The Model of the Formation of Values and the Information System of Their Determination in the Projects of the Creation of Territorial Emergency and Rescue Structures

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Abstract

Based on the performed analysis, the need to create territorial rescue structures to eliminate the consequences of emergencies of a military nature was established. A model of value formation from the implementation of projects for the creation of territorial rescue structures to eliminate the consequences of emergencies of a military nature is proposed. The model involves five stages that relate to the assessment of benefits for different groups of stakeholders (community population, community administration, business structures, project team, and the state). The peculiarities of the formation and structure of values, as well as their indicators, which are the basis of the quantitative assessment of value components, are defined. Based on the proposed model, an information system for decision support was developed. With the use of the information system, a quantitative assessment of the indicators of the basic cost of the projects for the creation of territorial rescue structures was carried out, taking into account the state of the project environment. It has been established that there is a weak correlation between the studied indicators of the basic value of projects for the creation of territorial rescue structures, which determines the use of intelligent methods for their forecasting. The distribution of the number of property losses of the population of communities from individual emergencies is substantiated. It was established that the implementation of the project to create an additional rescue formation will ensure a 33.2% reduction in the loss of community property.

Keywords 1

Model, information system, value, project, rescue structures, emergencies of military nature.

1. Introduction

Throughout the world, ensuring the security of territories and population security is a primary task [13]. The regions of individual countries where military operations are taking place require special attention in terms of creating security. Currently, this is highly relevant for Ukraine. In the territories liberated from the invaders, emergencies arise that relate to the neutralization of weapons and means of mass destruction, as well as the occurrence of secondary impact factors on the population (the occurrence of fires, the destruction of buildings and structures, the release of hazardous substances, etc.). Nevertheless, in the territories where hostilities are taking place, the systemic interrelationships between the components of security, both individual communities and the population living in these territories are disrupted. Often, after military operations, rescue formations that ensure the safety of individual territorial communities are partially or completely destroyed. There are also threats to the population of communities due to the mining of certain territories, the presence of explosive objects in

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the territories, and objects of people's life and activities, etc. Projects and their portfolios should be implemented to solve existing problems, which requires effective management [4-8; 40].

All of the above indicates the need to create territorial rescue structures to eliminate the consequences of emergencies of a military nature. At the same time, separate specific projects should be implemented, which should be based on a value approach [9-14]. Effective implementation of projects for creating territorial emergency and rescue structures to eliminate the consequences of emergencies of a military nature requires the development of information systems to support decision-making. They will provide management of these projects based on new approaches and taking into account the specific project environment. At the same time, the scientific and applied problem remains unsolved, which concerns the development of models and information systems for the formation of value from the implementation of projects for the creation of territorial rescue structures to eliminate the consequences of emergency situations of a military nature. Solving such a problem requires the performance of an appropriate IT project and involves the development of an appropriate model and approach [15-17].

2. Analysis of published data and problem setting

Scientists all over the world have paid enough attention to the development of models, methods, and approaches related to new and improved security systems of territories and populations. Separate works are devoted to solving the problems of determining the effectiveness and value of systems that ensure the security of territories and their population [18-25; 41]. The conducted studies relate to separate levels of consideration of security systems (international, state, regional, public, and object). In well-known scientific works, both methodological principles and practical tools have been developed for making high-quality management decisions regarding the implementation of projects [26-32; 42].

Separate scientific works are devoted to the development of value approaches and tools based on these approaches, which provide management of the configuration of development systems of territories [33-37]. However, it is impossible to use them in full during the implementation of projects to create territorial rescue structures to eliminate the consequences of emergencies of a military nature. This is because they have several contradictions and drawbacks. In particular, they do not take into consideration the specific design environment of projects for creating rescue structures to eliminate the consequences of the emergency post-war period. In addition, it is not envisaged to disclose the features of the formation of the systemic value of projects for the creation of territorial rescue structures for the elimination of the consequences of the emergency post-war period.

Unsolved parts of the overall problem. Having analyzed the existing scientific works related to the implementation of projects for the improvement and development of security systems of territories and their population, it is possible to ascertain their importance both for the theory of project management and for the practice of making quality management decisions. However, there are no scientific works on the development of decision-making support information systems for solving the current managerial problem of assessing the value of projects for creating territorial emergency and rescue structures for the elimination of the consequences of emergencies of a military nature. There was a need to develop models and an information system for assessing the value of projects for creating territorial emergency and rescue structures to eliminate the consequences of emergencies of a military nature. They will ensure that the specifics of these projects and their particular project environment are considered. This will make it possible to reveal the belonging of certain types of values to each of the groups of interested parties in the projects of creating territorial emergency and rescue structures for liquidation of the consequences of emergencies of a military nature. Also, based on them, it will be possible to carry out a quantitative assessment of the value, which is the basis for justifying the configuration of the specified projects.

3. The purpose and objectives of the study

The purpose of the work is to substantiate the models and information system of the value formation of projects for the creation of territorial rescue structures for the elimination of the

consequences of emergencies of a military nature, which are based on a new approach and take into account the peculiarities of the project environment.

To achieve the goal, the following tasks must be solved:

1. to substantiate the model of value formation of projects for the creation of territorial rescue structures for liquidation of the consequences of emergency situations of a military nature;
2. based on the developed model, create an information system for decision-making support and carry out a quantitative assessment of indicators of the basic value of projects for the creation of territorial rescue structures, taking into account the state of the project environment.

4. Justification of the value formation model of projects for the creation of territorial emergency and rescue structures to eliminate the consequences of emergency situations of a military nature

The creation of rescue structures to eliminate the consequences of emergencies of a military nature has a significant value for ensuring the safety of the population of communities and minimizing the consequences of military conflicts. Such structures may include rescue teams, psychological support groups, medical institutions, and other organizations that assist with the consequences of war.

The main value principal the rescue infrastructure project is that they provide an efficient and rapid response to a military emergency, reducing casualties and damage [38-39]. In addition, the creation of such structures will help to ensure coordination and cooperation between effective services and organizations, which provides the effectiveness of actions in case of emergency emergencies and a direct impact on reducing the number of casualties and damage. The creation of rescue structures can also positively affect the level of security and stability in the country. When people see that the state provides an effective response to a military emergency, it increases their trust in state authorities and contributes to the strengthening of national defense.

The proposed model of value formation from the implementation of projects for the creation of territorial rescue structures to eliminate the consequences of emergencies of a military nature involves the allocation of four of its components. It is they who ensure the formation of systemic value from the implementation of projects for the creation of territorial rescue structures to eliminate the consequences of emergencies of a military nature, which is the basis for the justification of the effective configuration of these projects (Figure 1).

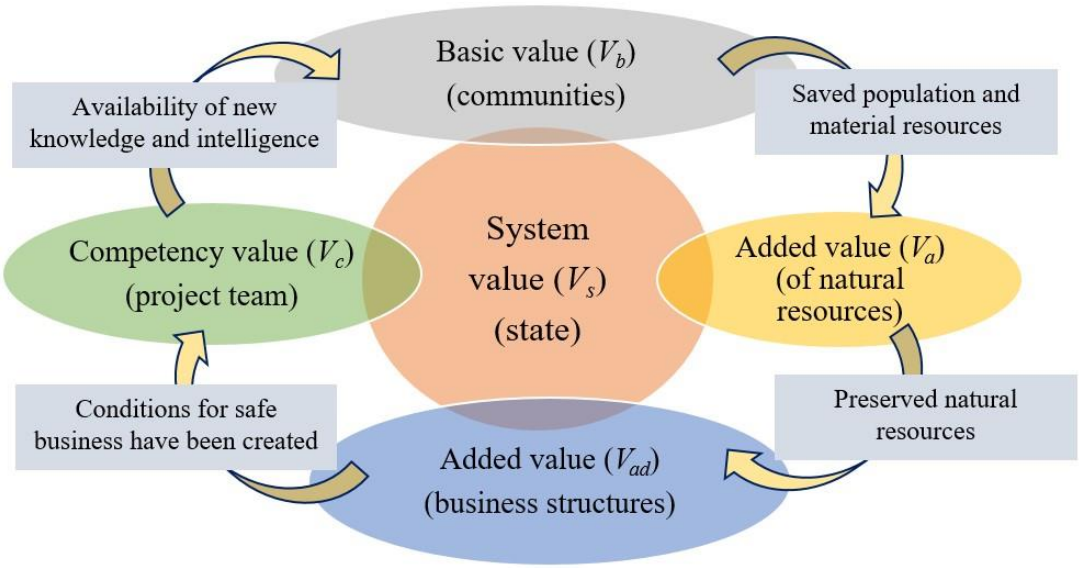

Figure 1: The model of value formation from the implementation of projects for the creation of territorial rescue structures for the elimination of the consequences of emergencies of a military nature

The proposed model of value (Figure 1), which is received by the stakeholders of the projects of creating territorial rescue structures for the elimination of the consequences of emergencies of a military nature, provides for its cyclical formation during the life of the specified projects. The number of these cycles depends on both changes in the components of the project environment of individual territories, and the volumes and stages of funding of these projects. In particular, the number of permanent residents and their activities in the territories where hostilities took place, the presence of previously unsurveyed territories that may be mined or have remnants of weapons and weapons of mass destruction are among the components of the design environment of individual territories that lead to changes in values. They lead to the occurrence of secondary impressive factors for the safety of the population, which lead to the occurrence of fires, the destruction of buildings and structures, the release of hazardous substances, etc., which in turn lead to the death of people, material values and the destruction of natural resources.

The state of the project environment of individual territories and communities is decisive in the configuration of projects for the creation of territorial rescue structures to eliminate the consequences of emergencies of a military nature, the implementation of which affects the quantitative indicators of the benefits received from them for certain groups of stakeholders. The main stakeholders of projects for the creation of territorial rescue structures to eliminate the consequences of emergencies of a military nature are the population of communities, community administrations, business structures, as well as district and regional administrations representing the state.

At the level of individual territorial communities, the main stakeholders are their population, which needs benefits from the preservation of the health and the d life of people, as well as their material resources (residential and other buildings, domestic animals, reserves of food and animal feed, acquired property, etc.) [43]. These benefits can be estimated by a set of indicators of population losses (deaths and loss of working capacity) and its material values $\{P_{vt}\}$, which characterize the basic value (V_b) of projects for the creation of territorial rescue structures to eliminate the consequences of emergencies of a military nature.

The next stakeholders of projects for the creation of territorial rescue structures to eliminate the consequences of emergencies of a military nature at the level of individual communities are their administrations. They take care of benefits related to the preservation of natural resources (absence of remnants of weapons and means of mass destruction in the fields and community territory, absence of hazardous emissions into water bodies and soils, absence of fires in forests and public buildings, etc.). They can be evaluated by a set of indicators that characterize the volume of unusable territory and objects due to the presence of remnants of weapons and means of mass destruction, as well as the loss of natural resources from the secondary effect of impressive factors of emergency military nature $\{M_{on}\}$, which characterize additional value (V_a) projects for the creation of territorial rescue structures for the liquidation of the specified emergency emergencies territories of communities where military operations were carried out, business structures are the stakeholders of projects for the creation of territorial rescue structures to eliminate the consequences of emergencies of a military nature. They care about the benefits of creating safe conditions for doing business (timely liquidation of the consequences of emergency emergencies of unprovoked explosions and fires, provision of clean water supply, availability of a safe area for their activities, etc.). They can be evaluated by a set of indicators that characterize the timeliness of the arrival of territorial rescue structures to eliminate the consequences of emergencies of a military nature and the duration of localization and elimination of fires from explosions of remnants of weapons, as well as the loss of material resources during their occurrence $\{P_{sp}\}$, which characterize the added value (V_{ad}) projects for the creation of territorial rescue structures for the liquidation of the specified emergencies.

For the project team, which implements the projects of creating territorial rescue structures for the liquidation of the specified emergencies, there are also benefits. In particular, project team members benefit from the emergence of new knowledge and skills that increase their intelligence [44]. They can be evaluated by a set of indicators that characterize the accessibility of the database and the availability of knowledge for making project decisions, the accuracy of the decisions made, as well as losses from ineffective management of the specified projects $\{P_{sc}\}$, which characterize the competence value (V_c) for the project team.

Thanks to the implementation of projects for the creation of territorial rescue structures for the liquidation of specified emergencies, system value (V_s) is obtained. It arises due to the coordination of

the benefits of all stakeholders of the specified projects, as well as due to the emergence of synergistic benefits that will multiply the benefits for interested parties based on the use of the created territorial rescue structures for the elimination of the consequences of emergencies of a military nature.

The affiliation of each of the specified components of value to the stakeholders of projects for the creation of territorial rescue structures for the elimination of the consequences of emergencies of a military nature, as well as the indicators by which they can be evaluated, are presented in the Table 1.

Based on the above, it can be said that the value (V_{PR}) from the implementation of projects for the creation of territorial rescue structures to eliminate the consequences of emergencies of a military nature is determined by the expression:

$$V_{PR} = V_{bi} + V_{ai} + V_{adi} + V_c + V_s, \quad (1)$$

where V_{PR} – value from the implementation of projects for the creation of territorial rescue structures to eliminate the consequences of emergencies of a military nature, thousand UAN; V_{ai}, V_{adi}, V_c, V_s – respectively, the basic, added, additional, competence and system value from the implementation of projects for the creation of territorial rescue structures for the elimination of the consequences of emergencies of a military nature, thousand UAN.

To carry out a quantitative assessment of each of the component values (V_{PR}) from the implementation of projects for the creation of territorial rescue structures to eliminate the consequences of emergencies of a military nature, presented in expression (1), their criteria and evaluation indicators should be used (Table 1).

The population of communities may have a different vision of the benefits of rescue structures during the liquidation of martial law emergencies. The formula is used to quantify the basic (V_{bi}) value for the population of communities:

$$V_{bi} = N_{ls} \cdot C_{ol} + R_{dp} \cdot C_{dp} + N_{tv} \cdot C_{tv} + N_{ps} \cdot C_{ps}, \quad (2)$$

where N_{ls} – the number of saved lives of the population of the community, persons; C_{ol} – the value of one life of the population of the community, thousand UAN; R_{dp} – the amount of saved property of the population of the community, units; C_{ol} – the value of the saved property of the population of the community, thousand UAN; N_{tv} – decrease in the number of the population of the community receiving medical care, persons; C_{tv} – the cost of treatment of one victim, thousand UAN; N_{ps} – decrease in the number of the population of the community receiving psychological support, persons; C_{ps} – the cost of psychological support, thousand UAN.

The number of lives saved in the territory of the community can be determined based on statistics on cases of life-saving as a result of the operation of rescue structures or based on forecasting the possible loss of life without the use of rescue structures during the liquidation of martial law emergencies. The cost of one life can be determined based on various factors such as average salary, life expectancy, etc.

Reduction of damage to community property can be determined based on the assessment of the damage that was saved or reduced thanks to the actions of rescue structures during the liquidation of martial law emergencies. The cost of the damaged property can be determined based on market prices for similar goods and services.

Reduction of costs for treatment of victims during liquidation of emergencies of martial law can be determined based on the estimation of average costs for treatment of various types of injuries and diseases. The cost of treating one victim can be determined based on an estimate of the average cost of treating various types of diseases.

The formula is used to quantify the additional (V_{ai}) value for community administration:

$$V_{ai} = Q_{nr} \cdot C_{nr} + C_{nr}, \quad (3)$$

where Q_{nr} – the volume of preserved natural resources, units; C_{nr} – the cost of a unit of natural resources, thousand UAN; R_{dp} – the amount of saved property of the population of the community, units; C_{nr} – the cost of reducing costs for the restoration of natural resources, thousand UAN.

The amount of preserved natural resources can be determined based on their assessment, which refers to the saved or the reduction of their damage due to the actions of rescue structures during the liquidation of emergencies of martial law. The cost of a unit of natural resources can be determined based on the market price for this resource or based on the cost of its use in a specific industry.

The cost of reducing the cost of restoring natural resources can be determined based on the cost estimate of their restoration. It is important to note that formula (3) can be more complicated and depend on the specific features of the liquidation of the consequences of emergencies of a military nature, the type of resources, and their importance for various spheres of life.

Table 1

Belonging of value components to stakeholders of projects for the creation of territorial rescue structures for liquidation of the consequences of emergencies of a military nature

Component of value	Stakeholders	Benefits	Evaluation indicators
Base value (Vb)	Population of communities	Preserved the life and health of the population, as well as their material resources	The volume of population losses (fatalities and loss of working capacity) and its material values.
Added value (Va)	Administration of communities	Preserved natural resources	The extent of unusable territory and facilities due to the presence of remnants of weapons and weapons of mass destruction. The volume of losses of natural resources from the secondary effect of impressive factors of emergencies of a military nature
Added value (Vad)	Business structures	Conditions have been created for safe business conduct	The duration of localization and liquidation of fires from explosions of remnants of weapons. Losses of material resources during the liquidation of the consequences of emergencies of a military nature.
Competency value (Vc)	Project team	Formation of a database and acquisition of new knowledge, growth of intelligence	Accuracy of decisions made. Losses from inefficient project management.
System value (Vs)	State	Creation of new jobs. Increasing the security of communities in the post-war period	The number of new jobs created. The share of welfare growth in the territory of the community in the post-war period.

The formula is used to quantify the added (V_{adi}) value for business structures:

$$V_{adi} = C_{cp} + C_{vp}, \quad (4)$$

where C_{cp} – the amount of loss reduction from the stoppage of production or trade, thousand UAN;
C_{vp} – the value of preserved property and assets during the liquidation of the consequences of emergencies of a military nature, thousand UAN.

The amount of reduction of losses from the stoppage of production or trade can be determined based on the assessment of the cost of possible losses in the event of the stoppage of production or trade, as well as based on the time required for the restoration of activities after the elimination of the consequences of emergencies of a military nature. The preservation of the value of property and assets

can be determined based on the assessment of their value, which was preserved through the action of rescue structures. It is important to note that formula (4) may be more complicated depending on the specific business sector and circumstances during the liquidation of the consequences of emergencies of a military nature.

The formula is used to quantify the competency value (V_c) value for the project team:

$$V_c = A_{ks} \cdot L_{tp}, \quad (5)$$

where A_{ks} – the amount of knowledge and skills used in the project; L_{tp} – the level of efficiency of the team.

The amount of knowledge and skills working on a project can be estimated based on the project profile, the requirements for the workgroup, and the professional experience of the team. The team's performance level can be determined based on the assessment of project deliverables, schedule maintenance, and overall productivity. Formula (5) can be useful in determining how effectively a project team performs its functions. In addition, what additional value can the project team bring to the project of creating territorial rescue structures for the elimination of the consequences of emergencies of a military nature thanks to the results of its work.

The system value (V_s) for the state is evaluated according to the criterion of the synergistic effect from the implementation of projects for the creation of territorial rescue structures to eliminate the consequences of emergencies of a military nature, which is determined by the formula:

$$V_s = (S_{pr} + F_{pr}) / B_{pr} \quad (6)$$

where S_{pr} – social benefit from project implementation, thousand UAN; F_{pr} – financial benefit from project implementation, thousand UAN; B_{pr} – project budget, thousand UAN.

The project of creation of territorial rescue structures for liquidation of the consequences of emergencies of a military nature is of a social orientation and can be evaluated based on the number of people who will be protected from the consequences of emergencies and the degree of improvement of the infrastructure provided by the project. The financial benefit of the project can be determined based on increased productivity, reduced costs, and increased profits. Project costs can be determined based on all costs associated with the development and implementation of the project, including costs of personnel, materials, equipment, and other resources.

The specified belonging of the components of value to project stakeholders, as well as indicators of the assessment of benefits for them, are the basis of the quantitative assessment of the value of the creation of territorial rescue structures. And this, in turn, provides indicators for the quality management of projects for the creation of territorial rescue structures to eliminate the consequences of emergencies of a military nature.

The proposed model of value formation from the implementation of projects for the creation of territorial rescue structures to eliminate the consequences of emergencies of a military nature (Fig. 1) makes it possible to reflect the peculiarities of the formation and structure of values, as well as indicators of their quantitative assessment. It is one of the important tools for the value-hybrid management of projects for the creation of territorial fire-rescue structures in the post-war period, which ensures the adoption of effective management decisions. It has been established that the values from the implementation of projects for the creation of territorial rescue structures to eliminate the consequences of emergencies of a military nature are evaluated in five stages, which relate to the benefits for different groups of stakeholders (community population, community administration, business structures, project team, and the state).

5. The results of the creation of an information system and quantitative assessment of the indicators of the basic cost of projects for the creation of territorial emergency and rescue structures

To speed up management decision-making, an appropriate information system was developed in Python 3.11 (Figure 2).

The proposed system provides user registration, quantification and visualization of indicators of the basic value from the implementation of projects for the creation of territorial rescue structures.

The decision-making support information system is based on the proposed model and approach to value formation from the implementation of projects for the creation of territorial rescue structures to eliminate the consequences of emergency situations of a military nature.

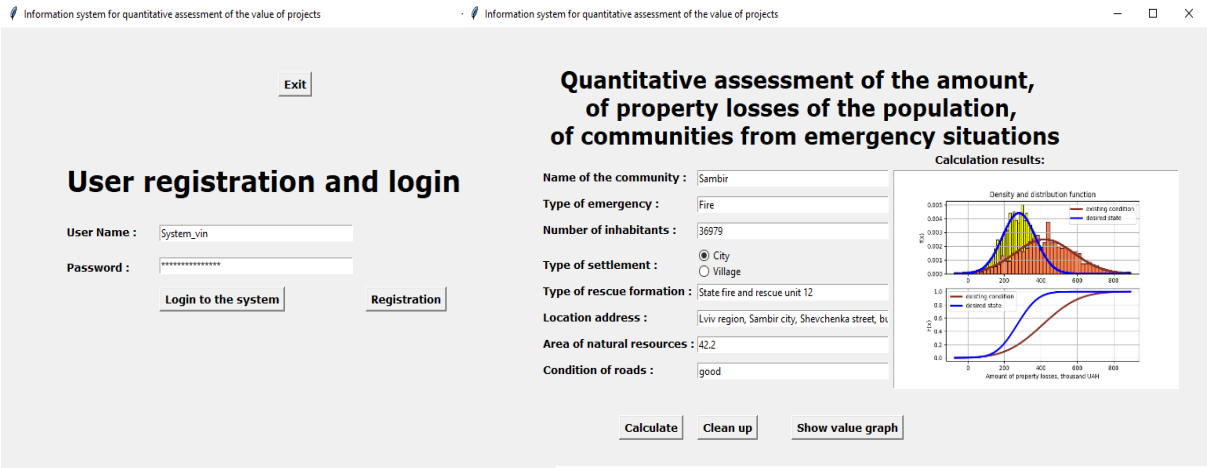

Figure 2: Windows of the decision support information system for quantitative assessment and visualization of indicators of the basic value of projects for the creation of territorial rescue structures

We performed a quantitative assessment of the indicators of the basic value from the implementation of projects for the creation of territorial rescue structures for the conditions of the Sambir district of the Lviv region, based on the analytical analysis of statistical data for 2018-2022. This made it possible to build the dependence of the number of property losses of the community population on the duration of the arrival of rescue formations to eliminate the emergency (Figure 3).

Based on the dependence obtained, it was established that there is a weak correlation between the studied indicators of the basic value of projects for the creation of territorial rescue structures, which characterize the number of property losses by the population of communities and the duration of the arrival of rescue formations to eliminate an emergency. This leads to the use of intelligent methods for forecasting indicators of the basic value of projects for the creation of territorial rescue structures.

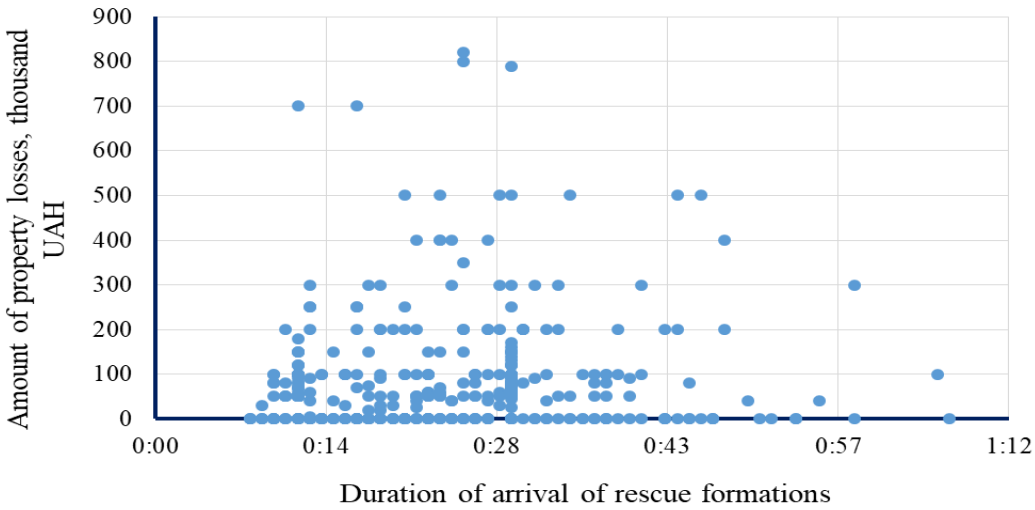

Figure 3: Dependence of the volume of property losses of the community population on the duration of the arrival of rescue formations to eliminate the emergency

Based on modeling and performing calculations, a quantitative assessment of the stochastic characteristics of the number of property losses of the population of communities from individual emergencies was carried out under two scenarios - the existing state and the desired state, which will

be obtained as a result of the implementation of the project of creating an additional rescue formation (Table 2).

Based on the results of the research, distributions of the number of property losses of the population of communities from individual emergencies under different scenarios of the operation of rescue formations were constructed (Figure 4).

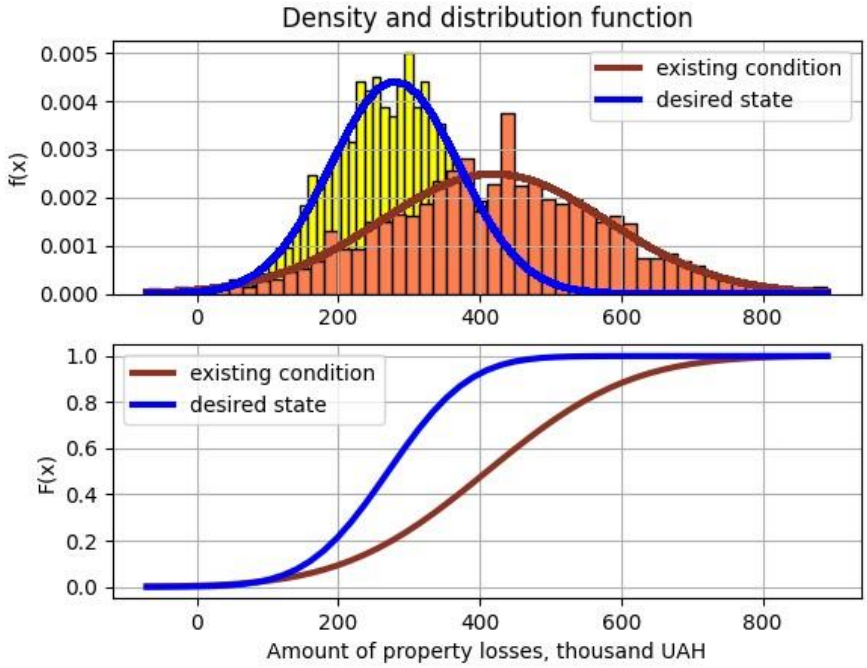

Figure 4: Density and function of distributions of the number of property losses of the population of communities from individual emergencies under different scenarios of the operation of rescue formations

Table 2

Characteristics of the number of property losses of the population of communities from individual emergencies under different scenarios of the operation of rescue formations, thousand UAN

Indicator	Scenario	
	existing condition	desired state
The mathematical expectation of the number of property losses of the community population	420.0	280.23
Root mean square deviation of the volume of property losses of the community population	160.1	90.4

The obtained densities and functions of the distribution of the number of property losses of the community population from individual emergencies indicate that the implementation of the project to create an additional rescue formation will ensure a 33.2% reduction in the loss of community property.

6. Conclusions

1. The proposed model of value formation from the implementation of projects for the creation of territorial rescue structures to eliminate the consequences of emergencies of a military nature involves five stages, which relate to the assessment of benefits for various groups of stakeholders (community population, community administration, business structures, project team, and the state),

which reflect the peculiarities of the formation and structure of values, as well as indicators of their quantitative assessment. The developed model is one of the important tools for the value-hybrid management of projects for the creation of territorial fire-rescue structures in the post-war period, which ensures the adoption of effective management decisions.

2. On the basis of the developed models and information system, a quantitative assessment of the indicators of the basic cost of the implementation of projects for the creation of territorial rescue structures was carried out, taking into account the state of the project environment. It was established that there is a weak correlation between the studied indicators of the basic value of projects for the creation of territorial rescue structures, which characterize the number of property losses by the population of communities and the duration of the arrival of rescue formations to eliminate an emergency, which leads to the use of intelligent methods for forecasting indicators of the basic value of projects for the creation territorial rescue structures. Reasonable distributions of the number of property losses of the community population from individual emergencies indicate that the implementation of the project to create an additional rescue formation will ensure a 33.2% reduction in the loss of community property.

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