



HAL
open science

Implementation of effective solutions to the crisis tasks and its regional management

Matúš Grega, Pavel Nečas

► **To cite this version:**

Matúš Grega, Pavel Nečas. Implementation of effective solutions to the crisis tasks and its regional management. *Insights into Regional Development*, 2022, 4 (4), pp.21 - 35. 10.9770/ird.2022.4.4(2) . hal-04242916

HAL Id: hal-04242916

<https://hal.science/hal-04242916v1>

Submitted on 15 Oct 2023

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Publisher

<http://jssidoi.org/esc/home>



IMPLEMENTATION OF EFFECTIVE SOLUTIONS TO THE CRISIS TASKS AND ITS REGIONAL MANAGEMENT *

Matúš Grega ¹, Pavel Nečas ^{2*}

¹ Armed Forces Academy, Demanová 393, 031 01 Liptovský Mikuláš, Slovakia

² Matej Bell University, Kurzmányho 1, 974 01 Banská Bystrica, Slovakia

E-mails: ¹ matus.grega@aos.sk; ^{2*} pavel.necas@umb.sk (Corresponding author)

Received 18 August 2022; accepted 20 October 2022; published 30 December 2022

Abstract. Because of unexpected negative social and natural phenomena, there is a growing need to prepare crisis structures of society, also due to technical and technological progress, which directly affect these facts. The facts defined in the article encourage the social requirement for practical, creative, and interactive training of individuals and teams in the public interest and public administration. The need for adequate preparation should reflect the logical and systematic analysis of dependencies and contexts in all procedures and processes of identifying negative phenomena to encourage and create thought stimuli of crisis staff, which were able to minimize losses and maximize opportunities. The potential of individual types of simulation technologies and their simulation tools is a possible means to achieve the already mentioned requirements for practical training of crisis staff.

Keywords: crisis management; crisis manager; education; simulation technology; financial calculation

Reference to this paper should be made as follows: Grega, M., Nečas, P. 2022. Implementation of effective solutions to the crisis tasks and its regional management. *Insights into Regional Development*, 4(2), 21-35. [http://doi.org/10.9770/IRD.2022.4.4\(2\)](http://doi.org/10.9770/IRD.2022.4.4(2))

JEL Classifications: I18, J28, K10, K22, K37

Additional disciplines political sciences; sociology; information and communication; informatics

1. Introduction

Society and the individual, which is an integral part of it, have constantly encountered security conditions that affected him existentially throughout his existence. From a historical point of view, it is observable that each society was purposefully preparing itself, in a certain way, for already existing and potential threats. Society was able to face, to some extent, avoid, eliminate and even predict the specifics of security conditions. Hazards arising from natural patterns, such as windstorms with torrential rains and subsequent floods, devastating fires, earthquakes, etc., but also direct anthropogenic threats, such as war clashes, industrial cataclysms and catastrophic and apocalyptic manifestations thereof, were accompanying features when the individual and society learned to

* This work was supported by the Slovak Research and Development Agency under the contract No. APVV-20-0334.

manage and control the patterns arising from them, they were forced to face them directly. They had to take measures to ensure historically conditioned security. (Blažek, 2014)

Following the threats, the field of public administration has structurally and in terms of content created and gradually became an essential tool of management function. This management function was used and shared by the elements of social system management, which ensure the operation of the society in all its areas of existence and represent public administration and the public interest. The facts mentioned above directly affected and, in a way, created the conditions for actions and works associated with the management function of responsible individuals or groups to begin to fulfil the tasks that result from the specific functions of crisis management as a functioning unit. (Hašanová, Dudor, 2014)

Ensuring basic internal security processes and areas, such as defence, protection, external and internal security, and security of the social apparatus (state or individual) represents important attributes that activate, stimulate and thus directly affect the components of public administration. From a historical point of view, analysis of knowledge and experience and scientific research, the fundamental pillars of public administration - the authorities, in terms of opinion, and legislation, jointly or separately, participated in creating and ensuring the security of states, their citizens and other elements that make up the security environment. The development of a public administration system is an ongoing process in which ties are permanently managed, responsibilities updated, new relationships defined, competencies and implemented administrative national and international standards, the application of which is subject to a specific component of public administration, are strengthened. Despite the constant improvement of ties, procedures, and processes in matters of communication, decision-making, control, planning, executive, execution, etc., historical development in the area has failed to prevent the emergence of newly created crises, phenomena and situations that public administration authority has to face and for which they must be well prepared.

In these intentions, it is necessary to realize that crisis phenomena and situations have been and will continue to accompany individuals and communities. They are a particular representative of the interaction of the individual with society, the mutual exchange of societies and individuals, and humanity's interaction with its external environment. This is the impact of the adverse effects on the individual and community. Their specifics and common denominators are:

- complicated prediction,
- destabilization of social and natural balance,
- destabilization of system subjects and their subsystems,
- a direct threat to individuals, society, and their mutual ties,
- Destruction of cultural, social, and historical values.

Crisis phenomena directly but indirectly affect the economy, politics, and infrastructure of the community negatively; they also affect the lives of individuals, biosocial groups, their health, and material goods and, to a significant extent, negatively destabilize the natural and socio-social aspects of an individual's life. Experience shows that the invoice value of lost or degraded goods, health and capacity constraints of logistics infrastructure represent only a visible part of the costs and losses of companies. (Korecki, Adámková, 2020)

2. Crisis management as a complex system

The concept of crisis management in a regional public arena has resonated for a long time. It has been the subject of frequent scientific controversies and interpretations in the theory of law, politics, economics, and the community. One may consider the following entities as being relevant elements of the system.

Public administration

In general, an opinion has been settled that public administration consists of two primary components, namely state administration and self-governance, which realize public interest activities. Its main features are activity, initiative, determination, and focus on shaping the future while complying with the law and learning general tasks. Public administration can also be understood as a complex of methods, measures, ways and procedures that put the mechanism of economic policy in place, ensuring its objectives, regulation and development. This clearly shows the interrelationship between economic policy and public administration, as economic policy cannot exist without public administration and public administration loses its importance without economic policy. In this context, a more precise definition by the authors Strecková and Malý has a deeper meaning and substance: "The public administration is represented by the performance of self-administration and state administration, because the sector is financed from public finances and public finances are formed from sources of the population, there is no entity available for public sector management other than the public administration". (Strecková, Malý, 1998, p.25).

Security system

The security system is representative of a complex of elements and means to ensure the safety and protection of lives, human health and property. It represents an integrator of elementary beams of security, institutional and system elements for its security. It is created based on risk identification, analysis, evaluation and taking the following measures to ensure security. Using the method of multitude quantitative risk analysis using mutual correlation, the dependency of the management structure of the selected critical infrastructure area is then determined, which is expressed by the mutual relation of identified risks. (Korecki, Adámková, 2018)

The created security system must represent a set of applications to have the qualities, which will enable it to ensure different levels of survival and functioning of the social whole in case of expected or unexpected threats. To ensure the required basic tasks, this system is designed to be open, flexible and evolving, with multiple interconnected networks of relationships in individual levels and levels of system and subsystems subjects, which allows it to respond adequately, to react to potential as well as natural threats (Ivančík, 2019). The primary qualitative attributes of a social security system include, for example, the ability to: analyze the security environment; identify and classify national security risks and threats and trends; identify procedures and measures to prevent or eliminate security risks and threats; ensure their continued readiness and ability to act (Ivančík, 2021); identify crisis solutions in line with current resources and capacities; ensure effective management of forces and aids in prevention, readiness to manage crises, adequate reactions and responses to the activated source of threat during an emergency, to mitigate and eliminate the consequences of situations and to create conditions for the renewal and development of society. Many of the tasks and requirements placed on the security system and its creation were often carried out in contrast to the situation, that the readiness of the system to act, to be adequately prepared for real as well as potential threats, could only be verified during an actual emergency or crisis. Experimenting with the security of society, states, and humanity is risky and possible only to a limited extent, so attention in this area has also focused on using crisis scenarios.

The gained experience and knowledge from personal crises of human society - natural disasters (floods, volcanic eruptions, earthquakes, extreme climatic fluctuations, etc.), technical and technological accidents (accidents of nuclear power plants, chemical plants, etc.), war conflicts (world and local war conflicts, the possibility to use weapons of mass destruction, etc.) were scientifically systematized. Attention was paid to the use of crisis scenarios in the crisis management system of public administration at all levels and areas.

The assumption that crisis scenarios are an effective and inexpensive tool for "managing" the adverse effects of crises, protection of lives, health and property of citizens and society, environment, defence and security interests has been confirmed. The growth of the close connection between the gained experience and scientific knowledge increased the importance of crisis scenarios for society. They became an essential part of theoretical and practical

activity in the security field, an important starting point for security policy and the creation of national security systems. In the current understanding, crisis scenarios result from recognizing the need to prepare society and individuals for threats and crises, the starting point for creating threats and problems identification tools, and mitigation or elimination of their adverse effects.

Crisis scenario

In the theory and practice of crisis management in public administration, we are increasingly facing the issue of crisis scenarios, which are the result of knowledge and risk assessment, as well as the development of the security environment. Crisis scenarios in public administration are based on historical experience and the degree of knowledge of their nature. The development of scientific knowledge in fields such as security risk theory, sociology, public administration theory, etc., enabled a deeper penetration into the essence of security, processes and mechanisms of ensuring it (security) as much as possible. At the same time, it enabled the transfer of scientific knowledge into crisis scenarios.

Throughout historical development, humans and their various social communities have encountered multiple forms of danger, threat, risk and the resulting crises. The historical stage of development of human society determined to what extent a particular community consciously prepared for natural as well as potential forms of threat and was able to prevent, confront or mitigate their harmful effects. Man, and human society, throughout their lives, have always encountered specific states of the security environment that have influenced it existentially as well as security, but also which he created by himself. In the historical development, emerged, structurally and in terms of content grew the field of public administration, which became a type of management activity by which the subjects of social system management carry out the course of the society in all areas of its existence and which constitutes public administration and management in the "public interest."

The attention of society was focused on the primary sources of danger, threats, risks, and the resulting crises, which it most frequently encountered in its historical development and whose destructive factors and extent was the greatest. Initially, supernatural forces were considered sources of threats depending on the development of science and human knowledge. They were gradually replaced by an approach that accepts the knowledge of natural and social pressures and their development patterns. Based on the gradual scientific penetration into their essence, three large groups of threat sources were created in the system of opinions: a congenial group of natural sources of threat, a congenial group of civilization sources of threat, and a disparate group of their combinations. We also encounter a simplified approach that presents the dangers, hazards, risks, and crises resulting from them in two large disparate groups, namely non-military and military threats. These are understood as:

- Non-military threats are real destructive potencies, the activation of which can lead to significant deterioration and weakening of the economic and security function of the state due to the action of natural, economic, internal, and international forces. Non-military threats must also be understood and analyzed in terms of mutual determination, accumulation, and the possibility of the emergence of an individual threats chain reaction, which may result in larger-scale threats. Non-military forces and means are used in the first place to eliminate them.
- Military threats represent such groups of activities of a state or coalition of states or organizations (especially terrorist ones) that endanger the security of coalitions of states or the state, comprising mainly the immediate use of military forces and means, as well as the mediated indirect use of military forces and means. The military threats associated with armed violence have become an area of exquisite growth in the historical development of humanity, even though it reflects a sad place in our history.

These groups of threats also correspond to crises:

- Non-military crisis - a crisis caused by the impact of natural disasters, technical and technological accidents, as well as the action of social forces. This type of crisis is in the legal norms of our state expressed in terms of an emergency state of emergency.
- Military crisis - a crisis that arose because of the threat of use or use of military force, which is expressed in our legal system in terms of the state of war, war.

Crises have different durations and intensities of harmful and destructive phenomena and affect different sizes of territories and numbers of people. They are the carriers of processes with a high degree of uncertainty for society and man. They hurt various areas of society; they can accumulate several random phenomena and trigger other destructive cycles. The core of the crisis consists of unexpected negative phenomena and their impact on the human, social system, social infrastructure, and the environment.

Crisis management in public administration

Crisis management in public administration represents a specifically hierarchical and fully functional system of public authorities and organizations, their ties, where their competencies and responsibilities are set. The output of this system is the implementation of approaches, opinions, experiences, recommendations, measures, and decisions. The general terminology about crisis management refers to solving various undesirable conditions. The first use of the term crisis management is highly debatable, but consensus prevails in the area where it was applied for the first time, and that is politics. In the 1970s, when the term crisis management became more widely used, the term began to be used in theories of business economics. However, its definitions differed, and the interpretation took different forms. Howard Chase and his colleague Barry Jones were the first, who try to define the term. They described crisis management as "an unsettled matter which is ready for decision" (Chase, 1984).

Today several definitions depending on the field in which it is applied (Bilczak, 2021; Rak et al., 2022). However, the essence remains unchanged. Crisis management represents a specific form of management that has a high degree of priority, and its main tasks are (Šenovský, Adamec, 2004):

- crisis state prevention,
- crisis state overcoming.

Prevention means undergoing critical processes using appropriate forecasting, analytical and management methods that allow the system to be protected and do not allow these essential processes to expand. Overcoming means a precisely oriented, thoughtful, and targeted reaction that recovers an incompetent, destroyed, or damaged system.

Public administration versus crisis management

In terms of universal definitions, it is possible to derive the meaning of crisis management for public administration. Crisis management in the context of public administration is understood as a set of tasks and measures that the administration performs independently or in cooperation with other organizations before, during and after crises to ensure the protection and security of the population. In a broader sense, these are:

- preservation and maintenance of public administration functionality,
- maintenance of population health,
- ensuring the availability of vital services to the population,
- ensuring vital material,
- securing private and public property,
- ensuring public order,
- preservation of cooperative activities of state rescue and security forces,
- ensuring informedness and
- provision of humanitarian aid.

Crisis management in public administration represents a specifically hierarchical and fully functional system of public authorities and organizations, their ties, where their competencies and responsibilities are set. The output of this system is the implementation of approaches, opinions, experiences, recommendations, measures, and decisions. Thus, crisis management represents a complex task whose primary goal is correction, prevention, contraction, reduction, and reconstruction. The problematic tasks and their goals should be based on a holistic point of view, i.e., that crisis state prevention and preparedness are both part of the process and partial tactical steps taken until the crisis occurs. This complex of tasks and their goals represents a closed circle because, after the elimination of a crisis state, there is a period of preparation for the future crisis state. (Figure 1)

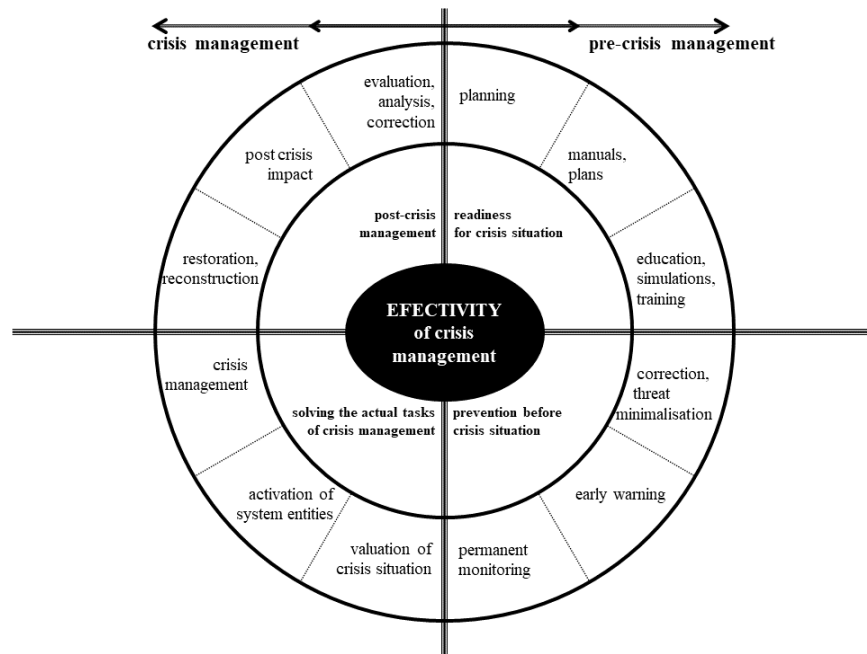


Fig. 1. Complex tasks and their goals by period

Source: Jaques (2007)

A specific group of managers, namely crisis managers, was also identified by introducing and defining the term crisis management. Tasks connected to crisis management performed by a crisis manager are not usually a decision of one person but rather are served by several crisis managers (experts in specific fields) who are members of the crisis staff. The crisis staff implements complex tasks and measures before, during and after the crisis.

The security system, as a representative of a complex of elements and means in solving the tasks of crisis management in public administration, must have elementary attributes without which such a system would not work:

- Broad-spectrum and centrality define the participatory approaches of individual components. The components are in coherence with each other, where the structure, hierarchy and responsibilities are precisely defined, and these components are effectively influenced and guided.
- Legitimacy and legality, which are defined by the law order of the Republic, by respecting the results of regional and parliamentary elections, as well as by applying international standards and obligations.

- Control and transparency exist where effective feedback mechanisms allow for evaluating the taken decisions and the planned decisions, especially in the competencies and responsibilities of crisis managers.
- Versatility is representative of the continuous functioning of the system in both crisis and "non-crisis" states.

Functions of crisis management of public administration authorities functionally (functional dimension) carry out a complex of tasks. These functions represent another elementary framework that cannot be neglected and whose primary goal is:

Correction - which means minimizing the resources or causes that precede the crisis state.

Prevention - which means preparing for action in a crisis state. The need to apply preventive measures, renewal and revision of emergency, alarm, crisis plans, joint operational procedures, etc.

Counter(re)action - active involvement in the emergence and gradation of the crisis state. The competent authorities need an erudite and practical approach based on early warning, notification, activation, analysis, and adoption of appropriate measures and decisions.

Reduction - minimizing the outbreaks of crisis states and eliminating their adverse effects. The executive needs a coordinated approach and an active process by the managing authorities.

Reconstruction means eliminating the consequences of a crisis state and returning to the state before the crisis state (stabilized condition). The need to stop the effects that caused a crisis state and take such decisions and measures that ensure that the recurrence of the crisis state is minimized.

The institutional dimension of crisis management of public administration authorities is presented as a competently integrated system of elements of crisis management. It is divided into management and executive components, which have a certain economic autonomy.

Crisis staff and crisis manager

The crisis staff is a working body of the statutory crisis management body serving their need to coordinate the intervening components and other elements in the cooperation of the components of the integrated rescue system in joint intervention and in resolving the crisis state. An inseparable assumption for ensuring the correct and efficient functioning of the crisis staff is its erudite and well-prepared staff.

The crisis manager, as a person, a member of the crisis staff, should be a representative of an effective, efficient and vigorous response, a representative of reception, analysis and correct evaluation of information and reports, as well as a representative of rationality, tolerance and complexity, when resolving a specific crisis state. The members of the crisis staff should form a group of erudite people who are efficient and united, where each member-element knows what his duties and competencies are. He is also aware that in resolving a crisis state, he must make quick and especially correct decisions under the stress factor of not only time. These reasons also represent a constant need for effective and efficient training for crisis managers. Training crisis managers is one of the essential elements to acquiring the necessary expertise and technical and technological readiness for solving potential crisis states and their management. (Grega, 2014)

The area crisis managers training should be prepared to prevent the occurrence of possible crisis states, ensure preparation for dealing with potential emergencies, ensure a well-founded solution to troubles within their competence at individual levels, solve tasks from superior authorities, also implementing measures to eliminate consequences of crisis states and the distribution of instructions to the executive elements involved in this process, is at a superficial level.

Crisis manager competencies

The abovementioned circumstances and facts point to the need for well-prepared staff. Nevertheless, what makes a crisis manager the right element in this system, what competencies should he have, and what negative factors should he eliminate when dealing with crises?

Decision-making is the most important function of managers at all levels of management, and all managerial procedures include decision-making. Decision-making, acceptance of a decision represents the principle of choice in the presence of several options by which a common goal can be achieved. Bad decisions by the crisis staff are often the result of an inability to consider all the contexts and doubts about the assumptions. The decision results in a consensus. However, it is acceptable only if it has not been adopted very quickly, given that unanimity does not prevail in the crisis staff because it suppresses the motivation to evaluate alternatives realistically.

The public administration crisis manager must consider the worst-case scenario when dealing with a crisis state. He must be adequately prepared for this state, and whereas he works in the public interest, he is the first to prevent the spread of panic, and he must be the first to inform the population and the media. The crisis manager takes preventive measures in the public interest to prevent the gradation of negative phenomena and must be able to evaluate what is a priority and paramount in a given situation.

3. Simulations

People want to be informed and prepared for the possible existence of incoming threats that could affect families, municipalities and cities, districts, or entire countries in any way. How to protect lives and properties, societies and their values? These denominators characterized the perception of security and readiness to respond correctly. The level of protection of specific fields, such as demography, the economy, the social and environmental field, and the political, reflects every society. In an unexpected, unplanned emergency, society must take appropriate measures to minimize negative phenomena (Cayirci, Marincic, 2009). The forces and means that must be used to protect population, property and social values are elements of the national security system. These elements must include all managerial, executive, operational and other components that must have different skills, such as the ability to communicate, make effective decisions, cooperate, cope with stress load, etc. Maintenance of these skills requires continuous and regular training using a variety of training methods based on simulation technologies. (Žentek, Nečas, 2020)

Simulations from the beginning, when implemented into the education and training environment, reflected the need to increase the effectiveness of staff training (from individual to coordinated staff) for events and situations that are very difficult to implement - to prepare in a natural environment. The benefits resulting from the implementation of individual types of simulations and their tools point to the growing interest and social need for their usage in the process of staff training in the field of management, coordination, and cooperation:

- improving the decision-making and planning process of staff (both civilian and military) in the preparation, planning and management of operations,
- obtaining alternative and backup solutions,
- risk reduction,
- saving staff capacity and time,
- minimizing adverse effects on the ecological environment, and
- saving costs and materials.

Any simulation of activities in terms of military and non-military operations is carried out on an appropriate, specific model based on statistical, mathematical, analytical methods, or a combination thereof, and on the widespread use of modern computer and information technologies. The method and methodological procedure of

its implementation depend mainly on the type of simulation used and the parameters of the created model at which the simulation is performed. Simulation has many advantages that encourage its constant development and expansion into new spheres and areas. Influenced by the development of the information-communication base, its potential is constantly enhancing. At present, simulation technologies have fully established themselves in the educational and training environment in the form of:

1. instrumented simulation (also referred to as live simulation),
2. virtual simulation,
3. constructive simulation and
4. distributed simulation, resp. blended simulation

Of course, there are many divisions and views on simulations. They can be classified according to approaches, according to the capacity of primary and secondary training elements (staff, tactical, operational, etc.), according to calculation methods (deterministic, stochastic, static, or dynamic), or also according to the end-user determination (military, police, medical, etc.). The simulation generally consists of five main parts (Cayirci, Marincic, 2009), resp. should consider the following aspects:

- simulation of performances that are performed in the simulation,
- models that provide real representations,
- input data that provide model definition,
- a visualization that shows the results of the simulation,
- communication that serves as a data interface.

Constructive simulation

Constructive simulation is the most used, in terms of time, the longest applied and the most used simulation, with a universal utilization and a wide range of uses. It is often referred to as the universal method. “The core of the constructive simulation is the usage of logical-mathematical models which are expressed usually by equations or systems of mathematical equations, inequalities (algebraic, differential, integral, etc.) and by algorithms or systems of closed or opened algorithms, while parameters (constant, variables) and interrelationships of these systems have deterministic or stochastic interpretation of material-energetic or thought-information objects and processes of armed encounter or conflict situation.” (Rybár, 2000).

Today, computer technologies and software solutions are fully applied, where the relationships and dependencies of mathematical-logical interpretation are implemented. It is usually used in a distributed form, where several computing systems are connected via a computer network, or it can also be applied separately on a specialized hardware element. Constructive simulation is thoroughly used in training staff responsible for an operation or situation's planning and decision-making phase. In this way, the staff is trained in individual staff positions and management functions in the process of command, control, and verification of planning and decision-making activities.

A constructive simulation can also be specified as an artificial entity (model) representative of a man with actual behaviour, a natural technique, or specific units or wholes. Such a model is defined according to real data regarding its tactical-technical data, behaviour, and representation. In a constructive simulation, a real object (being, vehicle, technical device, system, living creature, etc.) is replaced by a model - an entity. It is, therefore, a simulation where synthetic beings, vehicles, systems, or technical devices move in a virtual environment and, depending on the simulated activities, also appropriately perform the assigned tasks. (Hubáček, Hausner, Vráb, 2013) Artificial entities behave according to defined algorithms, programmed in separate property classes (entity behaviour level). These models - entities based on interactions and defined semi-automatics can be divided into:

- deterministic - those that contain only precisely determining relationships (algorithms),

- stochastic - those that have at least one relationship with the generated variable; other relationships are deterministic,
- an entity with intelligence imitated by the properties of application programs, i.e., artificial intelligence.

Constructive simulation is based on mathematical methods and has many advantages that stimulate its constant development and expansion into new application areas in education and training. Like any other simulation method, constructive simulation has certain drawbacks and limitations. The main advantages of productive simulation methods include that (Grega, Bučka, 2013):

- it allows for simulating sources of threat and destructive processes of destruction during a crisis economically and efficiently,
- it allows the creation of an environment that is very similar to the real conditions of the emergency and the stages of the crisis,
- it will enable the simulation of a situation taking place in different geographical regions, in different climatic conditions, with various forces and means,
- constructive simulation models form important components also in other types of simulations and crisis management activities; they represent a universal unifying basis for all groups of simulations,
- reduce the damages caused by training from an ecological point of view, and the environment is not bothered by such training,
- its universality results from the applied mathematical basis,
- quantification of phenomena and processes enables their more accurate analysis in the decision-making activity of management authorities,
- it allows to model and simulation, at any level of similarity or with any degree of generalization, objects, phenomena and processes at the selected level (tactical, operational, strategic),
- it allows an objective expression of the influence of the terrain and other environmental factors on the processes of the crisis, as well as on the activity of crisis management,
- it gives the possibility of quality registration of the course of training and their use for a more objective evaluation of their results and formulation of conclusions and recommendations for theory and practice,
- the usability of constructive simulation in problem-solving crisis management is evident,
- it mediates the possibility of interconnecting constructive simulation systems with simulation systems of other categories,
- sets a measurable factor to determine the results of the operation of individuals and teams,
- it documents the course of solving the situation in 2D and 3D display,
- offers partial and complex statistical data,
- it records the planned and actual activity of the units,
- it allows searching for optimal solutions using forces and resources,
- it will enable crisis managers to take risks due to their own decisions.

As mentioned above, constructive simulation is usually implemented in a distributed form. Its basis is the implementation of the so-called Computer Assisted Exercise (CAX). Such form of training can be characterized as a sophisticated method of training commanders, managers, officials, and crisis staff members of the state, by which simulated processes and phenomena are potentially emerging or developing in carrying out the specified activity of the decision-making process, planning process or command and control process. Computers simulate processes and phenomena in the real or specified time and environment to give training entities the impression of performing real operations and activities as if they were performed in a natural setting and actual conditions. Constructive simulations and their computer-assisted exercises are excellent training and education in crisis management, mainly due to their versatility, broad application support and ease of implementation.

Simulation tools and their technologies are currently a global leader in training commanders, staff and participating units in their subordination and cooperation to solve crisis management tasks. There is no doubt that a well-prepared crisis staff and its members are the basis for the successful resolution of crises, primarily in matters of domestic crisis management and in cases of crisis management at the international level.

4. Training effectiveness and evaluation

The use of constructive simulation for staff and managers training will expand only if its usage is practical (especially more financially advantageous) compared to other training methods, by which the intervening components of crisis management are prepared to fulfil their tasks. The exact methodology for calculating the cost of conducting training by live simulation (training in natural conditions) and for the relevant calculation of the expenses of constructive simulation does not yet exist. The evaluation mentioned in (1) is focused on the content of the training and is not applicable to evaluate the financial demands of the training. However, a simplified model can be developed that can be used for comparative analysis in certain circumstances. The basis of the training effectiveness calculation model is the premise that in the analytical relationship for cost calculation are accepted identical variables characterizing a given phenomenon, process, or behaviour from both constructive and live simulations. (Žentek, Bučka, 2019)

The relationship for calculating the costs associated with the N_{cv} training can be expressed by equation (1):

$$N_{cv} = N_a + N_b + N_t + N_p + N_n,$$

Wherein:

N_a are the costs of using the machinery in training in [€],

N_b are the costs of renting the premises for training in [€],

N_t are the costs of using the technical means for intervention (action) in [€],

N_p are the costs of supporting the training in [€],

N_n are (for now) unspecified costs in [€].

The variable N_a represents the costs of using all types of machinery in training (passenger, transport, goods and special vehicles, aircraft, reconnaissance aircraft, etc.). Its value can be expressed by equation (2).

$$N_a = \sum_{j=1}^n a_j \cdot l_j \cdot c_j$$

Wherein:

a_j is the number of j machinery used in training,

l_j is the number of kilometres the j machinery will cover (covered) during the training in [km],

c_k are the costs of j machinery per 1 km of driving in [€/km].

Live simulation (training in real terrain) can take place on premises, the use of which is conditioned by payment for rent. The calculation of its value is based on the price per m² of the j area (c_j) multiplied by the total used j area (P_j), or the total invoiced value is substituted into equation 2.

The N_b calculation can be performed according to equation (3).

$$N_b = \sum_{n=1}^j P_j \cdot c_j$$

Wherein:

P_j is the area of the j land used for training in [m^2],

c_j is the price per 1 m^2 of the j land in [$€/m^2$].

The costs of using technical means N_t represents the sum of funds, that must be spent for their use in training. The category of technical means refers to, for example, power plants for special power supplies and for powering other means (communication technology, computing technology, etc.). Equation (4) can be used to calculate these costs.

$$N_t = \sum_{n=1}^i t_i \cdot c_i$$

Wherein:

t_i is the time of use of the i technical means for training in hours,

c_i is the price of using the i technical means (operating costs) per 1 hour [$€/hour$].

The costs for supporting the N_p training in Equation 4 represent the estimated or spent funds needed to support the training. This group can include, for example, the fees for training figurants, simulation system operators, etc., i.e., for people who are not trainers but whose work is necessary for the course of the training. These costs can be calculated using equation (5).

$$N_p = \sum_{n=1}^i t_i \cdot c_i$$

Wherein:

t_i is the total time of deployment of i person to support the training in [hours],

c_i is the i person's hourly fee in [$€/hour$].

The N_n costs represent unforeseen, unpredictable, additional costs that may arise during training. This category of costs can include costs for dealing with damage caused to materials, machinery, property of the population, etc., in direct and indirect connection with the training.

A coefficient k can increase the total cost of the training or its components N_x , wherein k is the coefficient of tolerance of the population and its value is in the range [$k \geq 1$]. The coefficient k is dimensionless, and the value "1" means that the training is not perceived negatively by the population that does not participate in the training. The population participating in the training is included in the variable N_p (for example, in the category of figurants). If the population does not tolerate the training (because of restrictions, etc.), the coefficient k is greater than 1. The limit of the coefficient cannot be determined precisely yet, and its value will be estimated.

The overall effectiveness of the training is then evaluated as the ratio of the financial costs of live simulation training and training performed by constructive simulation. The verification of the described model was not exactly verified in the training conditions. Only an empirical comparison of training by constructive simulation with the equivalent of exercise performed in natural conditions (e.g., command and staff training in the military training area) was performed. The calculation showed that the training performed with the support of constructive simulation reaches the cost of about 10% of the cost of the training performed in real terrain. It can be assumed that in training on the components of crisis management using constructive simulation, a comparable value of training efficiency will be achieved. The costs associated with the catering for trainees and support elements, with their accommodation, the wage costs of trainees were not included in the calculations of the estimates, nor in the above model, as these costs are in many cases comparable regardless of whether the exercise is performed by constructive or live simulation. Accurate cost and training efficiency calculations are not yet possible because the data needed for the analysis are not available in 100% of cases.

Training using constructive simulation has been used by the armies of many countries for many years and brings results in the exercise of commanders and staff. Even in the case of this technology, it is becoming more and more widespread. In connection with this, its price is gradually falling, and the technology of constructive simulation is slowly beginning to be used outside the army. It is logical that the training of police and security forces, as well as rescuers, is another area into which this technology penetrates. Of course, the acquisition costs of simulation tools are not minor and will initially seem significantly higher than the cost of training in real conditions. Such activity cannot be replaced even by the perfect simulator, and the training of powerful elements must take place in a real environment with real equipment. However, only a limited number of people and machinery can participate in such training. Thus, lower management and performance elements are usually participating. A considerable complex training, with the participation of hundreds or thousands of intervening persons and dozens of special machineries, cannot be prepared in real conditions. Therefore, even the highest levels of management do not have adequate resources with an excellent response to their training. For these levels, the training using constructive simulation tools is tailor-made.

Individual training can be modified; it is possible to prepare various scenarios, move in space and not limit regular operation. For essential functions, live training remains the most important. Training using constructive simulation provides new opportunities in an almost real environment and expands training opportunities to an unprecedented extent. It allows preparing new members who can make mistakes during training without the risk of life-threatening and causing great material or other losses. The participants of such complex training can thus prepare to deal with real crises. The simulation can be repeated countless times with different staff, compare various solutions and learn from each other, gain new information, learn, look for weak points in the plans and improve before deploying. As in the case of the training of military rescuers, in future, the usage of constructive simulation can be expected for firefighters and civilian rescuers, including members of the crisis staff. Well-prepared control components can better coordinate rescue operations and prevent loss of life and material damage. As shown by the experience of floods in recent years, preparedness for crises is one of the primary conditions for successful interventions in a large area. However, it is better to gather this experience in a simulator than in a natural disaster at the cost of loss of life, destroyed houses, damaged infrastructure and other damage, especially if the actual training using the simulation is much cheaper than the same training in terrain. (Žentek, Grega, 2017)

Conclusions

The system of regional public administration is responsible for the human individual, their potential and the action of a particular societal group. It is the one which is the bearer of progress and modernization. But despite optimization procedures and methods, modern methods of work, the individual or the whole is unable to act

effectively in a matter of crises management unless it is qualified, well professionally erudite, technically and technologically prepared to deal with potential concerns (Andrassy, Grega, Nečas, 2018). The functionality of public administration in connection with organizational and managerial problems is integrated into the principal theoretical and practical demands, which are constantly discussed in the past and present. Interventions in this system, in its organizational structures, tend to be fundamental and substantial because their functional impact has a broad scope in the life of society in all its areas. (Šimák, 2006).

Modelling and simulation, aimed at optimizing activities using experimentation with a created computer model built into a real synthetic environment, provide an effective and efficient form of preparation and development of the characteristics and behaviour of individuals and groups. They appear to be a progressive means of training commanders and staff to find solutions to crises and acquiring habits and skills in individual and particular activities. Simulation technologies are therefore becoming a significant subject increasing the preparedness of individuals and groups in the frame of regional public administration, as a key to achieving training priorities because they can realistically simulate activities and prepare personnel to deal with complicated non-military and military operations of national as well as domestic crisis management.

References

- Andrassy, V., Grega, M., Nečas, P. 2018. Crisis management and simulations: scientific monograph. Ostrowiec Świętokrzyski: Published by Wyższa Szkoła Biznesu i Przedsiębiorczości w Ostrowcu Świętokrzyskim. ISBN 978-83-64557-33-0.
- Bilczak, M. 2021. Crisis diagnosis in cross-border region: lessons from the pandemic. *Entrepreneurship and Sustainability Issues*, 9(2), 223-237. [http://doi.org/10.9770/jesi.2021.9.2\(15\)](http://doi.org/10.9770/jesi.2021.9.2(15))
- Blažek, V. 2014. Východiská tvorby krízových scenárov pre potreby vzdelávania na APZ v Bratislave (The starting points for the creation of crisis scenarios for educational needs at APZ in Bratislava). Bratislava: Published by Academy of Police Forces.
- Cayirci, E., Marincic, D. 2009. Computer assisted exercises and training: A reference guide. Hoboken, (N.J.): Published by John Wiley. <https://doi.org/10.1002/9780470498620>
- Grega, M. 2014. Vzdelávanie krízových manažérov s podporou simulačných technológií (Education of crisis managers with the support of simulation technologies). In: Bezpečnosť, spoľahlivosť a rizika. Liberec: Technical University.
- Hašanová, J., Dudor, L. 2014. Základy správneho práva (Basics of administrative law). Plzeň: Published by Aleš Čeňek.
- Hubaček, M., Hausner, D., Vráb, V. 2013. The Use of Simulation Technologies in the Preparation for New Types of Operations. *Vojenské Rozhledy*, 22. <https://doi.org/10.3849/2336-2995.22.2013.01.149-159>
- Chase, W. H. 1984. Issue Management - Origins of the Future. Stamford, CT: Published by Issue Action Publications.
- Ivančík, R. 2019. Quo Vadis európska obrana a bezpečnosť (Quo Vadis European defense and security). *Politické Vedy*, 22(3), 47-67. ISSN 1335-2741. <https://doi.org/10.24040/politickevedy.2019.22.3.47-67>
- Ivančík, R. 2021. Informačná vojna - jeden z multidisciplinárnych fenoménov súčasnej ľudskej spoločnosti (Information war - one of the multidisciplinary phenomena of contemporary human society). *Politické Vedy*, 24(1), 135-152. ISSN 1335-2741. <https://doi.org/10.24040/politickevedy.2021.24.1.135-152>
- Jaques, T. (2007). Issue management and crisis management: An integrated, non-linear, relational construct. *Public Relations Review*, 33, 147-157. <https://doi.org/10.1016/j.pubrev.2007.02.001>
- Korecki, Z., Adámková, B. 2020. Multi-criteria evaluation of critical infrastructure resilience and economic impacts in selected airports in the Czech Republic. *Zeszyty Naukowe. Transport/Politechnika Śląska*. ISSN 0209-3324. 108, 95-+. <https://doi.org/10.20858/sjsutst.2020.108.9>

Korecki, Z., Adámková, B. 2018. Implement policies and processes to increase the level of security of the multi-tier logistics chain. In: In: 2018 XIII International Scientific Conference-New Trends in Aviation Development (NTAD). IEEE, 2018. p. 1-6. ISBN 978-153867918-0. <https://doi.org/10.1109/NTAD.2018.8551684>

Rak, R., Kopencova, D., Sulc, F., Vlach, F., Hudecova, V. 2022. Crisis Development and its management. *Entrepreneurship and Sustainability Issues*, 9(3), 414-428. [http://doi.org/10.9770/jesi.2022.9.3\(25\)](http://doi.org/10.9770/jesi.2022.9.3(25))

Strečková, Y., Malý, I. et col. 1998. Veřejná ekonomie pro školu i praxi. (Public economics for school and practice) Praha: Published by Computer Press.

Šimák, L. 2006. Manažment rizík (Risk management). Žilina: Published by University of Žilina.

Šenovský, M., Adamec, V. 2004. Základy krízového manažmentu (Basics of crisis management). Ostrava: Published by SPBI.

Žentek, M., Bučka, P. 2019. Safety model scenarios in the synthetic air traffic management environment on bases of LETVIS real information system. In: New Trends in Aviation Development 2019. Institute of Electrical and Electronics Engineers. ISBN 978-1-7281-4078-0, 218-222. <https://doi.org/10.1109/NTAD.2019.8875569>

Žentek, M., Grega, M. 2017. Simulation tools in the armed forces interfaced by the operational design. *Revista Academiei Fortelor Terestre*. ISSN 1582-6384. 22(2 (86)), 134-140. <https://doi.org/10.1515/raft-2017-0019>

Žentek, M., Nečas, P. 2020. European air C2 system national requirements. *Incas Bulletin*. ISSN 2066-8201 12(1), 249-260. <https://doi.org/10.13111/2066-8201.2020.12.1.24>

Funding: This work was supported by the Slovak Research and Development Agency under the contract No. APVV-20-0334.

Author Contributions: The authors contributed qually.

Matúš GREGA, Dipl.Eng, PhD. is the researcher in Simulation Centre in Armed Forces Academy in Liptovský Mikuláš, where he deals with the issue of simulation tools and their application to the environment of education and training of crisis management personnel. He is the author and co-author of many scientific and professional monographs, articles, scripts and studies dealing with modeling and simulation, security and crisis management. He is the author of many research reports of national and international science and research projects. He was 6 years active in the Science and Technology Organization of NATO in the Modeling and Simulation Group.

ORCID ID: <https://orcid.org/0000-0003-1065-2355>

Pavel NEČAS, Dr.h.c. Prof. Dipl. Eng. PhD., MBA is professor at the Department of Security Studies and the Vice-Dean at the Faculty of Political Science and International Relations of Matej Bel University in Banská Bystrica. His research is focused on political-military strategic issues, particularly in defence and security policy, international relations, and international security studies. HE is an experienced European researcher and the author of several monographs, books, papers and articles related to the political sciences, security and defence published worldwide.

ORCID ID: <https://orcid.org/0000-0001-7743-0453>

Copyright © 2022 by author(s) and VsI Entrepreneurship and Sustainability Center

This work is licensed under the Creative Commons Attribution International License (CC BY).

<http://creativecommons.org/licenses/by/4.0/>

