 – in satisfactory condition and 16 – in good condition.

In general, inactive pesticides are a powerful source of contamination of soils and crops grown in the immediate vicinity of the warehouses. Unsuitable pesticides are capable of migrating into food chains and spatial migration and are a potential threat to consumers of agricultural products. Criteria for soil and plant contamination are hygienic standards for pesticides. The degree of soil contamination by unsuitable pesticides is recommended to be used as a regional indicator of the possibility of green growth of agroecosystems.

We should also mention the enterprises of the space industry. Ecological safety at the enterprises of space industry is provided by performance of measures which are provided by the resolution on quality of STP 155.1.91.195-2004 which is harmonized with the basic provisions of the international standards of the ISO 14000 series, and the standard of the enterprise STP 155,1.14.182-2001. Organized environmental protection services. Verification of compliance with environmental safety requirements is carried out by sanitary epidemiological stations, environmental inspections and regional divisions of the Ministry of Ecology and Natural Resources of Ukraine. To reduce the impact on the environment, enterprises use galvanic-chemical effluent neutralization stations, ponds – ash sludge settlers and treatment facilities.

Objects of increased ecological danger are enterprises that use in their production activities galvanic, paint and foundry production (SE “VO” Southern Machine-Building Plant named after O.M. Makarov”, PJSC “Hartron”, DNVP “Union Communist”, Kyivprilad,

SPB Arsenal). Increased environmental hazard is also an object of increased hazard of the 2nd class “Test station of liquid rocket engines and other rocket systems” (SE “CB” Southern”, SE “VO” Southern Machine-Building plant named after O.M. Makarow”).

2. Classification of management environmental decisions. General characteristics and features of management information environmental decisions

It is proposed to systematize management environmental decisions as a set of three branches of decisions: information, organizational and operational decisions (fig. 1).

Information solutions involve obtaining reliable information about the state of the environment and man-made objects (critical infrastructure).

Organizational solutions determine the required organizational and automated structure required to achieve a specific management goal (environmental safety, ecological balance, environmental protection: biosphere, atmosphere, hydrosphere, lithosphere, cosmosphere, species of fauna and flora, natural resources, health and human activities).

Operational solutions determine the ways to achieve a certain goal and include: the distribution of specialists and technical means, the task of actions, delivery of tasks to subordinates.

Environmental information solutions determine which data obtained from different sources are considered true. To manage environmental safety, the manager (decision maker (DM)) does not need an absolute reflection of the situation: excessive detail will only complicate it. The level of detail must correspond to the specific task: the model must be adequate. Thus, making an information decision means not only separating the right information from the wrong (from misinformation), but also a reasonable generalization, the elimination of unnecessary details.

Making an information decision also involves assessing the quality of the decision, the degree of its reliability and the level of generalization. The leader must know how close his decision is to the truth. The information decision is the source material for operational and organizational decisions.

Information decisions are based on a plausible model of what is happening. It is easiest to make an information decision when there is a minimum number of two alternative solutions that are independent of each other. Then the decision on each alternative is at the same time part of the general stage decision, and the decisions on all alternatives make the general information decision. Transformation of a multi-alternative solution into a simple one, i. e. into a minimum of independent two-alternative solutions, is part of the general methodology of preparation of information solutions.

From the standpoint of a systems approach, it is possible to propose the following defini-

tion of the category “managerial environmental decision-making”: decision-making is a process that begins with identifying a problematic environmental situation and ends with choosing a solution, i.e. choosing actions to address the problem and ensure environmental safety.

The process of making environmental management decisions is influenced by many different factors. The most important of these are:

- the degree of risk of the wrong decision – it is understood that there is always the possibility of making the wrong decision, which may adversely affect the organization (increasing the responsibility of DM);
- the time allotted to DM for decision-making (in practice, most managers do not have the opportunity to analyze all possible alternatives, feeling the lack of time);
- the degree of support for DM by the team – this factor takes into account the fact that new managers are not perceived immediately. If the understanding and support of other managers and subordinates is not enough, the problem should be eliminated at the expense of their personal traits, which should contribute to the implementation of decisions.
- personal qualities of DM – one of the most important factors. No matter how managers make decisions and are responsible for them, they must have the ability to make the right decisions.
- policy of the organization – in this case, the subjective factor is taken into account when making an environmental decision (cost, prestige, ease of implementation – all this can affect the adoption of a decision).

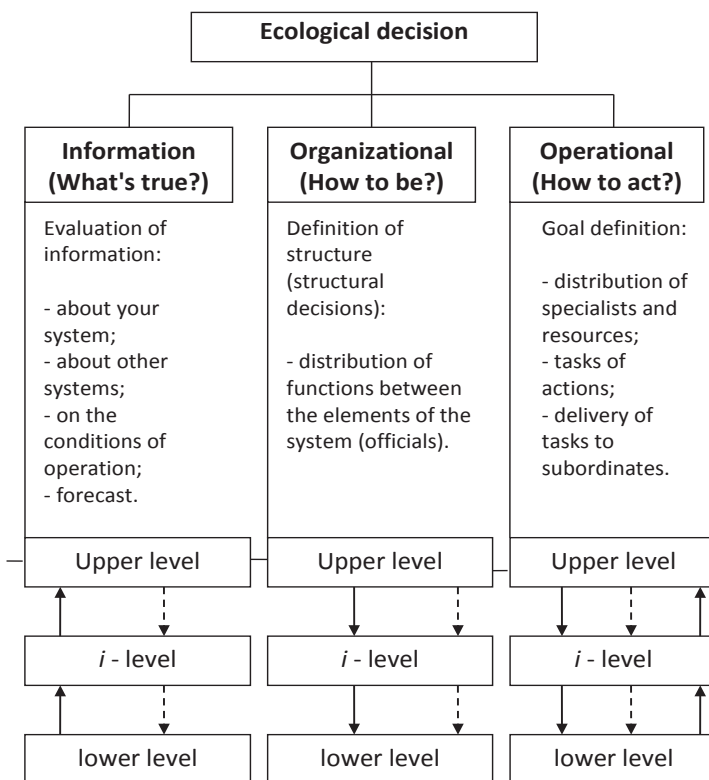


Fig. 1. Classification of management environmental decisions

The end result of decision-making is the managerial environmental decision, which appears as the primary, basic element of the management process, ensuring the functioning of the ecological system through the relationship of formal and informal, intellectual and organizational-practical aspects of management. Management environmental decision is a tool to influence the object of management and its individual subsystems, an important part of the formation and implementation of management relations in the organization; forms the basis for the implementation of each management function.

3. The process of making environmental information decisions

It is possible to identify two main areas of environmental safety: regulatory and descriptive.

Representatives of the normative approach focus on the development of organizational, informational and methodological principles of rational environmental decision-making. The normative approach elaborates the “rules of the road” in management work, compliance with which should ensure the adoption of a rational environmental decision.

The descriptive approach is aimed at an empirical study of the behavior of individuals and groups of people in the decision-making process. It aims to determine the patterns of formation in the process of interaction of the initial parameters of the problem to be solved and the characteristics of the decision-maker.

Within the framework of the normative approach, the procedure (general technology) of making managerial ecological decisions is first of all investigated.

The simplest technology for making environmental information decisions is intuitive. Under intuitive technology, the experience of decision-making in similar (similar) situations, which has accumulated by the subject of management and determines the decision itself. Therefore, if in the past accumulated experience of the subject of management no similar decisions have been made, the probability of making a wrong decision increases. The advantage of intuitive technology is the speed of decision-making, and the main disadvantage – a high probability of error.

The rational technology of decision-making is more perfect, but the concrete order of passing of separate stages is not reflected. Thus in the course of preparation of the information ecological decision on rational technology there is a necessity of specification or adjustment of results of the following stages: the diagnosis of an ecological problem, accumulation of the information on an ecological problem; development of alternatives, evaluation of alternatives, decision making.

Diagnosis of environmental problem:

– identification and description of the problematic environmental situation (means awareness and reflection in any form of the contradiction between changes in the environment of the ecosystem and its ability to ensure environmental safety under such conditions);

– establishing the purpose of solving the problematic environmental situation (determining the desired end result of solving the problematic environmental situation);

– identification of criteria for making management decisions (determination of features on the basis of which the assessment of the solution of the problematic environmental situation will be conducted, as well as the ordering of these features according to the degree of importance).

The accumulation of information about an environmental problem means the collection and processing of various information about the problem under consideration. The quality of solving the problem depends on the quality of information about it. The quality of information materials in turn is assessed using the following criteria:

– objectivity is an integral criterion that combines the following partial criteria: completeness of information (determined by the availability of information, including contradictory, which is necessary and sufficient for decision-making); accuracy of information (the degree of conformity of the information to the original); consistency of information (separate parts of the same information should not contradict each other); persuasiveness of information (proof of information that makes you believe in its authenticity);

– conciseness – is the brevity and clarity of the information (achieved through high convolution of information without losing its necessary completeness);

– relevance – is the compliance of information with objective information needs;

– timeliness – is the ability to meet the information need within a reasonable time;

– communicativeness – is the property of information to be clear to whom it is addressed.

The development of alternatives means the development, description and compilation of a list of all possible options for action to address the problematic environmental situation.

Evaluation of alternatives. The content of this stage is to test each alternative found by the criteria: realism (the possibility of its implementation in general, taking into account external circumstances that do not depend on the ecosystem itself); legal restrictions; capabilities of existing technologies; moral and ethical norms, etc.; compliance with the resources available to ATS; acceptability of the consequences of the implementation of the alternative.

In the process of identifying the possible consequences of the implementation of each alternative must take into account not only the main (related to achieving the goal), but also side effects.

Decision making. At this stage, the comparison of alternatives by the expected effects of their implementation and the selection of the best alternative in the institution of the criteria identified at the stage of diagnosis of the problem.

4. Technology of information solutions in ecosystems

From the standpoint of a systems approach, it is possible to propose the following basic methods of preparing information decisions in ecosystems for implementation in environmental decision support systems: data comparison method (correlation method); data filtering method; situation recognition method.

4.1. Method of comparing data of ecological observations

The first stage is data grouping. It is most convenient to group data by creating a matrix of messages in which solutions (alternatives) are located vertically, and data sources are located horizontally. The intersection of rows and columns fits the content of messages. The matrix of messages must be compiled so that it contains all available data (regardless of the reliability of the source). It should also contain all possible information solutions related to the situation (regardless of the quality of the data involved in this decision).

When determining the operational weight (importance) should take into account the characteristics of information sources and conditions of observation. Mathematically, the weight can be represented as the probability that the message is true. Formal method of determining the weight of determining the presence of the relevant observation factor. Assuming the independence of the factors, the conditional probability of the truth of the message is calculated. The operation of determining the weight should be performed on electronic computers. For environmental monitoring equipment, such data (e. g., probability of correct detection and probability of false alarm for environmental monitoring equipment) are an important part of the environmental communication. Sometimes it is easier for DM to give a general assessment of the reliability of environmental information without resorting to a detailed analysis of the message. For an electronic computer, such an analysis is inevitable, and the degree of its detail is determined by the participation of DM in a particular stage of work. After determining the weight of the messages, the data can be reduced to a more compact form using weights (reliability).

For each decision two thresholds are defined: top and bottom. The size of the upper threshold should take into account the level of risk when making a positive decision. The lower limit is set based on similar considerations: the greater the a priori probability and the higher the responsibility, the lower the threshold. The decision is made based on a comparative procedure: if the weight exceeds the upper threshold, the alternative is accepted, if below the lower threshold –

is rejected, in the intermediate case, additional data are required (additional environmental observations).

Thus, the decision is made, the weight of which is the maximum. The method of data comparison should be used to organize the program of action, as a person, and technical means.

4.2. Method of filtering data of ecological observations

The essence of the filtering method is that the solution of environmental problems is based on the comparison of the received information messages with a set of pre-formulated independent features, each of which is assigned “weight” (importance). This mortgage is a filter. In this case, the filter is considered as a substantiated by experience and theory system of semantic and logical intersections between the properties of the ecological situation, the object of observation, event, phenomenon and its external manifestations, signs. The features included in the filter are treated as filter parameters. Thus data of ecological supervision are classified, and further their reliability is estimated. After that, a separate decision is made on each of the filter parameters: is there a corresponding sign or not. Informational environmental decision is made based on confirmed features by comparing their total weight with the threshold.

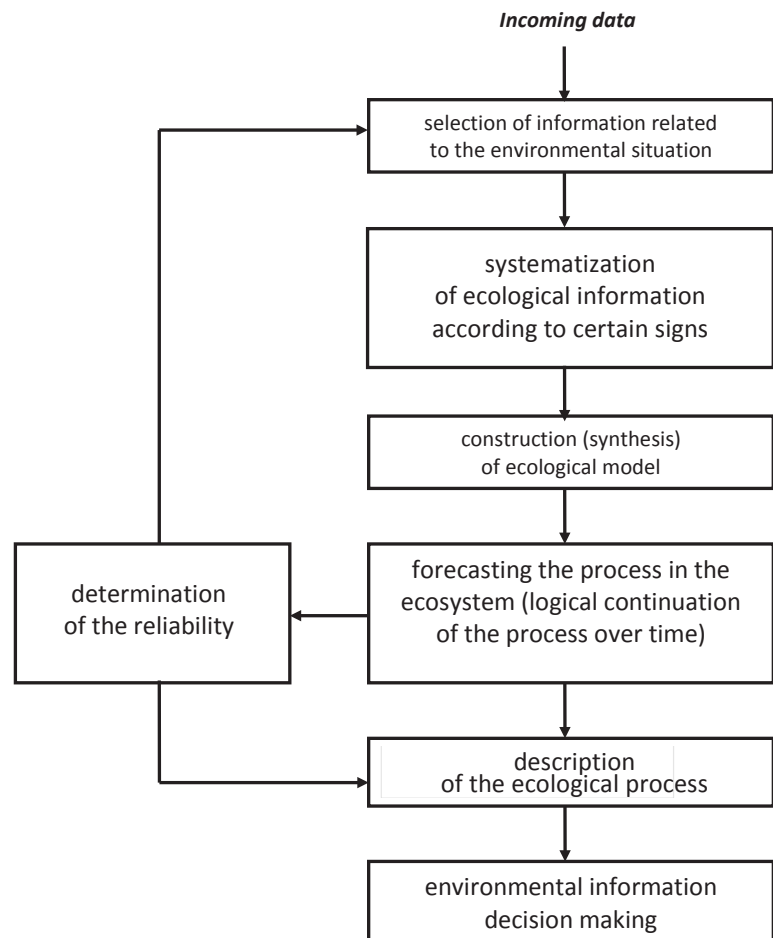


Fig. 2. Scheme of recognition of the ecological situation

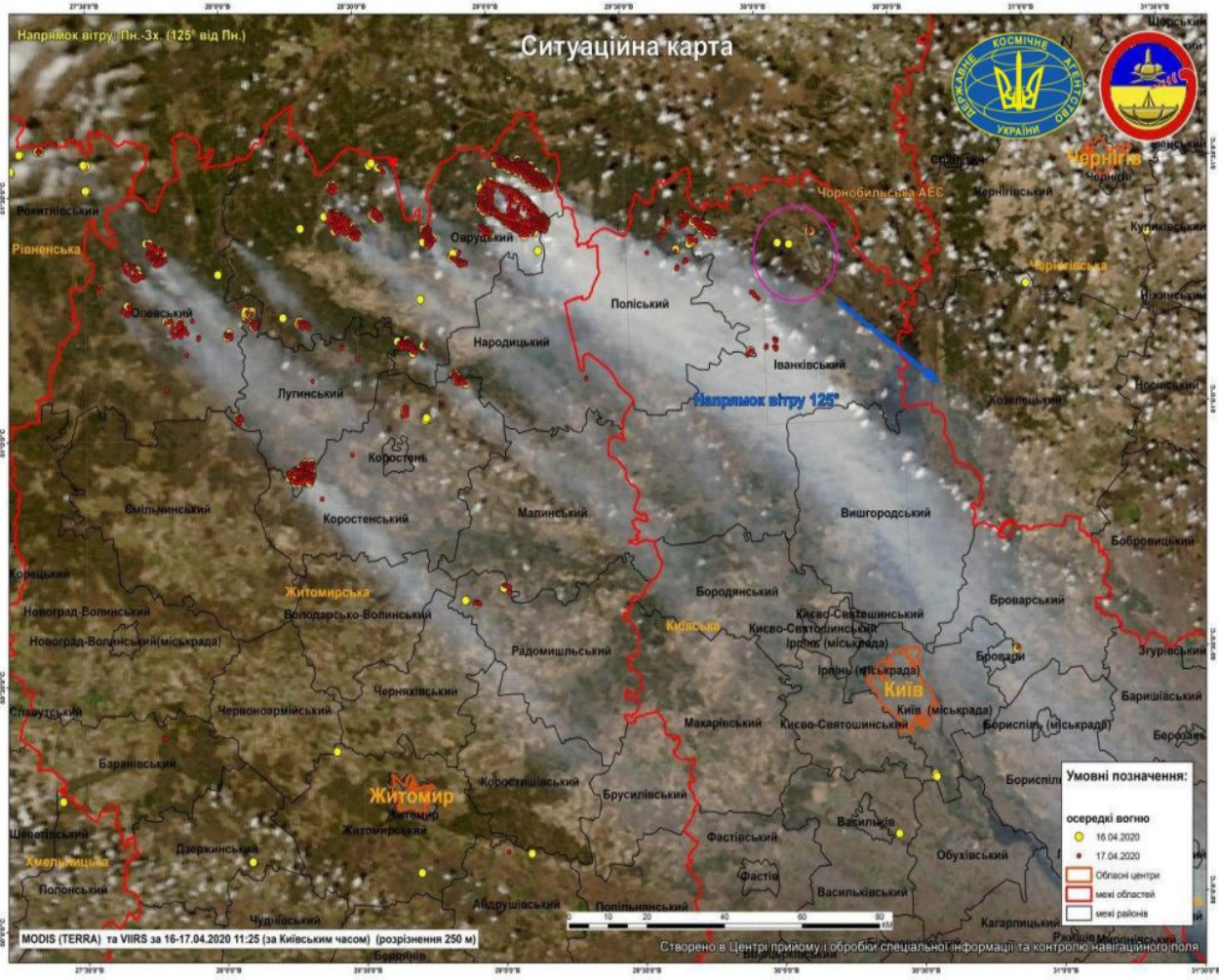


Fig. 3. Situational map of environmental monitoring

The main advantage of the filtering method is its relative simplicity (there is no complicated and ambiguous procedure for determining comparable features in different messages). But the disadvantage is that the data, which is canceled by the filter parameters, is no longer used. This is a certain conservatism, contempt for “insignificant” information that can be used in the future.

Thus, the filtering method contains the following steps: data analysis with filter parameters; detection of confirmations; determination of weights; data aggregation; compare with the threshold; making an information decision.

From the given brief description it is clear that the filtering method provides a reasonable selection of parameters and accurate determination of their weight in the solution. This must be done in advance. Therefore, this method should be used in automated decision support systems at the level of object observation.

4.3. Method of recognizing the ecological situation

A situation is a set of events that develop in time and space and have environmental consequences. It is assumed that the consequences can be clearly articulated and important. The fundamental novelty

of the method of recognizing the ecological situation is that the properties of the process are considered dynamically, over time.

The recognition procedure contains the following stages (fig. 2).

1. Selection of information about the situation (i. e., the situation and the process of its development) from the general flow of information.
2. Analysis of this information, division into parts that relate to various features of the situation and process.
3. Definition of signs, i. e. restoration of a situation and process of its development, proceeding from the received information.
4. Forecasting, determining possible consequences.
5. Determining the level of reliability of the forecast and comparing it with the original information, eliminating contradictions.
6. Arranging descriptions in general.
7. Decision making.

The peculiarity of the information decision using the method of situation recognition is that the decision concerns the situation of the whole ecosystem, and not individual features and facts. In this case, when mak-

ing an information decision, special importance must be given to the completeness and integrity of the initial information (input data).

The method of recognizing the environmental situation should be used in systems to support environmental solutions using remote sensing systems of the Earth, the use of aerospace technologies.

The space industry is a science-intensive and strategic industry that forms the image of Ukraine as a country with high innovation and intellectual potential. The space industry is not just about launching rockets and training astronauts, it is, first and foremost, technologies that can be used in many projects, from agricultural to defense, from educational to telecommunications. Today, the use of satellite imagery to solve crimes against the environment is being considered.

The application of the method of recognizing the ecological situation was carried out by the authors together with the specialists of the National Center for Space Management and Testing in the study of the causes of fires in the Chornobyl zone (fig. 3).

In 2020, the National Space Management and Testing Center, the State Space Agency and the NPU Water and Air Support Department plan to work together to prevent and detect environmental crimes, drug crimes and smuggling.

Also, due to the use of remote sensing of the earth's surface, it is possible to establish areas of probable cultivation of narcotic substances; place, time and vessels involved in pollution of the exclusive maritime economic zone of the state.

Conclusions and suggestions. The article considers the problems of creating a system of support for environmental information solutions as a system of environmental security of the state. From the standpoint of a systematic approach, which determines the components of the management system of a complex object, environmental safety consists of environmental audit, monitoring, forecast of the environmental situation, environmental management. Carrying out of these actions

provides processing and transfer of the ecological information for formation of administrative decisions.

The application of a systematic approach to ensuring the environmental security of the state involves addressing the following issues: classification of environmental management decisions; determination of features of managerial information ecological decisions; making informational environmental decisions; application of information solutions technology in ecosystems.

When applying a systematic approach to ensuring the environmental security of the State, it is expedient to determine the tasks to which management information decisions in the environmental security management system are aimed, as well as the main systemic threats in the environmental sphere.

It is determined that managerial environmental decisions should be formalized as a set of three branches of decisions: informational, organizational and operational decisions.

In the process of preparation of the information ecological decision on rational technology there is a necessity of specification or adjustment of results of the following stages: the diagnosis of an ecological problem, accumulation of the information on an ecological problem; development of alternatives, evaluation of alternatives, decision making.

The considered questions about ecological management decisions can be applied to creation of system of support of ecological decisions and modeling of ecological processes in environment and technogenic dangerous objects. Theoretical questions are aimed at preparing for the following practical actions: to set and formulate the task of analysis and synthesis of environmental management structures; to form the purposes of ecological management and to define object of ecological management; plan and make management decisions in ecological systems. The material is the basis for the practical activities of specialists as researchers and managers in the field of environmental safety with the use of aerospace technologies.

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