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Oleksandr Ignatyev
postgraduate student,
educational and production center of the
National university of civil protection of Ukraine, Kharkiv

Victoriia Shvedun
Doctor of Science in Public Administration,
Full Professor, Professor,
Department of Public Administration and Untrepreneurship,
National Aerospace University H.E. Zhukovsky «Kharkiv Aviation Institute»

Situation centers as a mechanism state department of monitoring potentially dangerous objects

The article substantiates the use of state regulation mechanisms of risk and safety management of monitoring potentially dangerous objects (PDO). The conceptual basis for the analysis of technogenic risk of the emergency situation (ES) of potentially dangerous objects is considered. The analysis of creation and direction of development of the situational centers (SC) abroad and in Ukraine. It is indicated that the efficiency of the SC operation is directly dependent of the developed system of monitoring potentially dangerous objects.

Keywords: *mechanisms of state administration, monitoring of potentially dangerous objects, emergency situation, situational center.*

Formulation the problem of article. The development and implementation of effective measures to minimize the inevitable damage from emergency situations (ES) at potentially dangerous objects (PDO), the prevention of technogenic emergencies in ES are put forward among the priority tasks of public administration. The sustainable development of the Ukrainian economy, an increase in the well-being and health of the country's population depends on the successful solution of these article.

The end of the 20th century was characterized by an increase in the number of technogenic emergencies, and accordingly there was an increase in the associated damage [1]. It became obvious that efforts aimed at eliminating the consequences of emergencies are becoming less effective, extremely unprofitable and inexpedient from an economic point of view. Therefore, in this period, the tasks of forecasting and preventing emergencies become the priority tasks in the field of protecting the population and territories [1]. At the same time, the task of eliminating the consequences of emergencies (reducing the amount of possible losses and damage to the consequences of emergencies) is not removed from the agenda.

The mechanism that systematically monitors and controls objects, processes and protection systems, predicts the size of zones and the consequences of possible

emergencies, the state of implementation of preventive measures to reduce their scale, collecting, processing, transferring and storing this information is the monitoring of the state of PDO [2].

A significant drawback in the prevention of technogenic emergencies is currently the lack of systematized information about the state of ES, the reasons for deviations and violations during their operation.

To create a modern system of technogenic monitoring, a unified national approach must be developed and departmental disunity must be overcome, in which various information flows are "privatized" by individual departments and do not enter a single center of state administration.

Taking into account the world experience, the most effective is risk management, which is based on achieving a certain level of safety, a balance of benefits and costs within an individual facility, territory and state as a whole. Thus, the safety of the population and territories in an emergency is achieved through risk management.

To date, risk management mechanisms that are aimed at reducing their values have not received widespread practical application. Thus, a quantitative risk assessment is used only in certain areas, namely, in the analysis of the safety of nuclear power plants, in the declaration of the safety of PDO. At the same time, imperfect regulatory, organizational and technical methods of risk management do not allow today to achieve risk levels corresponding to the levels of economically developed countries [3].

Therefore, it is very important to ensure risk and safety management in emergencies with the use of mechanisms of state regulation, namely: the creation of a regulatory and legal framework; implementation of scientific and technical policy in the field of monitoring the state of PDO; organizational principles; economic mechanisms for preventing emergencies and mitigating their consequences [4, 5]. As part of improving the mechanisms of public administration and decision-making, a situational center (SC) is becoming a fundamental concept - a software and hardware complex that includes a secure virtual corporate network, a single geographically distributed information fund, modeling tools, visualization tools and a decision support system.

Analysis of research and publications. Famous scientists V. Andronov, E. Grinchenko, S. Dombrovskaya, M. Kuleshov, S. Maistro, R. Prikhodko, V. Sadkovy, O. Sobol, V. Tyutyunik and others [8–10] were engaged in the creation of mechanisms of public administration towards the development of safety systems in the event of an emergency.

The analysis of scientific works indicates that when building systems for monitoring and forecasting the development of emergencies, the greatest attention is paid to building an effective information and analytical system for managing processes of anticipating and localizing the consequences of emergencies through integrated inclusion in the existing system of the Unified State Civil Protection System (USCPS) vertically from the object to the state levels of various functional elements of the territorial emergency monitoring system and the components of the

SC [7].

Presentation of the main research material. After the accident at the Chernobyl nuclear power plant, which occurred against the background of an almost universal belief in the complete safety of nuclear power in the USSR, the methodological approaches reflected in the regulatory framework for the safety of a nuclear power plant changed extremely slowly. It took many years to understand that the requirements developed during the implementation of the acceptable risk policy (for example, the quality standards for human health and the environment) determine the requirements that the technical safety systems of potentially hazardous objects must meet. At the same time, the entire legislative and executive safety management system had to be radically changed: the concept of "react and correct, minimize the consequences" had to be replaced by the concept of "foresee and prevent". As time and experience of economically developed countries have shown, this concept turned out to be the most economically profitable. It was after the Chernobyl disaster that research on the assessment, analysis and management of risks began to develop in our country [11].

In the world, especially in countries with developed economies, since the 80s (in the Russian Federation since the 90s) there has been a change in state policy. The first place was taken by emergency prevention and risk regulation. In most cases, it turns out to be more efficient and economical [12]. As a result of the implementation of state measures for the prevention of emergencies (regulation of the risk of emergencies), the number of accidents and disasters at potentially dangerous facilities in countries, for example, in Western Europe, has decreased by 7-10 times [1].

The risk analysis process includes the following main steps:

- monitoring the state of PDO;
- identification of hazards;
- risk assessment of an accident at PDO and (or) its components;
- establishing the degree of hazard of accidents at PDO and (or) determining the most dangerous (taking into account the possibility of occurrence and the severity of the consequences of accidents) components of the PDO;
- development (adjustment) of measures to reduce the risk of accidents.

The conceptual framework for the analysis of technogenic risk can be presented in the form of a block diagram shown in Figure 1.

The condition for the implementation of the standardization of risk levels when monitoring potentially hazardous objects is to determine and ensure the achievement of the necessary reliability indicators for those technical elements and technologies that can lead to accidents, as well as indicators of the reliability of emergency protection systems and protective structures.

The basis of the regulatory framework of risks is two main regulatory levels of risks, minimum and maximum permissible. When determining the levels of acceptable risks, the values of the risks used in economically developed countries are used, namely: the minimum risk is less than or equal to $1 \cdot 10^{-8}$; maximum permissible risk equal to $1 \cdot 10^{-5}$. The risk, the value of which is less than or equal to the minimum, is considered absolutely acceptable [3].

Risk indicators are needed to enable emergency risks to be compared with each other and to make an informed choice in favor of one of the strategies. Quantitative and qualitative risk assessment corresponds to quantitative and qualitative indicators: qualitative indicators are used when there is no possibility of quantitative assessments (in the absence of statistical data or mathematical models); quantitative indicators - numerical values of the risks of emergencies. The numerical values of the risks of emergencies are preferable, since they can be used to build mathematical models and perform various mathematical operations on them. The risk of an emergency is defined as a measure of the hazard of an emergency that combines the likelihood of an emergency and its consequences [11].

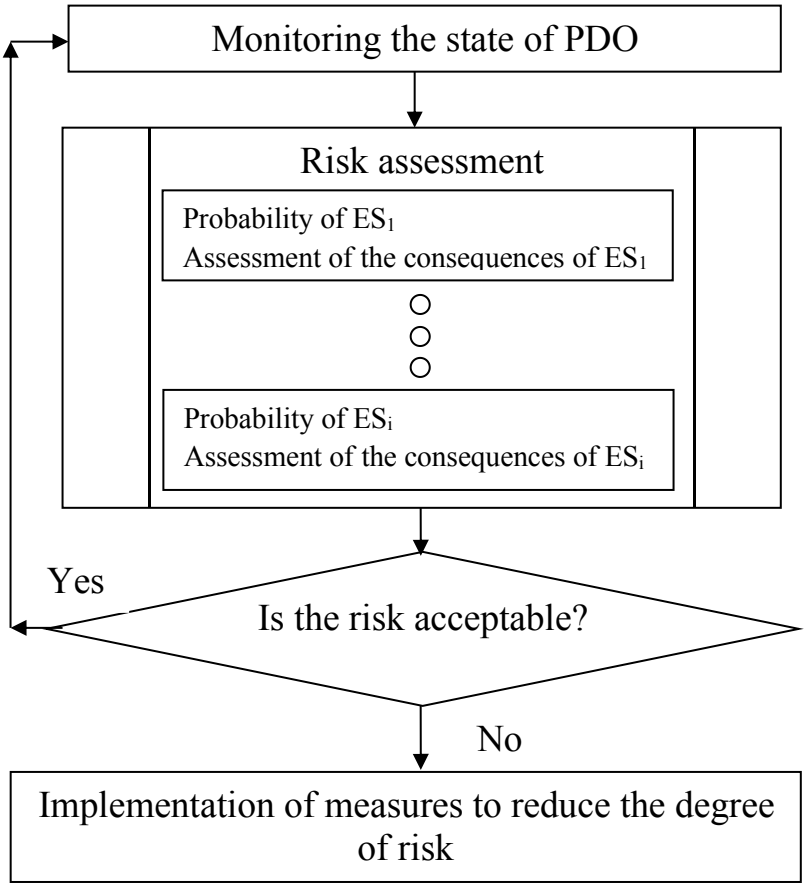

Figure 1 - Block diagram of the risk analysis of a man-made accident

In mathematical formalization, the risk R is a function of two variables - the frequency F and the consequences U of an undesirable event:

$$R = f(F,U). \quad (1)$$

According to the Order of the Ministry of Labor and Social Policy of Ukraine № 637 of 04.12.2002 "About the consolidation of the Methodology for the designation of risks and acceptable levels for the declaration of safety in the case of insecurity," the magnitude of the territorial risk is the probability of death within a year place of space, from possible sources of danger of potentially dangerous objects.

It is assumed that the territory is located in a specific region outside the sanitary protection zone of the enterprise, which includes at least one potentially dangerous object (city, town, village, on the territory of the industrial zone of enterprises). The territorial risk associated with accidents at PDO is recommended to be considered absolutely acceptable at its level $R \leq 10^{-7}$. If N dangerous events can occur during the year, then one of the risk indicators is the sum of damages from all events.

For example, consider three options for the process of PDO functioning. The probability of an accident for the first is 10^{-2} / year, the second 10^{-4} / year, and for the third 10^{-4} / year. Possible damage in the event of an accident during the first variant of the process is 5 million hryvnia, the second - 200 million hryvnia, and the third - 680 million hryvnia. Let's calculate the preference of projects from the point of view of security. The risks of all three options for the process of PDO functioning are:
Option 1 10^{-2} accidents / year × 5 million UAH / year = 50 thousand UAH / year;
Option 2 10^{-4} accidents / year × 200 million UAH / year = 20 thousand UAH / year;
Option 3 10^{-4} accidents / year × 680 million UAH / year = 68 thousand UAH / year;

Thus, the second option is preferable from the point of view of safety (the lowest value of material losses was obtained). It follows from the above ratios that the independent variables used to assess the risk are time and damage, and to assess (predict) the risk, it is necessary to determine the frequency of occurrence of dangerous phenomena (events) and the damage from them.

The effectiveness of risk mitigation measures (G_{mi}) can be assessed by the following quantitative indicator:

$$G_{mi} = C / (M_0 - M_1), \quad (2)$$

where C is the cost of the event, M_0 is the mathematical expectation of the amount of damage before the event, M_1 is the mathematical expectation of the amount of damage after the event [13].

The above methodological foundations of risk analysis indicate that the management tasks solved in public authorities regarding monitoring the state of PDO are highly dynamic, complex, multidimensional, and have a significant degree of uncertainty. Under these conditions, the intellectual capabilities of a person can come into conflict with the complexity of processing significant amounts of information about the state of PDO and the desire to avoid mistakes when making responsible managerial decisions. The main means of overcoming this contradiction include the expansion of the team of persons involved in the process of developing and making decisions, and the use of modern information and analytical technologies to support their activities.

It is obvious that in order to ensure a comprehensive, operational, intelligent analysis of the situation and the development of adequate solutions for risk management when monitoring the state of PDO, it is necessary to create situational centers (SC). Integration in one organizational and functional structure of a set of administrative, technical, information, software and telecommunication resources, as well as teams of experts, introduces fundamentally new changes in the processes of

discussion and analysis of large and complex problems of public administration, providing comprehensive intellectual processing of information based on the use of new analysis methods [14] and information visualization tools.

The concept of "situationality" in management problems first appeared almost 100 years ago: American sociologist Mary Parker Follett (1868-1933) formulated in the 1920s the so-called "law of the situation", according to which the best leader (and at the same time the executor of decisions) - not some abstract absolute value, but a person who possesses the necessary qualities and skills and meets the requirements put forward by a specific situation. Further development of the situational approach and the formation of control theory began somewhat later, in the 1950s. A significant contribution to the development of this theory was made by D. Woodward, T. Berne, D. Stalker, P. Lawrence, D. Lorsch, D. Pugh, D. Hickson, P. Blau, R. Schechner, A. Chandler. Among the main characteristics of the modern situational approach are:

- possession of the head of the organization with effective management tools and skills;
- assessment of the strengths and weaknesses of each management decision;
- correct interpretation of the situation;
- linking specific management techniques to specific situations [15].

It is generally accepted that the world's first SC to optimize the work of the presidential administration was created in 1962 in the United States under the leadership of Anthony Stafford Beer. By the 70s E.S. Beer proposed the concept of SCs, his ideas were embodied in Chile, which is in a difficult economic and socio-political situation. Abroad, the idea of creating SCs as decision support systems has become very relevant since the 1970s.

Currently, 5 functionally specialized SCs (centers for analytical decision support) are organized under the President of the United States, the most famous center is the White House Situation Room WHSR. It belongs to the class of centers for monitoring and making strategic decisions. In this shielded room, 30 full-time specialists and about 100 alternating personnel are on duty, receiving data over secure communication lines, taking service information for the President of the United States and his national security adviser. The upcoming bulletins also include the most important news from the press, news agencies, radio and television. Every day, about 1,000 messages are received and processed, which are sent to the computers of the staff of the National Security Council apparatus. If the president is away, urgent or necessary information for making decisions is transmitted to him via a special communication line [16].

The governors have situation rooms deployed, the SC is in the Pentagon, the US Air Force Innovation Center, the FBI, the US Federal Aviation Administration, the US Postal Service, under the Secretary General of the European Union. In Germany, the SC is focused on solving social and economic problems. Several dozen SCs for various purposes have been created in Norway. Large commercial companies that make strategic decisions based on multidimensional analysis also have strategic research centers. Among such firms are Price Waterhouse Cooper (USA), Boeing

(USA), Eastman Chemicals (USA), Computer Science Corporation (USA) Aerospatiale (France), Nokia (Finland).

In 1998, the FBI headquarters put into operation the Strategic Information and Opera tions Center SIOC, which belongs to the class of crisis SC. The center is able to simultaneously track five or six crisis situations both in the United States and abroad. The permanent staff of the center is 10 employees, but in crisis situations it can employ up to 450 specialists. $ 20 million was spent on the creation of the SIOC. SIOC is equipped with 184 computers and the most modern communication technology. The center has conditions for holding closed conference calls on specific crisis situations with the involvement of task forces in the country and US missions abroad.

The Homeland Security Coordination Center HSCC has been operating since 2002, it belongs to the class of crisis SC. Located on the territory of the US Navy office complex (7 km from the White House in Washington). The task of this SC is to ensure the interaction of the federal government with local authorities and to provide information support to the situation room of the White House. It is envisaged that in the event of an emergency evacuation of the president's office, the HSCC will become a backup point for its relocation. One of the main structural divisions of the HSCC is the Threat Monitoring Center, equipped with computer equipment for video conferencing with the ability to simultaneously involve representatives of most federal departments, including the Department of Defense, FBI, CIA, Immigration and Naturalization Service, in the discussion. In addition, the staff of the center have access to all major national TV and radio broadcasting channels, which, if necessary, ensures reliable interaction with the media. Another important unit of the HSCC is the Coordination Center (CC), which should come into action in the event of an emergency [16].

In the military sphere, SCs are the most widespread. These are available at the Pentagon: the Naval Communications Center (NMCC), the Curent Action Center, and the Center AV Communications for the Defense Chiefs of Staff Committee. All of them work according to the same functional scheme. Meetings are held in rooms with advanced visualization tools, information for which is prepared outside these rooms, and often even in other buildings. There are powerful tools for preparing information in traditional forms, as well as audio and video information.

Currently, the Council of the European Union is completing the recruitment of the EU JOINT Situation Center, the decision to create of which was made after the terrorist attacks in the United States on September 11, 2001. The tasks of the center include providing the Military Committee of the European Union, as well as the planning and early warning department of the office of the Secretary General Of the Council of the EU with analytical documents on crisis situations in various regions of the world with a forecast of their development and determination of possible measures for a military-political settlement. At the first stage, this structure will work in the interests of 8 states: France, Germany, Great Britain, Italy, Spain and the Benelux countries. In the future, it is planned to expand the activities of the United SC to all members of the European Union.

Of interest is the number of staff of the SC - it is 150-200 employees. When recruiting, priority is given to analysts with experience tracking crisis situations. As this unit expands, it is expected to provide round-the-clock duty of experts to prepare analytical documents in real time.

Mobile SC components are undergoing serious development. In particular, for the control systems of law enforcement agencies, mobile command centers (MCC) are provided, equipped with powerful video cameras with the ability to send video images over a radio channel to a stationary SC and means of displaying various types of information on plasma panels in the MCC itself. Analysis of foreign experience of using SC shows that the basic solution is a complex branched hierarchical structure of SC organization. At the top of such a structure is usually a situation room with presentation facilities. Information for presentation in the situation room is prepared in information preparation centers, which, in turn, rely on an extensive network of specialized agencies. Much attention has recently been paid to the development of the video conferencing mode and mobile components of the SC [17].

The main tasks solved by foreign SC are:

- monitoring the state of the object (including VET);
- forecasting the development of the situation based on evolutionary modeling;
- modeling the consequences of management decisions;
- solution of management tasks, taking into account the constant changes in the situation and characteristics of the object;
- communicating the decisions made to the executors of the management hierarchy and monitoring their implementation based on the document flow system and monitoring the execution of orders;
- coordination of the activities of various organizations engaged in solving the same problem.

In the USSR, the "official" year of birth of the SC was 1986 - the center was created as part of the operation to eliminate the consequences of the Chernobyl nuclear power plant. In 1988, the need arose for the situation room of the Chairman of the Government of the USSR, a catastrophic earthquake occurred in Armenia. All this predetermined the design of the SC of the Commission of the Council of Ministers of the USSR on Emergency Situations (1990, it functions in our time on the territory of the Russian Federation as a national center for crisis management).

For example, the design of the SC of the President of the Russian Federation was started in 1994, in 1996 the center was put into operation. To date, about two hundred SCs have been created in the Russian Federation, which mostly serve the needs of state administration both at the federal (IAS "Federation", IS "Obstoyanie", IAS "FTP"), and at the regional levels (IAS "North Caucasus" , SC of the Vologda and Voronezh regions, St. Petersburg). SCs of federal districts of the Russian Federation, centers of large state corporations - Gazprom, Rosatom, Rosneft, Russian Railways, PJSC Aeroflot) are successfully operating [15].

In Ukraine, in recent years, there has been a tendency to create a departmental SC. A large number of scientific works are devoted to the creation of specialized SC, the work of which is somewhat narrowly focused [18-20].

When identifying the sources of emergency situations, the greatest attention is paid to PDO, assessment of their technical condition and danger for the population living near them, as well as facilities located in zones of possible adverse and dangerous natural phenomena and processes. At the next stage, an assessment is made of the likelihood of natural disasters, accidents, natural and man-made disasters and the amount of possible damage from them, which characterize the risk of the corresponding emergencies.

The forecast of the likelihood of accidents at PDO and their possible consequences is organized and carried out by the managers and specialists of these facilities. The forecast of emergencies risks caused by natural disasters, accidents, natural and man-made disasters, possible in the territories of regions, regions, is carried out by the corresponding territorial units (centers) of the USSGZ.

It should be emphasized, as long experience suggests, that without taking into account monitoring data and forecasting emergencies, it is impossible to plan the development of territories, make decisions on the construction of industrial and social facilities, develop programs and plans for the prevention and elimination of possible emergencies. The effectiveness and quality of the developed programs, plans and decision-making for the prevention and elimination of emergencies largely depends on the efficiency and quality of monitoring and forecasting [2].

Currently, the issue of creating complex SC is extremely relevant. For example, it is planned to complete the design and start construction of the SC, which will unite all operational services to respond to various emergencies, in the city of Kharkov in mid-2021. The city SC is planned to be built in the airport area. It will house an operational control room, a traffic control center, a communication center, a crisis room, offices for representatives of the National Police, as well as technical rooms and halls for conducting joint trainings and training for representatives of emergency response services (including employees of the State Emergency Service of Ukraine). It is planned that the center's specialists will receive emergency calls from the population around the clock, monitor emergencies, transmit information to the response services, and simulate possible emergency situations.

The main problem requiring an early solution is the organization of effective coordination of interagency actions in response to calls from emergency services. The increase in the safety of the population, which is a direct consequence of the improvement in the organization of the interaction of emergency services, determines the priority of solving this problem.

President of Ukraine Volodymyr Zelenskyy signed a decree that puts into effect the decision of the National Security and Defense Council of Ukraine dated 04.06.2021 "On improving the network of situational centers and digital transformation of the national security and defense sphere" (the corresponding document No. 260/2021 was published on the website of the chapter state). It notes that the Council decided to recognize the need to expand and further develop a single network of SC in order to increase the efficiency of information and analytical support for managerial decision-making, interaction, coordination and control over the activities of executive authorities, law enforcement agencies and military

formations in the spheres of national security and defense. in peacetime, as well as in a special period, including in martial law, in a state of emergency and in the event of crisis situations that threaten the national security of Ukraine.

The network should include the Main SC of Ukraine, the government SC, SCs of the security and defense sector bodies, SCs of the central executive authorities, the Council of Ministers of the Autonomous Republic of Crimea, the Regional State Administration, the Kiev and Sevastopol city state administrations, as well as reserve and mobile SC -NS.

In addition, the decision of the NSDC provides for equipping all SCs (except for the Main) with unified software and hardware for information and analytical support for making managerial decisions, which should include:

- data warehouse and database management system;
- tools for analyzing and visualizing data from various sources, as well as building models based on them;
- module of geographic information systems and technologies for creating and working with sets of geospatial data;
- secure video conferencing to ensure the synchronous exchange of audiovisual information in real time;
- electronic communication networks for the exchange of information;
- technical support of the hardware and software complex to ensure stable and continuous operation, testing, configuration and performance tracking in accordance with certain regulations.

Also, according to the decision of the NSDC, the Cabinet, the NSDC apparatus, the SBU and the SVR must ensure the further development of the SC network using the information and analytical system of the Main SC of Ukraine and the possibility of deploying backup SCs in spare (city, suburban) control points, as well as mobile SCs. -sov to ensure the stability and survivability of the state administration system in a special period, in particular in martial law, in a state of emergency and in the event of crisis situations that threaten the national security of Ukraine.

"The Cabinet of Ministers of Ukraine, within three months, to approve the regulation on the government situation center; model regulations on the situation centers of the security and defense sector bodies, the situation center of the central executive body, the Council of Ministers of the Autonomous Republic of Crimea, the Regional State Administration, the Kiev and Sevastopol city state administrations; typical requirements for software and hardware support of the situation center, its subsystems and networks, as well as the creation of a complex of technical protection of information, "the document says.

It notes that the government SC must start working no later than 6 months after the decision comes into force. The document also obliges the NSDC apparatus to take measures to ensure the connection of all SCs, which should be part of a single network, to the information and analytical system of the Main SC of Ukraine.

In turn, the administration of the State Service for Special Communications and Information Protection of Ukraine should take measures to ensure the acquisition and deployment of technical means of the government SC within the framework of

building up a secure video conferencing network of the subsystem of a special switch of Ukraine and their further operation, as well as provide all SCs included in composition of a single network, access to the resource of the National Telecommunication Network.

Conclusions. Thus, it becomes obvious the need for joint use of emergency rescue forces, material, technical, medical, food, financial and information resources for the implementation of measures to prevent and eliminate the consequences of emergencies. Without a developed system for monitoring the state of VET, effective work of the SC to prevent technogenic emergencies is impossible.

Analysis of foreign experience has shown that the main design solutions and information technologies that are used in our country when creating a SC, in general, correspond to world standards and application trends. Extensive global experience predicts a significant increase in 2021-2025. the number of functionally developed SCs, created primarily in the interests of the USSGZ, as well as heads of large enterprises and organizations.

The development of effective solutions requires the involvement of experts from various fields, who could, among other things, connect to work remotely through various channels. Remote work of experts in the SC will create a "collective mind" for finding optimal solutions. On the other hand, remote involvement of experts in order to make management decisions will significantly expand the capabilities of remote (mobile) SC complexes and increase their efficiency.

In all developed countries there are SCs and in terms of software and hardware they are all almost identical. However, hardware and software systems are only one of the components of the SC equipment. The most significant component of the SC is information resources, means of presentation and visualization of information, instrumental-modeling tools and tools for analysis and forecasting, which together constitute a system for preparing and making decisions. In this direction, time is needed to create a database, develop methods and algorithms for the operation of knowledge bases, and test expert systems.

It is obvious that Ukraine lags somewhat behind the economically developed countries in this direction. Immediate acceleration of work on financing the creation of the SC will reduce this gap, and most importantly, already now move to a more cost-effective system, where the priority will be the tasks of forecasting and preventing, rather than eliminating emergencies. The system for monitoring the state of PDO is the basis that will determine the efficiency of the SC as a whole. We must not forget that among the mechanisms of public administration, both at the legislative level and at the level of funding, the issues of ensuring reliable telecommunications, information security systems and the training of qualified personnel for the correct and effective operation of hardware, technical and software facilities of the SC are provided.

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