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Modification of Emergency Management Systems Based on Experiences of Germany and Ukraine

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ABSTRACT

This paper is aimed at studying the systemic problems of decentralized and centralized civil protection systems during the response to local accidents and large-scale disasters and the development of a modified emergency management system that would combine the advantages of both systems. The study used evaluative and comparative research methods, in which data were collected from a comprehensive review of the literature, regulatory framework, and a description of the processes during response to various accidents. The analysis of functional principles of civil protection systems in the Federal Republic of Germany and in Ukraine showed that the decentralized structure of civil protection has benefits in the elimination of local accidents, while in the response to large-scale disasters, the centralized structure of civil protection has significant advantages. According to the results of the analysis, alternative modifications of the classical system of emergency management are determined. A modified emergency management system has been drafted, which simplifies the management process due to the presence of standard algorithms or operating procedures for the elimination of typical local accidents while, at the same time, has the ability to use a multi-level centralized management system with clear lines of command in large-scale disasters.

1. INTRODUCTION

The modern system of public administration, with its administrative and legal powers, is not fully able to perform its tasks of protecting the population and territories against disasters, and it is therefore important to improve it in the field of disaster prevention and preparedness [1].

Emergency management systems for individual organizations have their specific similarities and distinctive properties. Common features include limited time for collecting and analysing information, lack of complete information, the work of performers and decision-makers in emergency situations, and more. However, emergency management during the response to accidents such as the release of hazardous chemicals and radioactive substances, the disposal of explosives, forest fires, and local military conflicts, has its own characteristics. These incidents are associated with the involvement of a large number of units of different administrative subordination and multilevel management structure.

The public perception is that the executive branch of government is responsible for actions in crisis and emergency situations. However, recently, experts tend to recognize the fact that the tasks of ensuring readiness to act under appropriate conditions apply to all public authorities without exception, including the legislature, as well as non-governmental organizations and institutions. A prerequisite for an adequate perception of this provision is a clear understanding of the nature of crisis and emergency situations in terms of the functions and tasks of public administration [2].

The search for ways to solve this problem in disasters should be carried out not only through transformations of the existing functional structure and advanced training of management personnel, but also through modernization to a modern management paradigm - a new system of views based on the basic provisions of strategic management, according to which the construction of a disaster management system is a response to environmental impacts of various kinds. At the same time, the disaster management system is considered to be an open system, and its successful functioning is determined by the basic conditions that are not inside it, but outside [3].

In other words, the efficiency of a system's operation is related to how accurately it responds to the environment, how well it can withstand unexpected changes in the environment, including strategic changes, and how efficiently it uses potential capacity (different types of reserves).

The methodological specificity of the systemic approach is that the purpose of the study is to examine the patterns and mechanisms of formation of a complex object from certain components. At the same time, special attention is paid to the

diversity of internal and external relations of the system, to the process (procedure) of combining the basic concepts into a single theoretical picture, which makes it possible to reveal the essence of the system's integrity.

Large complex systems are made up of parts that can be considered as systems in their turn. The systemic approach contains a fundamentally new main idea aimed at identifying specific mechanisms of integrity of an object and, if possible, a complete typology of its connections. Significant difficulties that complicate the solution of this main task are that the identification of different types of connections in multicomponent objects is only one of the main tasks of the study of a system object. On the other hand, it is important to compare the dynamics of the entire variety of relationships in a commensurate form according to a logically homogeneous criterion common to the entire system. For example, in a control system, the amount of information received by the controlling structures is measured in bits. The important thing is that this way not only the quantity but also the quality of information, i.e., its content for a particular communication channel and the system as a whole, is established [4].

It should be noted that a systematic understanding of its components and elements, their interrelationships is of fundamental theoretical and methodological importance for the field of public administration. Almost everything associated with public administration and management depends on what is meant by the system of public administration, which and in what order the management manifestations are included in it, how they relate to each other and are brought into real interaction. First of all, this refers to the relationship between the subject of public administration and the objects of management.

The system of public management and administration itself should cover: organization and functioning of the subject of management - the management system; the structure of the relationship of the management system with the social system - objects; components of the social system or their individual manifestations, which interconnect to create the structure of the managed system and directly perceive public administration influences or participate in their formation. Most scholars in the field of public administration agree with this opinion [5].

Then, the interrelationships of the problem's components are established, quantified where possible, and the problem is thus structured. After that, it is possible to use the apparatus of mathematical modeling and selection of the best solutions, the stages and sequence of which are also often the scope of the systematic approach.

Despite the common features of emergencies of different origins, each country in the world is building an individual system of emergency management in the field of civil protection. The individuality of national emergency management systems is related to the state legal norms and governing documents of each state.

In the elimination of large-scale disasters, the emergency management system of civil defence is significantly affected by the national governance system. A centralized system of public administration requires the setup of a centralized system of emergency management, while in a decentralized state there are opportunities to provide territorial units of civil protection with special powers [6].

The structure of the German civil protection service is closely linked to the structure of the state. After the Second World War, Germany was strictly decentralized and after 5 years was divided into two separate states. In 1989, even after the reunification of Germany, each state had fairly broad autonomy. This allowed for the effective development of the institute of volunteer rescuers, and today more than 80% of rescuers in Germany are volunteers. This does not reduce the overall level of safety and allows for significant savings for communities.

In 1991, after gaining independence, Ukraine inherited a centralized civil protection management system. However, the analysis and search for the optimal structure began almost immediately [7]. In 2003, Ukraine created the Ministry of Emergency Situations, which merged all rescue services from the Ministry of Internal Affairs and the Ministry of Defence. However, this ministry retained a centralized structure with special ranks of employees. Since 2012, the status of the ministry has been downgraded to the State Emergency Service within the Ministry of Internal Affairs. After 2014, a decentralized system was chosen as a priority in the state and active decentralization activities began. Germany was chosen as a prototype. However, after the full-scale invasion of Russia, this process was suspended. It is clear that now there are other problems. However, now the question arose again. Which way to choose: centralized or decentralized?

The problem considered in the paper is to identify the pros and cons of centralized and decentralized civil protection systems in relation to the elimination of both local accidents and large-scale emergencies.

2. ANALYSIS OF CIVIL PROTECTION SYSTEMS

The Ukrainian and German civil protection systems will be discussed and analyzed in this section.

Regarding the methodology for analyzing the civil protection systems of both countries, firstly, the legal framework of both nations had been subdivided into three administrative levels: national (federal), regional (state), and local (city, town, community). Secondly, it has been essential to analyze selected documents and determine the subordination relationships, both within each group and between groups. Based on feedback from emergency managers of different levels, the main shortcomings of the management system that prevented them from performing their tasks efficiently were identified.

The primary focus is to compare the public administration systems of Germany and Ukraine, as these determine the emergency management system.

Germany has 357,581 square kilometers in area, the population of approximately 83.1 million, and the population average of 233 people per 1 square kilometer. In 2019, gross domestic product reached 3.449 trillion euros.

Ukraine is the largest country, located entirely in Europe, with an area of 603,628 square kilometers and a population of approximately 41.5 million. Therefore, the population density is 69 people per 1 square kilometer. In 2019, gross domestic product reached $155 billion [8].

Before delving deeper into the two national systems, some words should be spent on international terminology. Is civil protection and civil defence the same? Up to now, the terms had been used interchangeably without giving due account. And is civil protection in Germany the same as civil protection in Ukraine?

Per definition, definitely not. The German security architecture separates civil protection (Zivilschutz) from

disaster protection (Katastrophenschutz) in the sense that civil protection only applies in cases of armed conflict such as is the case when a state of defence is declared according to Article 115a of the German Basic Law. Other activation mechanisms include a state of tension (Article 80a, Section 1) and the so-called casus foederis (Article 80a, Section 3) in case of collective defence, e.g., under Article 5 of the Washington Treaty [9].

To briefly summarize, in Germany disaster protection is carried out in peacetime and civil protection in wartime. The general term for both is population protection. As explained later, these are subject to different laws, responsibilities and funding mechanisms. The war-peace period distinction is very important in Germany.

When looking at the term civil defence, the taxonomy becomes even more complex. Civil defence within Germany can be seen as the civilian part of an overall national defence strategy, next to military defence executed by the armed forces. Civil defence covers much more than civil protection, latter being only one element of it:

The task of civil defence is to plan, prepare and carry out all civilian measures to establish and maintain defence capability, including protecting the public and ensuring the provision of vital services. These measures include:

• Ensuring the continuity of state and government functions;

• Protecting the public against threats that may arise during a state of defence (civil protection);

• Providing the necessary goods and services for the public, state and government bodies, the armed forces, the organizations responsible for civil protection and the government agencies responsible for emergency preparedness;

• Helping the armed forces establish and maintain their defence capability and freedom to operate" [10, 11].

Ukraine uses a broader definition for the term civil protection. Ukrainian civil protection applies an all-hazard approach according to Articles 4 and 5 of the Code of Civil Protection of Ukraine and does not separate between civil protection in wartime and disaster protection in peacetime. Article 4 of the code defines civil protection as a state function with the goal to protect the population, territories, environment, and property from emergencies by prevention of such circumstances, elimination of the consequences, and provision of assistance to victims both in peacetime and in so-called special periods [12]. Those special periods are for example times of martial law. Article 5 classifies emergency situations according to their type of origin: man-made/technogenic, natural, social, and military [13]. Due to this all-encompassing approach, Ukrainian civil protection is equivalent to protection of the population in Germany, as can be seen in Table 1.

Table 1. Comparison of German and Ukrainian terminology in the field of civil protection

(Bevölkerungsschutz) Protection of the Population (in Ukraine: "Civil Protection")			
(Verteidigungsfall) State of Defence or State of Tension or Casus Foerderis ***Federal Jurisdiction Pursuant to Art. 73 Basic Law***		**(Friedenszeit) Peacetime** ***State Jurisdiction Pursuant to Art. 70 Basic Law***	
(Gesamtverteidigung) Overall Defence (Zivile Verteidigung) Civil Defence (Zivilschutz) Civil Protection being one element of Civil Defence in wartime	(Militärische Verteidigung) Military Defence	(Tägliche Gefahrenabwehr) Daily Hazard Prevention	(Katastrophenschutz) Disaster Protection, e.g., technical, man-made or natural disasters

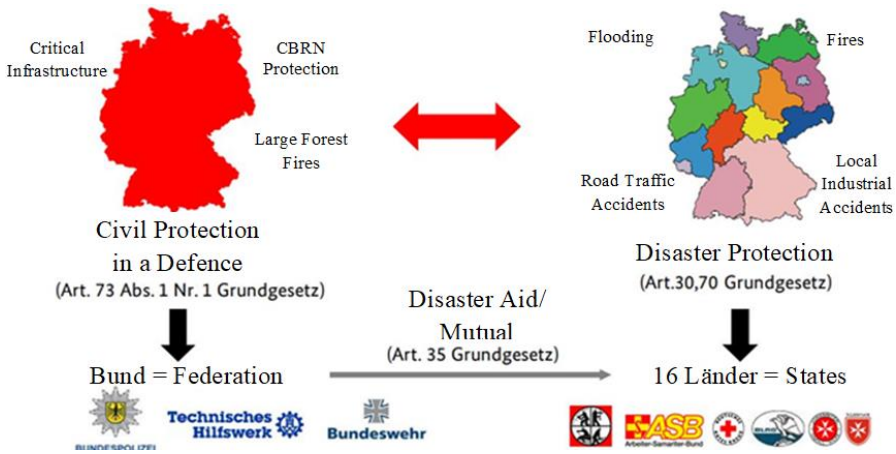

Figure 1. The civil protection system of the Federal Republic of Germany

2.1 Decentralized civil protection system of the Federal Republic of Germany

Germany is a federal republic, as reflected in its name. It is made up of 16 federal states, which are individually authorized to regulate certain aspects of everyday life in accordance with the Basic Law of Germany (Articles 70-74) which distinguishes between concurrent and exclusive legislative powers. For instance, there exist 16 state building codes, 16 fire protection laws, 16 emergency medical services laws, and 16 disaster protection laws, since all these legal areas fall under state jurisdiction. However, civil protection in wartime falls under federal responsibility and legislation according to Article 73 of the Basic Law. Thus, there exists only one federal code, the Act on Federal Civil Protection and Disaster Relief (ZSKG) (Figure 1).

Generally, this means that each of the 16 states is responsible for preventing everyday hazards, such as small accidents and disaster protection in case of major accidents or disasters. States and local communities have their own equipment, volunteers and professional staff, and state fire academies.

Here one important fact should be emphasized: most of the non-police personnel involved in threat prevention are German volunteers who, in addition to other specialties, perform firefighting, emergency medical, water rescue and technical support operations besides other specialties. Volunteering to protect people has a long tradition in Germany. Public and private organizations involved in civil protection and disaster management are deeply rooted in society [14]. In Germany, both public and private organizations are involved in accident response. In addition to fire departments, these include: the German Red Cross (DRK), Workers' Samaritan Federation (ASB), the German Life Saving Federation (DLRG), Johanniter Emergency Service (JUH) and Malteser Hilfsdienst (MHD). Another structure is the Federal Agency for Technical Relief (THW), which has specialized units in each land. The professional staff is small and mostly located in large population centers. Speaking of numbers, of the 1.3 million firefighters organized within 41,327 fire departments, over 1 million serve as volunteers.

As for the protection of citizens in war period, there is a dual-use approach for technical recourses and personnel already in the state for peacetime purposes. Although civil protection in a state of tension, defence or collective defence is regulated by federal legislation, there is no specific civil protection organization on stand-by. For some of its tasks in the protection of citizens, the Federation makes use of the resources of the Länder (states) and complements them as necessary (integrated emergency response system).

This additional equipment of the state, provided by the federal government, is used for CBRN defense and decontamination, fire protection, maintenance and medical services. It focuses on: Article 35 of the Basic Law, which regulates legal and administrative support in the event of a disaster, in addition to the provisions for Federal civilian protection in time of war. Mutual assistance between different states and authorities can be justified in the Decrees of the Article.

Otherwise, the law and responsibility remain with the affected states whether it is a small accident or a major disaster, part of the prevention of everyday dangers. Despite the factors of having different state fire service schools and state codes, relying heavily on volunteers, and meeting numerous organizations at an incident scene, management as well as command and control is usually governed by principles of fire service regulation FwDV 100. Based on the scale of the emergency, there are four different levels of incident command, also called echelons of command:

Echelon A: commanding without a command unit

Echelon B: commanding with local command units

Echelon C: commanding with a command group

Echelon D: commanding with a command group or with a command staff

Germany's civil protection system is open, as it interacts with external structures (police, border guards, army) when necessary and in conditions of high threats.

Also, at large scale disasters or disasters with a prolonged anticipation, overall command moves to the head of local or regional authority on political level, called the political component having overall responsibility. This political head component is then supported by an administrative-organizational component (staff) and an operative-tactical component (staff) [15].

2.2 Centralized civil protection system of Ukraine

As discussed earlier, protection of the Ukrainian population is not separated into civil protection and disaster protection. It is simply civil protection, governed by one federal codex, the Code of Civil Protection of Ukraine, encompassing 140 Articles. The code, with its latest amendment in March 2024, covers a multitude of topics such as definitions, types of emergencies, prevention, monitoring, warning, victim assistance, and the civil service regulations for staff members. Even the European emergency number 112 deserves an article. Discussing all topics would go beyond the scope of this publication, though.

The head entity in the civil protection system of Ukraine is the Ministry of Internal Affairs. Here are the services in which CBRN teams can be found. It is the State Emergency Service, which has the most numerous groups and the greatest potential. It exists the border guard service that mainly operates in the sphere of border protection. And there is the National Guard, which does not have special CBRN equipment and only responds to political incidents. The National Guard is also involved in the elimination of large-scale accidents, for example, to evacuate the population from large accident zones.

The big player in Ukrainian civil protection is the State Emergency Service of Ukraine (Державна служба України з надзвичайних ситуацій) (SES). The SES dates back to December 2012 when its two predecessor organizations, the Ministry of Emergencies of Ukraine and the State Inspectorate for Technogenic Security of Ukraine, had been merged. The goal of the multi-step reformation process was to develop a modern, demilitarized, streamlined organization acting as competence center for all civil protection matters in the independent, post-Soviet Ukraine. With the new organization came a change in terminology, favoring civil protection instead of civil defence [16].

The SES fights fires, rescues people in the mountains and on water, repairs roofs destroyed by shelling, performs CBRN monitoring and analysis, monitors meteorological and hydrological parameters, extricates traffic victims, clears mines and unexploded ordnances, and educates young cadets, to name a few of its activities. Ambulance service and emergency medical services, however, are not the responsibility of the SES. The vast majority is paid staff. Although the Code of Civil Protection of Ukraine allows for volunteer units, those are very rare and hard to find. Even in villages, there are, for instance, fire stations with fulltime paid staff, where there would be volunteer stations in Germany.

The SES is a centralized government service under control of the Ukrainian Ministry of the Interior. Its organization is based on two pillars, a functional subsystem, with focus on administration and management, and a territorial subsystem, with the actual boots on the ground spread in each oblast. Oblast is the Ukrainian equivalent to a state (in German: Bundesland). The SES and other stakeholders in civil protection are all embedded in the so-called unified state system of civil protection, stipulated in Chapter II of the

Code of Civil Protection. This system is always active and legally binding for all parties involved and at all emergency scenes. The system is also adaptable to the current threat level (everyday operation; high readiness; emergency; state of emergency) (Article 11) and to the scale of the emergency (object; local; regional; national) (Article 5). Applicable federal legislation provides indicators for scaling and classifying each emergency by looking at (estimated) monetary losses, impact on the population, violated normal living conditions, and territorial spread [17].

The SES is a centralized agency which consists of several departments. The Executive Office is home to the Department of Emergency Response, which coordinates operations and rescue work. There is also the Department for Organization of Civil Protection Measures, which prepares and trains the population, the administration of regions and the industry for correct action and behavior in emergencies. This department is also involved in the development of emergency management plans and evacuation plans, as well as the development and update of a legal framework for civil protection. It is these two departments that work to effectively eliminate CBRN accidents. Simply, the Department for Organization of Civil Protection Measures performs preparatory work and the Department of Emergency Response is doing operational response. Also, the Department of State Control over Fire Prevention, Technogenic Safety and Civil Protection is a part of the Executive Office. The main objective of this department is the prevention of accidents and control over the implementation of safety rules, both in the industrial and the public sphere. In addition, there is a Department of Resources and a Department of Personnel in SES. Given by their name, their responsibilities are obvious. Efficient assistance at the elimination of large-scale accidents, such as forest fires, is provided by the Aviation, Air Search and Rescue Unit. Also the executive office includes such services as the Central Medical Expert Commission, the Hydrometeorological Office, the Office for European Integration and International Cooperation and others.

In each oblast, the SES operates a main department (головне управління (ГУ) ДСНС) with a command and control center and the respective dispatch center for receiving alarms by citizens. Additional command and control points can be established in the field in a supporting role. Directly at the incident scene, the Slavic word Штаб is used for marking the local incident command, although this might lead to confusion with the English word “staff”. The actual staff, if required due to emergency scale, meets dislocated in the control center of the oblast’s main department of the DSNS or even at higher, national level.

In addition to territorial units, there are special units of central subordination of the SES. Those are the Interregional Center in Sumy Region and the Mobile Center in Kiev. Two more special centers are situated in Lviv and Odessa regions. Finally, there is one special aviation group. Special centers are located in different sides of the country - in the East, West and South. However, for liquidation of CBRN incidents, the main players are the Interregional Center and the Mobile Center. They have the most suitable technical equipment in Ukraine and provide for specific experts regarding the elimination of CBRN hazards. Nonetheless, these units are only alerted to large-scale interventions, when territorial special groups cannot cope.

The SES consists of educational and research institutions as well. The National University of Civil Defence of Ukraine in Kharkiv is the main center for the training of specialists in CBRN response. Furthermore, in Lviv, there is the State University of Life Safety. Kiev has an Institute of Public Administration in the Sphere of Civil Protection. The primary training of ordinary firefighters takes place at the higher school. There is a training center for the Rescue Service of Civil Protection in the Kharkiv region. This center hosts special trainings in various civil protection specialties, including CBRN response. There are two training centers in Ukraine for the education of CBRN rescue workers. The training center prepares ordinary rescue workers and low commanders, while the University provides educational programs to Chief, Staff Workers and Experts. The SES also encompasses two research institutes: The Ukrainian Research Institute of Civil Protection and the Ukrainian Hydrometeorological Institute. There are training centers in each region where the population is trained, such as teachers or those responsible for fire safety in the industrial sector.

3. MODIFICATION OF THE EMERGENCY MANAGEMENT SYSTEM

An analysis of the civil protection systems of Ukraine and Germany showed that each has its own advantages and disadvantages, therefore, we further propose a modification of the crisis management system in order to combine the advantages of both systems.

3.1 The classical emergency management system

The classical management system which is presented in Figure 2 consists of four basic subsystems – Monitoring (M), Forecasting (F), Decision-Making (D), Decision-Implementation (I).

In an accident condition, the management system functions as follows:

Prime action is collecting qualitative information about the accident. Information collection can take place simultaneously about several features (for example: accident center, defeat zone, meteorological situation, etc.). Qualitative information is meant as timely collecting sufficient (at the same time not excessive) information. Next, the collected information is being processed and converted to a form, convenient for perception [18]. Then, the information gets systematized and simplified for an evaluation and subsequent analysis. At the same time, additional information can be taken from existing databases, reference books, etc. [19].

1. The processed results of monitoring get to a forecasting subsystem. Here, the head making decisions sets criteria for evaluating the situation in a zone of accident. By using the monitoring information and available modelling instruments, forecasting the development of the situation at different parameters is possible [20].
2. Forecasting results are then evaluated by the decision maker. The head, based on the available data, takes the most effective decision and forwards it to a subsystem of decision-implementation. In case the head is not authorized/responsible to resolve the accident, or he or she has not enough resources, then the received administrative decision is transferred to a

higher level.

In a decision-implementation subsystem, the received administrative decision is formalized. Tasks to performers based on this decision on elimination of the accident are being assigned. Direct impact on the accident scenario with the purpose to minimize negative side effects of the accident is the goal. At the same time, impact on the accident can be carried out in parallel in several directions (for example: fire extinguishing, hazard substances sedimentation, evacuation of the victims, etc.).

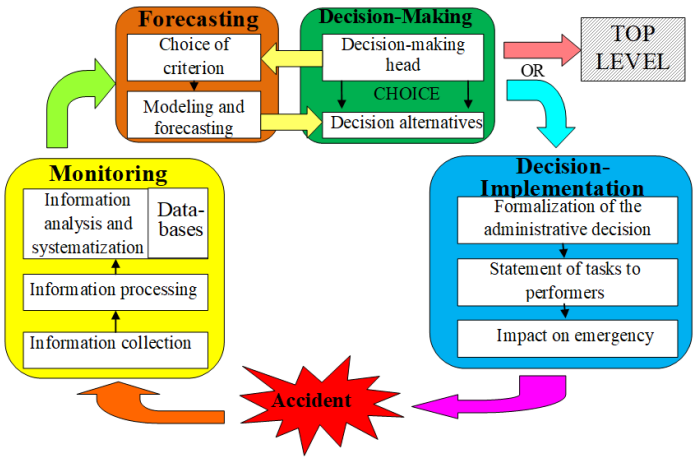

Figure 2. The classical circle of emergency management

3.2 The modified emergency management system

However, in the presented system (Figure 2), the most difficult and long stage is to make the effective decision and forecasting of a situation at various alternatives of the decision. In accident conditions where the time factor plays a critical role, it creates considerable problems. Therefore, a modified management system will be offered (Figure 3).

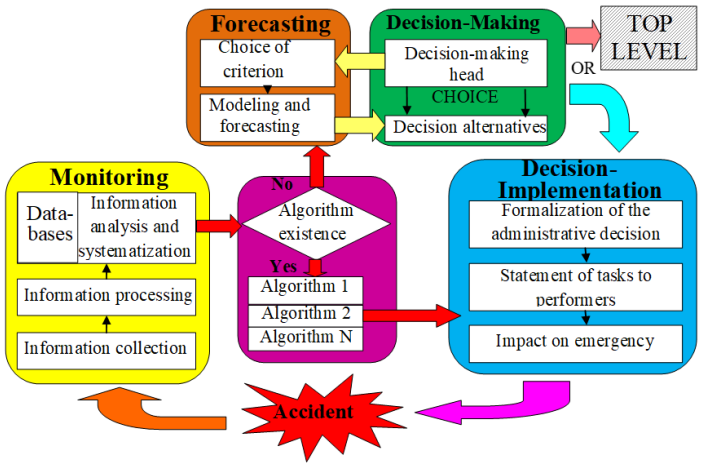

Figure 3. The modified circle of emergency management

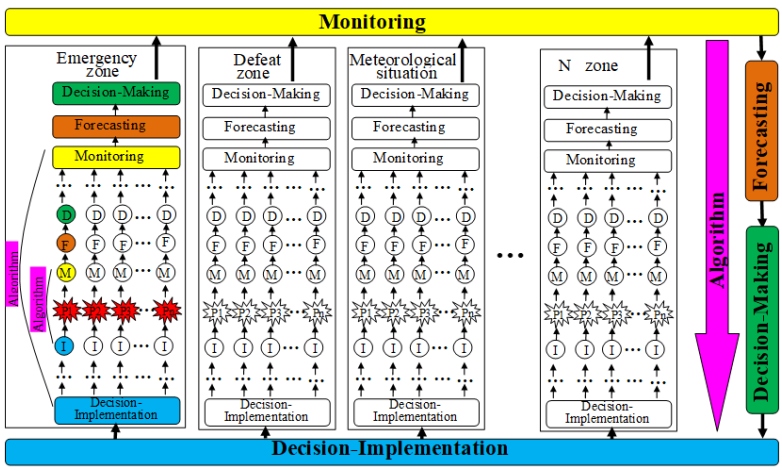

Figure 4. The multilevel circle of emergency management

Distinctive element of this system is the existence of rescue teams' action algorithms for standard, most often met situations. Search of an applicable standard algorithm for correct action in this situation is carried out in the monitoring stage. In case of existence of a standard algorithm, the most suitable algorithm is being selected and then, directly, statement of tasks to rescue teams is carried out. If a suitable standard algorithm of action is missing, the already known stages of information analysis, forecasting and development of rational decisions are started.

3.3 The multilevel emergency management system

In case of large emergency situations where many units of various specialties are involved, the command-and-control system gains multilevel character. In that case, the decisions of lower-level division heads are transferred to the top level where they will be analyzed and evaluated. The number of levels depends on the type of accident, its size and the number of parameters (P) which need to be controlled. An example of a multilevel management system during the elimination of a major accident is presented in Figure 4.

4. CHECKING THE EFFICIENCY OF A MULTILEVEL MANAGEMENT SYSTEM

In order to test the effectiveness of the proposed multi-level disaster management system, a numerical comparative analysis of the functioning of the civil protection system in some regions of Ukraine was conducted. As mentioned above, the civil protection system of Ukraine has already started the process of decentralization by 2014 and has already taken some practical steps in this direction. However, after the start of the full-scale invasion of Russia in February 2022, the centralized component of the system was activated and strengthened. Therefore, 2021 before the start of large-scale military operations (Figure 5(a)) and 2022, the first year of the full-scale invasion (Figure 5(b)), were chosen for comparison. The overall degree of decentralization of Ukraine's civil protection system for the period of 2021-2022 can be considered 40-45%.

Two eastern regions of Ukraine (Kharkiv and Sumy oblasts), which have suffered the most since the beginning of 2022, and two western regions (Lviv and Ternopil oblasts), which have experienced almost no hostilities at this time, were selected for analysis.

The analysis compared the state budget expenditures for the maintenance of rescue units in each region with the material assets saved and people rescued during disaster response. Of course, comparing material resources and human lives is ethically questionable, as no human life can be measured in monetary terms, but this data is important and must be taken into account in the analysis.

When analyzing Figure 5, it can be seen that Kharkiv region needed the most funds to maintain the civil protection system in 2021 and 2022. This is due to the population, which is 2.7% higher than in Lviv region and 2.4 times higher than in Ternopil region. In addition, the industrial potential of Kharkiv region is estimated to be 37% higher than that of Lviv region. The increase in the cost of maintaining rescue units in all regions of Ukraine in 2022 is explained by additional funding to overcome military threats and currency devaluation.

As shown in Figure 5(a), the cost of maintaining rescue units in all these regions of Ukraine exceeds the amount of money saved. Although the expediency of such a system can be justified by saving lives and health, it is these indicators that prompted the authorities to intensify the decentralization process.

In the face of large-scale threats in 2022 (Figure 5(b)), the combined emergency management system has already demonstrated its effectiveness - the amount of property saved in the regions of active hostilities significantly exceeds the amount of money spent. The number of lives saved further confirms the effectiveness of this system.

It should be noted that even in wartime, the regional emergency management system retains a high level of decentralization. In each region of Ukraine, a civil-military administration has been established, which has broad powers to manage operational and rescue units.

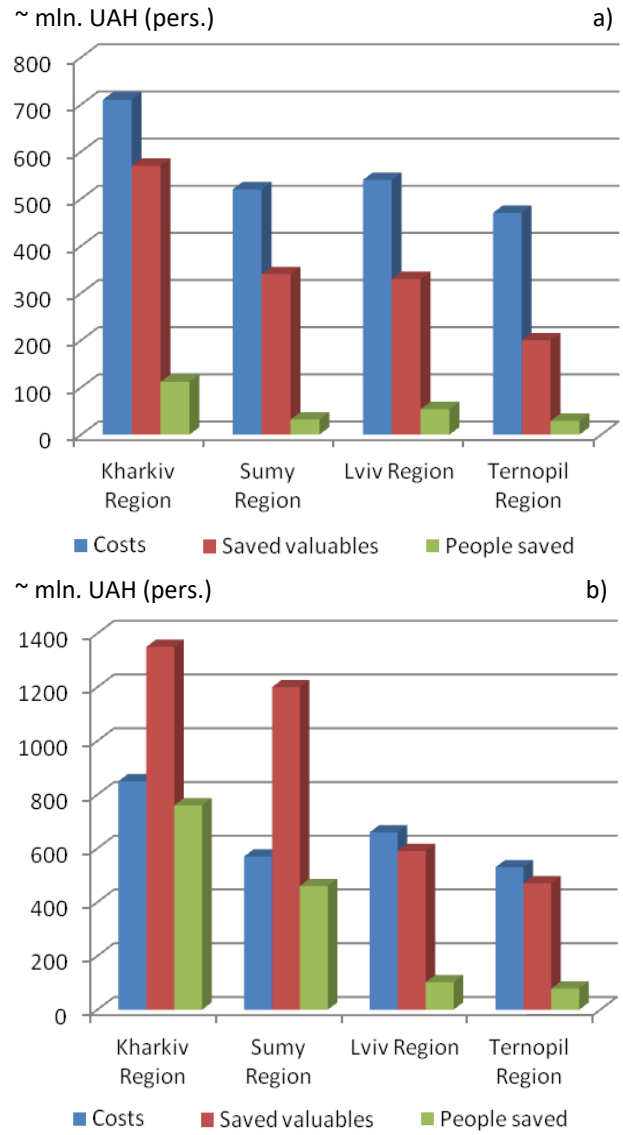

Figure 5. The ratio of funds spent on the maintenance of rescue units to valuables and people saved in some regions of Ukraine in 2021 (a) and 2022 (b)

Lviv and Ternopil regions, like all regions of Ukraine, came under rocket fire as well, which also demonstrates the effectiveness of the proposed emergency management system.

5. CONCLUSIONS

An analysis of the functioning of civil protection systems in the Federal Republic of Germany and in Ukraine had been performed. The analysis took into account the peculiarities of the operation of these systems in the elimination of minor accidents, such as local fires, traffic accidents, damage to local power and others, as well as during the elimination of large-scale disasters such as floods, accidents at nuclear power plants, military conflicts, landscape fires, etc. The analysis showed that the decentralized structure of civil protection in Germany has advantages in the elimination of local accidents. These advantages are based on a more flexible system of adaptation to the needs of the local area, a greater emphasis on the responsibility of local authorities to the community, and the lack of a complex hierarchical structure for the coordination of management decisions. This allows to build a system of civil protection in a separate territorial-administrative unit depending on the characteristics of the territory, population density, the presence of high-risk facilities, the number of critical infrastructures, to respond quickly to changes in these factors and to increase the speed of management decisions. These factors are the main shortcomings in the centralized structure of civil protection in Ukraine. However, in the elimination of large-scale disasters, the centralized structure of civil protection has significant advantages, such as a clearly defined and repeatedly worked out hierarchical structure of subordination and interaction of different services and units, efficiency of technical and financial reserves, clear division of responsibilities, and a proven system of interaction between territorial subsystems.

Based on the results of the analysis of the functioning of the civil defence systems of Germany and Ukraine, a way of modification of the classical systems of emergency management had been offered. The modified emergency management system simplifies the management process due to the availability of standard algorithms or operating procedures for the elimination of typical local accidents and it can activate a multi-level centralized management system for large-scale disasters. It is important to identify the most typical local accidents for a particular territorial unit that require similar actions for rescue services and to develop such algorithms or standard operating procedures for their localization and elimination. Bringing these standard operational procedures to the primary rescue units will simplify and speed up the management decision-making process and increase the efficiency of the rescue unit due to the possibility of early testing of the standard algorithm of actions at the scene. The implementation of the proposed modified emergency management system will combine the positive properties of decentralized and centralized civil protection systems.

In order to implement and activate the developed multi-level emergency management system, it is necessary to develop new and update existing emergency response plans for all involved services. A prerequisite for maintaining vertical line management links is the development of such plans on a top-down basis according to a common procedure. That is, the first step is to approve a general framework for drafting emergency response plans, the second step is to draft a national (federal) level response plan, and the third step is to develop regional response plans based on the national plan and proceed down to the local level. To safeguard the overall management system's agility, each upper level of the plan should clearly specify the subordinate levels' responsibilities and freedoms. Therefore, follow-up research is needed to develop a standard algorithm for emergency response plans for all levels of management with clear separation of those parts that demand centralized action and those allowing for independent, decentralized action.

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NOMENCLATURE

P	Parameters which need to be controlled during emergency
M	Monitoring
F	Forecasting
D	Decision-Making
I	Decision-Implementation
SES	State Emergency Service of Ukraine
CBRN	Chemical, biological, radiological, nuclear
ZSKG	German act on federal civil protection and disaster relief
DRK	German Red Cross
JUH	Johanniter Emergency Service
MHD	Malteser Hilfsdienst
ASB	Workers' Samaritan Federation
DLRG	German Life Saving Federation
THW	German Federal Agency for Technical Relief
BBK	German Federal Office of Civil Protection and Disaster Assistance