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MOBILE CENTER FOR PREVENTION AND REDUCTION OF EMERGENCY SITUATION

MOBILNE CENTRUM ZAPOBIEGANIA I ZMNIEJSZENIA SYTUACJI AWARYJNEJ

Abstract: The article covers the problem issues of the formation of Mobile Emergency Operations Center of the General Inspectorate of Emergency Situations of the Republic of Moldova. In the paper determined the key objectives assigned to the Situational Center, as well

as the peculiarities of the developing organizational structure of the information interoperability of the Center's employees, the providing subsystems' composition, and the directions aimed enhancing efficiency.

Keywords: situational centers, Mobile Emergency Operations Center, unique communication protocol, the main scenarios of emergencies, effective solutions

Streszczenie: Artykuł dotyczy zagadnień związanych z utworzeniem Mobilnego Centrum Operacji Kryzysowych Generalnego Inspektoratu Sytuacji Awaryjnych Republiki Mołdawii. W artykule określono kluczowe cele przypisane Centrum sytuacyjnemu, a także specyfikę rozwijającej się struktury organizacyjnej interoperacyjności informacyjnej pracowników Centrum, skład podsystemów dostarczających oraz kierunki mające na celu zwiększenie wydajności.

Słowa kluczowe: centra sytuacyjne, Mobilne Centrum Operacji Kryzysowych, unikalny protokół komunikacyjny, główne scenariusze sytuacji awaryjnych, skuteczne rozwiązania

Introduction

The first reference to the issues of the population protection against various natural disasters as well as civilian and state property dates from the year 1834, where the head of the city ordered the construction of a fire station in Chisinau. As early as 1907 there were 5 brigades and one voluntary society already functioning in Bessarabia, in which 435 employees worked.

At 09.20.1940 there was created the General Staff of the local air defense within the Council of People's Commissars of the RCCM, later on named The Department of Civil Protection and Special Situations. At 10.02.1996 The Department of Civil Protection and Emergency Situations was created by withdrawing the Department of Civil Protection and Special Situations from the Ministry of Defense with a subsequent merger with the Department of Firefighters and Rescuers removed from the Ministry of Internal Affairs of the Republic of Moldova.

Government Resolution no. 137 of 02.27.2019 in Republic of Moldova was established the maximum number of the general inspectors for emergency situations in the amount of 2,467 units, including 2,395 state employees with special status, 7 civil servants and 65 employees of the staff[1].

This is the last organizational and operational structure which has incorporated and grouped the units together in the three fundamental directions:

Prevention - the union combining of all departments that carry out prevention and analysis of all regulatory documents;

[1] *Government Resolution no. 137 of 2.27.2019*, Republic of Moldova http://lex.justice.md/md/379715/.

Intervention - Combining all Response Forces including:
Divisions = 10;
Service's = 25;
Territorial Search and Rescue Units = 2;
Training Republican Centre = 1 **Support and logistical support** - Combining all support units. Strategic plans and material reserves, logistics, finance, lawyers, public relations, international cooperation, internal audit, workflow, etc.

Acceleration in the rate of information and communications technologies development ensures a considerable reduction in the time of decision-making, which is especially crucial when making decisions in crises and emergency situations. One of the main tools of the improvement of quality and efficiency in the management of the General Inspectorate for Emergency Situation of the Republic of Moldova starting with 2014 becomes National Emergency Operation Centre (NEOC), which main task is gathering and processing the incoming information about emergency situations, allowing to estimate the current situation, to model and forecast the scenarios, to elaborate a set of measures to prevent the effects without waiting for crisis situation. Structurally, the Center is divided into 3 main parts: 1 Emergency dispatcher center, aiming to receive and handle the calls incoming, dispatching forces and facilities. 2 National emergency coordination center, while working together in a crisis cell can monitor, forecast and model all kinds of possible scenarios. 3 National Commission for emergency situation meeting room, where the Ministers under the chairmanship of the prime-minister make the final decision about the liquidation of emergency situations.

Government Resolution no. 1340 of 04.12 2001 on the Commission for emergency situations of the Republic of Moldova establishes the 27 people[2].

In the process of liquidation of Emergency Situations (ES) and their effects there take part different ministries, having their own dispatching centers, the main task of which is monitoring. An important objective in an emergency situation is to ensure the exchange of gathered and processed data. As a rule, the exchange is carried out by means of phone calls, fax, SMS and e-mail. Lately, such messengers as Viber, WhatsApp and Telegram are used.

At present, the following emergency operational services function independently, throughout the Republic of Moldova: fire brigades, police, emergency medical assistance, gas leak emergency units and other analogical organizations, each having a different telephone numbers. In addition, all these services are based on different organization principles, they lack high-tech information processing platforms. Moreover, they have limited caller ID and reverse connection. All these factors lead to confuse situations and time loss in emergency situations, making difficult to obtain a fast and safe response to a crisis.

[2] *Government Resolution no. 1340 of 4.12.2001*, Commission for emergency situations of the Republic of Moldova, http://lex.justice.md/document_rom.php?id=30E457D7:1A7901A5.

Starting with July the 1st, 2018, the dispatching offices of such subunits as fire brigades, police and emergency medical assistance began to work on the basis of the single platform 112.

According to the current legislation, the classification of emergency situations in made taking into consideration the following

1. Technogenic emergency situations
2. Natural Emergency Situations
3. Emergency situations with a biological and social feature

Civil Protection conceived in this way, beside its traditional focus on disaster preparedness and response, can stimulate the engagement of governments to address appropriate disaster risk reduction policies. This can include the participation of Civil Protection sectors in National Platforms for disaster risk reduction[3]. The Civil Protection structures of each European country demonstrate differences in the organization of civil protection, including the level of preparedness and ability to effectively monitor hazards and evaluate potential vulnerabilities. The nature of the risks each country faces, from both natural and technological hazards, and Civil Protection procedures at a legislative and administrative level (national, regional and municipal), including an assessment of early-warning systems and disaster management capacities. Special attention in forming Mobile Emergency Operation Centre should be paid to procedures and technologies employing in trans-border Hazard.

The goal of the present work is the research of possibilities to enhance the efficiency of prevention and liquidation of emergency situations in the Republic of Moldova by means of elaborating a system of information and analysis of ES with the allocation of multifunctional Mobile Emergency Operations Center.

The main purpose of this system and Mobile Emergency Operation Center consists in preparation of management decisions through acceleration of prevention, liquidation and analysis of emergency situations, as well as minimizing loss of life and economic losses due to emergency situations.

The Situational Center represents a combination of hardware, software and organizational solutions, which embraces:

- hardware, including a set of workstations, servers, interactive media, data protection,
- telecommunication support (global and local networks, communication channels),
- information support (standards, regulations, methods, normative documents, information sources, data flow, which are processed in the Situational Center,
- software support of management decisions making (information gathering and storage systems, structuring and processing, analysis and forecast, preparation for visualization, information security software).

[3] *The Structure, Role and Mandate of Civil Protection in Disaster Risk Reduction for South Eastern Europe. Report 2008*, https://www.unisdr.org/files/9346_Europe.pdf.

The main purpose of the Situational Center is to enhance the efficiency and quality of management decisions, prevention and elimination of crisis and emergency situations. The Situational Center is to ensure information and analytical support of procedures and processes allowing to promptly analyze, model and forecast the possible scenarios and promptly develop efficient solutions.

1. Literature Overview

Many publications are devoted to the study of emergency management problems. There is a type of tasks connected with the improvement of decision-making processes, information support, communications, special software, etc. Let's consider the main ones:

The project considers the main threats as a source of emergency situations typical for our region. It's worth noting the proposed classifier of threats, as well as a detailed consideration of the problems of risk and vulnerability management, the identification of the main threats and risks, possible measures to reduce risks and dangers[4].

The basis of concept Mobile Center of Excellence is suggested as an efficient way of creation and implementation of the centralized mobility of objects strategy[5]. The present approach seeks to solve a number of problems, including such as the effective creation of scenarios within the model; the avoidance of duplication of costs; effective lifecycle management etc. The road map of mobility includes: identifying drivers; obtaining budget funding and developing a mobile strategy; setting the system management; Mobile Innovation Management Mobile Solutions Management Mobile Governance Management Mobile Partner Management and others[6].

The approach based on social software is of great practical importance for crisis situations management (Wikis= General Wikis+Specialized Wikis; Blogs=Blogs/Weblogs+Microblog; Social Networks=General Social Networks; Social Sharing/collaborative key wording systems-Social Bookmarking+Content Provider)[7]. A good and effective example of the interoperation of services of the confrontation of emergency situations and risk management at the regional and international levels is the interaction of the specialized services of the two nearby regions of Romania (the Timus region) and Serbia (the Banat region)[8].

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[4] N. Steiner, R. Andriciuc, *Managementul situațiilor de urgență create de dezastre*, Guvernul Romaniei. Institutul National De Administratie, Bucuresti 2009, https://www.academia.edu/34034085/30.

[5] *Mobile Center of Excellence: An Enterprise Playbook. Cognizant Reports,* February 2014, https://www.cognizant.com/InsightsWhitepapers/Mobile-Center-of-Excellence-An-Enterprise-Playbook.pdf

[6] M. Romano, T. Onorati, I. Aedo, P. Diaz, *Designing Mobile Applications for Emergency Response: Citizens Acting as Human Sensors,* "Sensors" 2016, No. 16, https://doi.org/10.3390/s16030406.

[7] C. Reuter, A. Marx, V. Pipek. *Crisis Management 2.0: Towards a Systematization of Social Software Use in Crisis Situations*, "International Journal of Information Systems for Crisis Response and Management" 2012, No. 4(1).

[8] *Studiu de specialitate din domeniul managementului situațiilor de risc* în *regiunea transfrontalieră*

An important feature of modern information systems is the use of mobile technologies[9]. Their composition is constantly complemented by new devices having new properties, which requires constant review of information security requirements.

One of the actual problems of the information systems functioning in general, and mobile situation centers in particular, is the problem of information security providing. First of all, this problem requires the development of a classifier of security threats and its specification, information security policy and a complex of organizational measures on confrontation attempts upon organizing unauthorized access to information and software. The starting point in the implementation of this process there can be the work on the identification of risk, the introduction of information security standards, etc.[10] As the main factors of classification of threats to information security serve the following: the level of danger of the effects of the threat; the purposes and motivation of the sources of threats; the threat carrier; signs of manifestation of the threat; mechanisms and tools for the implementation of threats.

2. Research methodology

Nowadays the actual problem for the General Inspectorate for Emergency Situation of the Republic of Moldova is the introduction and improving of information and communication technologies, which ensure:

- quick access to professional and reference information,
- processing of large amounts of information,
- timely response to the situation changes,
- forecasting the development of the situation,
- analysis of the experience accumulated, etc.

All these are supposed to be directly related to the geographical, seismic, technological and social features of the objects.

The situation center of the General Inspectorate for Emergency Situation of the Republic of Moldova has the following objectives:

- gathering information from many different sources (video observation, telemetering, Internet and media analysis, dispatching information systems etc.);
- operational analysis of information (identification of significant events (incidents), their grouping in cascades corresponding to emergency situations);

româno - sârbă (*județul Timiș, România* și *districtul Banatul Central, Serbia*), https://tm.prefectura.mai.gov.ro/wp-content/uploads/sites/22/2017/12/situatii-de-urgenta-situatii-de-risc.pdf.

[9] H. Scheepers, R. Scheepers, *Implementation of Mobile Technology in Organizations: Expanding Individual Use Contexts*, ICIS 2004 Proceedings, Paper 14, http://aisel.aisnet.org/icis2004/14.

[10] O.V. Kazarin, R.A. Sharyapov, V.V. Yashchenko, *Multifactorial classification of threats to information security of cyber-physical systems*, RSUH/RGGU Bulletin, "Information Science. Information Security. Mathematics" Series 2018, No. 1(1); P. Dreyer, T. Jones, K. Klima, J. Oberholtzer, A. Strong, J.W. Welburn, Z. Winkelman, *Estimating the Global Cost of Cyber Risk Methodology and Examples*, RAND CORPORATION 2018, www.rand.org/t/RR2299.

- notification of operators and responsible persons about incidents;
- support of decision making – modeling of emergency situations scenarios, evaluation of their possible effects, providing options to decision makers;
- planning and control of implementation of measures upon emergency situations liquidation;
- retrospective analysis of incidents and actions to eliminate them, planning on this basis of measures aimed at improving emergency situation preparedness.

The task of ensuring security itself can be divided into two: notification of a disaster end organization of an emergency rescue operation. In practice, the management process has been worked out, which is a sequence of targeted actions included in the management, the implementation of which leads to the achievement of the ultimate goal of management as a whole.

The standard list of actions included in the management process embraces:

- determination of management objective,
- assessment of the situation and the initial state in which the control object is located,
- forecasting the development of the situation,
- identification and evaluation of the sequence of actions that collectively are supposed to lead to the achievement of the management goal,
- adoption of the most rational sequence of actions as a management decision.

In evaluating the chosen decision, the main role is played by determining the forces and facilities necessary for the implementation of the solution, the financial costs, the allocation of resources, etc.

The basis of the work carried out on the designing of the Mobile Emergency Operation Centre is the technology of decision-making in crisis situations, which can be marked as organizational and information technologies having a number of common characteristics: they are aimed at increasing the amount of information on the problem; they allow to get specific information that is missing at the moment from the point of view of the person making the decision; they generate alternative variants of solutions that can be compared; they allow you to work in crisis situations, becoming a kind of anti-crisis tools, they combine the efforts of entire teams, creating an appropriate synergetic effect.

The Mobile Emergency Operation Centre development project is based on the following components:

1. Key clients: state specialized services 112, 901, 902 and 903.
2. Information providers: Agency of Financial Relations of the Republic of Moldova; dispatching services.
3. Input data: GSM operators (information about the phone number and its geolocation); information about the caller – the address and description of the initial situation).

4. Output data: the geolocation map of the caller; information about the location of the nearest cars; interview content and questions for the operator; dispatcher response plan; response reports.
5. Users: service operators 112; emergency dispatchers.

3. Obtained results

The main result of this paper is to consider the formulation of the main tasks of the decision-making technology of the Mobile Emergency Operation Center.

The scientific task associated with the development of effective methods, algorithms and programs for conducting a predictive study of the process of functioning of emergency situations management system is of a considerable interest.

Among the many subtasks that, according to the authors, should be addressed within the Mobile Emergency Operation Center, we highlight the following:

- Mobilization plan resources production optimization;
- Optimal distribution of mobilization resources production plan;
- Choice of an optimal technology of mobile resources production

The solution of these subtasks will allow to formulate a list of main activities, a sequence of emergency situations management rules and to determine the list of necessary resources[11].

Thus, while developing an optimal plan of mobilization resources production a multi-criterial extreme problem appears, timely and precise solution of which is possible based on economic-mathematical methods and building appropriate models.

In order to optimize mobilization resources, we will build a mathematical model, considering the following limitations: a need for products(services); a limit of deficit material resources in every category;

- production plan projects;
- planned production capacities considering planned introduction of any new ones.

The following will be used as optimum criteria:

- minimal expenses in production;
- maximal product output;
- maximum benefit from production.

In the outcome of problem solution, an optimal plan is produced satisfying the requirements for production and nomenclature, based on required deficit material resources, available production capacities, corresponding to the goal function extreme value.

[11] S. Ohrimenco, G. Borta, *Optimizing Mobilization Resources in Case of a Disaster*, INFOS-2019.

In order to build a mathematical model, the following symbols will be used:

n - the number of good types to be produced;

i - good type index 1≤i≤n;

m - the amount material resource types to be allocated;

j - resource type index 1≤j≤n;

l - the number of used production resources (equipment, space, etc.);

k - used production resource index, 1≤k≤l

π_i - i-type good production lower limit;

Π_i - i-type good production upper limit;

R_j- j-type material resource limit;

r_ji- j-type material resource amount required in order to produce a unit of i--type good;

Φ_k- k-type production resource calculated fund;

a_ki- k-type production resource progressive norm for an i-type good type;

S_i- i-type good type planned expenses;

C_i- i-type good type effective price;

X_i - i-type good type amount in an optimal plan.

In the abovementioned symbols, the mathematical model may be formulated as follows:

Find the set of unknowns , satisfying the following limit system:

$$\pi_i \le x_i \le \Pi_i, i = \overline{1,n} \quad 1)$$

$$\sum_{i=1}^{n} r_{ji} x_i \le R_j \,, j = \overline{1,m} \quad 2)$$

$$\sum_{i=1}^{n} a_{ki} x_i \le \Phi_k \,, k = \overline{1,l} \quad 3)$$

According to which the function

$$F_1 = \sum_{i=1}^{n} S_i x_i \quad 4)$$

Will assume its minimal value, while the functions

$$F_2 = \sum_{i=1}^{n} (C_i - S_i) x_i \quad 5)$$

Will assume its maximum value.

After the linear programming problem is solved an optimal plan can be singled out or a compromise proposed.

4. Further research

Recognizing the need for the further development of work to improve the Mobile Emergency Operation Center, we consider it necessary to focus on the elaboration of the following important issues.

First, the construction of an information security system tailored to the specificity of the Mobile Emergency Operation Center in accordance with the requirements of the ISO 27000 family standard.

An important role in ensuring information security is played by the development and implementation of an information security policy. This document allows us to define priorities at the conceptual level in the field of information security and outline the main ways to ensure it.

To achieve this goal, it is necessary to solve certain tasks: identifying requirements that must be taken into account when creating a policy; analysis of the main stages of its construction; study of the main content of the sections constituting the information security policy.

When developing an information security policy, a number of requirements should be taken into account. The requirement of legality implies that the security policy being implemented must comply with the existing regulatory framework.

This applies not only to national legislation, but also to international standards adopted and approved at the state level, internal regulatory documents or contracts concluded with third parties and third-party organizations.

The requirement of personal responsibility implies that a responsible person must be appointed — an employee who will be responsible for the security policy throughout its life cycle, i.e., when planning a policy, monitoring its implementation, reviewing, updating, etc.

The requirement of relevance means that the security policy must conform to the ever-changing realities of the General Inspectorate for Emergency Situations, and be updated and revised in accordance with them.

The process of ensuring information security is associated with continuous activity, and not with the development of a specific set of measures and activities. When planning an information security policy, it is necessary to take into account the possibility of the emergence of new threats to the protected information and, in this connection, envisage amending the provisions of the document in question.

The requirement to control information security policy means that the policy should be subjected to an independent external audit to confirm its effectiveness, correct-

ness and compliance with the standards and requirements of regulatory documents.

In the capacity of promising developments we can also underline the following: digital transformation of management processes; digital ecosystem design; designing the form and content of a digital passport of objects; development of digital objects using The 3D "twin" technology; creation of industrial Internet networks, etc.

We consider one of the promising areas of the activity to be working not with specific physical objects, but with its digital copy. The talk is about the processes of creating, analyzing and managing the so-called digital counterparts. It is these processes that will ultimately reduce the risks and costs while working with real physical assets.

We consider it possible to note the need for an "independent" interaction of the digital twin with the physical "original" and vice versa[12]. The physical "original" must transfer data about itself to the digital counterpart, which carries out data analysis. In the data stream, deviations are identified according to certain indicators, models, and transferred to the situational center for decision-making.

The further work should be aimed at the development of the supporting the Mobile Emergency Operation Center subsystems in particular: expansion of the infrastructure of management objects; development of an integrated communication and data transmission network (fixed-line network, radio-mobile network); improving the efficiency of the automated system of interdepartmental information interaction (information and navigation system and warning system); monitoring systems of potentially hazardous objects and territories; information security system.

Conclusion

The considered issues of the design and operation of the Mobile Control Centers are far from exhausting the diversity of the problems of transforming the management processes of the General Inspectorate for Emergency Situation. Solving these problems requires, above all, awareness of the relevance of digitalization issues, the development of selection plans and the introduction of new technologies for collecting, processing and storing unstructured information for preparing emergency situations management solutions.

Thus, the paper proposes an approach used for the design and operation of the Mobile Emergency Operation Centre for the General Inspectorate for Emergency Situation of the Ministry of Internal Affairs of the Republic of Moldova in order to improve the safety of the population's life and infrastructure.

[12] *Analytic Engine for the Digital Power Plant. GE Digital Twin*, https://www.ge.com/digital/sites/default/files/download_assets/Digital-Twin-for-the-digital-power-plant-.pdf; A. Parrott, L. Warshaw, *Industry 4.0 and the Digital Twin. Manufacturing meets its match,* https://www2.deloitte.com/insights/us/en/focus/industry-4-0/digital-twin-technology-smart-factory.html.

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