SIMULATION SYSTEMS IN CRISIS MANAGEMENT. SELECTED EXAMPLES

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ABSTRACT

The paper presents an overview of simulation systems used by state institutions and centres dealing with crisis management science. Computer simulations, Crisis Management in particular,find more and more supporters among the representatives of the security sciences. This is proven by a growing number of scientific papers in which simulations are conducted as a method to verify various hypotheses. In the article the author presents the functional architecture of an exemplary simulator of a crisis management system developed in Poland, used as a "Laboratory of Crisis Scenarios ", the main objective of which is to develop diagnoses of the current status of procedures, and verification of the knowledge, skills and competences of various services involved in the crisis management process.

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Augmented reality, crisis management, simulation systems.

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Introduction

Crisis Management in Poland consists of preventing crisis situations that are the results of threats,of preparing to take control over them through a series of planned actions; reacting and taking actions; and of removing their effects. The Crisis Management System makes it possible to protect the health and life of people as well as to protect the property and the environment. It also focuses on counteractingthe threats that may trigger a crisis situation that would destabilise the functioning of the state organs or the life of a society. The threats that commonly fall underCrisis Management include natural and civilizational disasters that result from social behaviour as well as terrorist attacks. With the use of the available resources, the Crisis Management System was introduced in Polandin order to ensure effective counteractionon the threats andminimisation of human, property and environmental losses.

It is a multi-level and multi-element system encompassing all ranks of government and local-government administration. It hasthe structure that enablesto implement tasks concerning the protection of health and life of people, property and the environ-

ment; it has been integrated with the NATO and EU crisis systems. This system is a relatively new partof the field of security. It is dynamically developing and is a subject of change and improvement during its operation.What is extremely important, is that it is not yet fully defined. This is why, it is crucial to conduct research and develop concepts for theimprovement of this system[1]. When creating the system of such type, it is vital to consider such IT solutions that are able to implement complicated processes in the most effective way. In contrast to many "simple" information systems (financial-accounting, warehouse management, etc.), the systems presented later in this article display the use of different technologies, starting from database solutions, through technologies related to the so-called spatial visualization support with augmented reality, including time and location parameters and the impact of weather conditions.

In the process of improving the Crisis Management System, simulation systems play an important role as tools that support training and academic research. Simulation systems have been used for a long time. Their development progressed in three basic categories: 1) simple simulation devices used since the beginning of the last century; 2) simulation systems, already in use in the middle of the last century, mainly for modelling complex production processes; 3) systems integrating simulations of conditions and processes with real scientific research and experiments. Such systems appeared at the end of the last century, and their development took place at the beginning of the 21st century and is still in progress.

Practice, and more specifically, simulations help promotingpreparedness by allowing participants to experience the environment that looks the most realistic in a selected situation, both in an emergency and in a crisis situation. Management personnel must develop adaptive response procedures in stressful conditions, in order tolearn how to cope in a crisis situation. Those stressful conditions include uncertainty and time pressure and the response procedures are based on previous experiences unrelated to this unique situation. It is important, therefore, that the staff pay attention to the possibilities arising in a crisis situation. Learning from mistakes helps when developingpreparedness; experience can increase effectiveness in the future. Simulations aim to provide experience to the personnel, to students of crisis management, and more generally, to the participants. It enables them to deal with a virtual but realistic situation that lets them practice their organization. In order tobuild simulations that are capable of creating such opportunities, it is important to check whether they reproduce specific conditions of a given situation and to ensure that participants experience the most realistic environment. The aim ofcrisis simulations is to increase awareness by accurately recreating psychological atmosphere of a particular crisis. The purpose of emergency simulations is to check if aplan can be applied to it. Therefore, they must recreate the physical reality as accurately as possible[2]. Examples of such systems and a brief description are presented later in this article.

Laboratory of Crisis Scenarios (LSK) is a product by Nowatel and it has each of these solutions. The main purpose of the laboratory is to conduct research and experiments and to support didactics in the field of crisis management. Itoffers training of the process of decision making and reaction in the face of hypothetical crisis events, in condi-

[1] J. Falecki, Dylematy zarządzania kryzysowego w Rzeczypospolitej Polskiej, Oficyna Wydawnicza „Humanitas" publishing, Sosnowiec 2016.

[2] Clément Judek, Abla-Mimi Edjossan-Sossou „Crisis and emergency situation Simulation considering cascading effects methodology"

tionsresembling real situations as closely as possible. Belowone may find a short presentation of training and simulation systems in selected countries of the world.

Review of systems that contribute to the research on safety

System for the analysis and visualization of risk scenarios (SAVER)

Developed in 2010 in Mexico, the system is used by civil protection authorities to include risk scenarios in emergency preparedness planning. The system integrates risk maps and geo- referenced information on hospitals, schools, public infrastructure and the population into one single database. Currently, its capacity to create risk scenarios is one of its most important characteristics. SAVER is the result of a horizontal and vertical coordination effort across the public administration. The ministries of Social Development, Communications and Transport and Public Education provided location data and descriptive information about infrastructures under their responsibility as the inputs to the system's database. Currently, the system comprises 700 hazard layers together with socio-economic and vulnerability data. With the development of SAVER 2.0 in 2011, authorised organisations may provide input to the database online. Public entries in charge of social, territorial and human development could also use the system to support policy decision making. The system provides them with information on potential damages and what populations may be affected based on disaster occurrence records. In its next version SAVER 3.0, introduced in 2015,the integration of all of the 32 state risk maps and data-bases occurred, resulting in a system that is useful for all services[3].

American simulation and training system EDMSIM.

EDMSIM by c4itrgtech is an interactive, electronic table top training solution for emergency response and crisis rehearsal training, designed specifically for Emergency Management staff, Emergency Operations Centres and Civil Leadership. A highly flexible and adaptable tool, EDMSIM allows teams to improve communications, validate contingency plans and procedures and perform better in an environment which realistically portrays the environment of a natural or man-made disaster.

EDMSIM is a proven performer used by the US Northern Command, US Army, US National Guard, Centres for Disease Control and NATO for the conduct of training exercises. EDMSIM exercises are scalable so that training can be conducted at a local, regional or higher level. All agencies responding to an event can be modelled. EDMSIM training enables the implementation and validation of previously prepared procedures and contingency plans. The Operations Centre staff operates within the same venue and with the same resources as during an actual crisis. All of the resources available for use during the exercise scenario are imported into the EDMSIM database as part of the scenario creation process. As in real life, the Operations Centre staff must allocate and manage these resources during the course of the exercise. The software was designed from the outset to be operated by first responders with basic computer skills. Within two hours of simulation instruction, the first responders learn to operate the simulation stations. EDMSIM provides the replay of the simulation from any perspective and allows significant events to be highlighted.

[3] Za: Krajowe Centrum Zapobiegania Katastrofom w Meksyku (CENAPRED).

User defined reports can be generated detailing information on damage, casualties and logistic consumption[4].

The European Union project CRISMA

CRISMA Integration Project focused on large scale crisis scenarios with immediate and extended human, societal, structural and economic, often irreversible, consequences and impacts. Typically, these crisis scenarios cannot be managed alone with regular emergency and first responder resources, but require multi-organisational and multi-national cooperation including humanitarian aid.

The CRISMA project developed a simulation-based decision support system, for modelling crisis management, improved action and preparedness. The CRISMA System facilitates simulation and modelling of realistic crisis scenarios, possible response actions, and the impacts of crisis depending on both the external factors driving the crisis development and the various actions of the crisis management team.

A common set of criteria and performance indicators for simulation and optimization of crisis management, provided by the CRISMA modelling system enables decision makers and crisis managers: (1) To model realistic, multi-sectoral crisis scenarios and consequences. (2) To simulate and compare impacts from alternative actions,(3) To make strategic decisions, (4) To optimise the deployment of, e.g. resources, (5) To make better action plans for the preparedness and response phases[5].

Laboratory of Crisis Scenarios (LSK)

The Laboratory presented below is a Polish product, designed to diagnose the current status of procedures and to verify the knowledge, skills and competences of various services involved in the crisis management process, with particular emphasis on public administration, city and municipal guards, fire brigades, medical rescue, police and territorial defence forces and complex administration in the context of contemporary natural and intentional threats with the use of highly specialized research tools. Integrated research and development infrastructure allows for comprehensive research on local phenomena and events that threaten public safety in any voivodeship.

Additionally, it provides teaching infrastructure for the purposes of conducting training and exercises for employees of teams and crisis management centres, work place managers, employeesof community, country andvoivodeshipoffices as well as emergency formations. It can also be used to train soldiers of the Territorial Defence Forces, officers of the Fire Brigade, Police, Civil Liability and universal self-defence.

Furthermore, the system help to work outthe concepts and research algorithms for the preparation and the development of the catalogue of threats, as well as risk level assessment, simulation of phenomena and impact forecasting. At the same time, it ensures the collection of data on the status of: the environment, infrastructure, forces and resources, and the sources of threats. It then processes this data by: selecting, verifying and analysing data withthe detection of threshold (critical) changes. It allows to assess the threat in real or fixed time (forecasting) with simultaneous presentation of the object's status, agglomeration of

[4] Za: https://www.c4itrgtech.com/products/edmsim/

[5] P. Dihé1 and oth. An architecture for integrated crisis management simulation, https://doi.org/10.1007/s10111-011-0176-5

the studied area and risk assessment on the map of threats and risks. It also allows to conduct the process of diagnosis of the current state of knowledge and skills and competences of various uniformed services involved in the crisis management process in the context of contemporary natural and intentional threats. Itdiagnoses gaps in knowledge, competencies and skills that require filling due to the use of new techniques, methods and training areas using simulators.

The specificity of the issues related to the implementation of emergency calls is a complex process. Usually, theyare dynamic events, where time and location of a particular phenomenon play significant roles. Therefore, when designing these kind of systems, one should take into account IT solutionsthat are able to "handle" them in the most effective way. As opposed to many "simple" information systems (financial-accounting, warehouse management, etc.), different technologies have been usedhere. They range from database solutions to technologies of to the so-called spatial visualization support with augmented reality, including time and location parameters. The basic infrastructure of the Laboratory of Crisis Scenarios includes:

- crisis scenario generator,
- operating room of crisis management teams,
- room of duty service and analyst team,
- conference room - social communication,
- laboratory for crisis management support systems,
- ICT security lab,
- server room.

The most important element of the Laboratory is the **Crisis Scenario Generator** (GSK). The generator is a tool that, in a way similar to real conditions, supports the decision-making and reaction processes in the face of hypothetical crisis events. It allows the user to generate and simulate all parameters of the test environment for the purpose of research and exercise.

The generator allows to generate scenarios of crisis situations for the administrative level: community, countyandvoivodenship. In addition, it enables editing, adding and defining new scenarios by teaching staff, e.g. Crisis incident – a single incident occurring in a designated place and time and Crisis situation – a group of crisis events occurring dependently or independently of each other at a specific time and place.

The depiction of these scenarios is carried out using spatial projections. It enables to locatethe event on the GIS map, marks the nearest elements of spatial database and generates suggestions about forces and resources as well as possible additional threats.It also allows to determine event parameters depending on its type (amount of leakage, time of occurrence and duration, number of injured persons).Based on these data, information (reports) is generated for the participants of the exercise. All actions within the scenario are recorded in the event log and are the basis for the assessment of the exercises and of the participants.

The generator (GSK) is a set of applications with an extensive database that allows to generate scenarios of crisis situations using spatial projections. In addition, it is integrated with the infrastructure of the laboratory and with modules and applications for crisis management support. The software is divided into two applications:

- Simulator of Research Scenarios, which were used to create concepts and research plans, to prepare simulations and scientific experiments,
- Simulator of Crisis Scenarios – enabling creation and management of crisis event and training scenarios for the needs of trainings.

The laboratory offers five ready-made scenarios for user-defined crisis situations listed below, and also enables the teaching and didactic staff to create new scenarios. The process of preparing defined scenarios can occur by using previously prepared list of event types, including the following ones:

a) Disasters,
b) Natural disasters,
c) Fire,
d) Chemical contamination,
e) Epidemic diseases.

Relevant scenarios can be developed according to the needs of a particular user. The system is made in the client-server structure.When implementing the project, the following basic components of the system were defined:

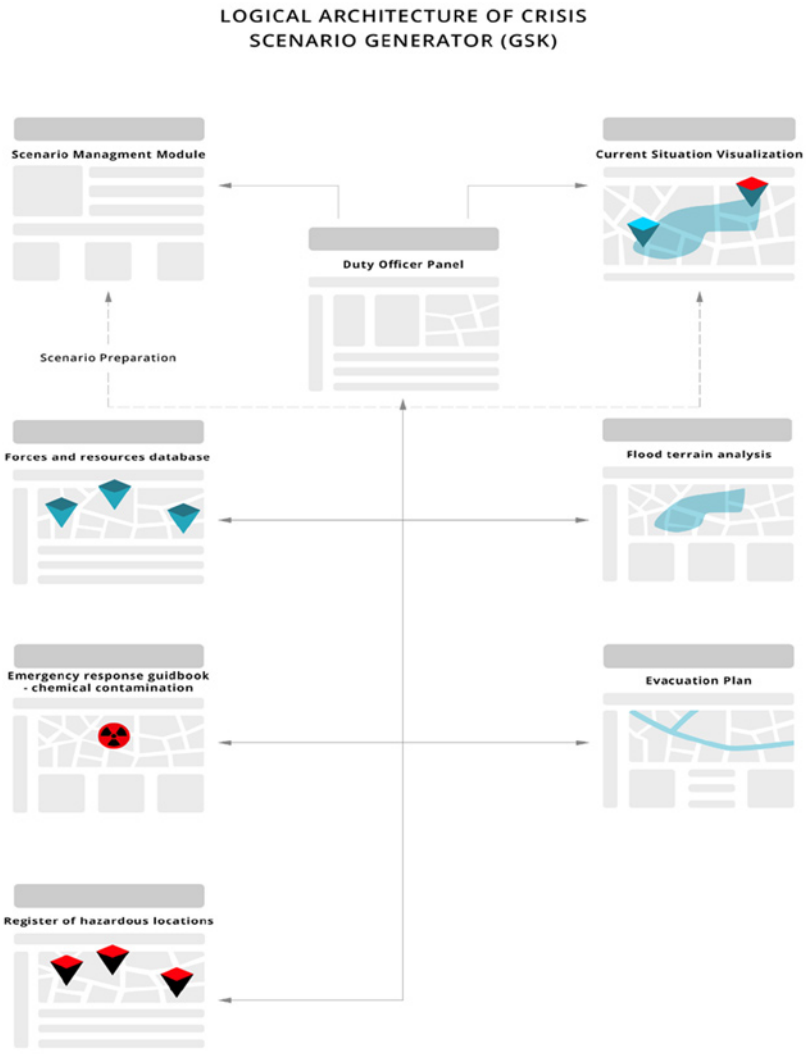
– database engine – PostgreSQL with PostGIS extension,
– web services server – Apache TomCat (mainly due to support for JavaServlets and Java Server Pages),
– server for spatial services – GeoServer,
– system modules – IT products, applications that perform the system tasks.

The key element for the system is the use of GIS (geographic information systems) technology. From the range of the main GIS technology tools, the GSK system is equipped with the following elements:

- conversion tools for the spatial systems – in Poland the most frequently used algorithm for converting is the so-called „WGS'84" system into a geodetic system State System PUWG'92 (non-zonal) or PUWG'2000 (zonal); this algorithm is particularly applicable in the presentation process of spatial data, where the source data (transferred directly from the site by means of GPS transmitters) is delivered to the system in the WGS'84 system;
- the tools for conducting various types of spatial analysis such as selecting data of one spatial layer by another or by selecting multiple layers which can result in a separate spatial layer;
- the tools for converting the so-called, temporary graphic layer into a basic graphic layer with a specific geometric representation (this is particularly applicable when implementing tasks related to analysis of chemical hazards of the ERG);
- the tools used for so-called network analysis (roads, watercourses, etc.), are especially used when analysing roadblocks or flood risks.

The system was built in modular architecture. Each module has specific goals and an independent form of task management. The system's modular platform is presented in Figure 1 below, in the form of a chart that includes information flow and the hierarchy of the implementation of processes.

Fig. 1. Based on Nowatel's advertising materials



The GSK system provides roles for at least four main users; the roles have been assigned as follows:

User type	Assigned role
Administrator	- database management - spatial data management GIS - managing system users - the access to all system modules
Lecturer	- creating didactic scenarios - managing didactic scenarios - creating teams for the implementation of scenarios - managing the student assessment system - the access to all system modules

Trainee	- the access to the assigned modules of the system - the implementation of tasks by assigned scenario - the insight into the assessment of a running scenario (group, individual)
Guest	- the access to assigned modules of the system - the implementation of tasks according to an assigned scenario

Crisis Scenario Generator modules

The logical architecture described earlier presents the system on the so-called modular platform, i.e. all modules, apart from their main functions also meet the general requirements, characteristic of these kinds of solutions. The system's modules have a kind of functional and operational separation, i.e., the work on the selected module is independent. In practice, this applies to the situation in which the system can operate independently with one module, intended for a particular user.

The Crisis Scenario Generator (GSK) consists of 7 basic modules:

1. Scenario management (ZS).
2. Visualization and event simulation (Mod WiSZ).
3. Forces and resources database (Mod BSS).
4. Register of hazardouslocations (Mod RMN).
5. Evacuation plan (Mod PE).
6. Flood terrain analysis (Mod ATZ),
7. Emergency Response Guidebook – Chemical contamination (Mod ERG).

Functional description of system modules

Scenario Management Module (Mod ZS)

This is one of the most important modules. It is a tool that, in a way similar to real conditions, supports decision-making and reactionary processes in the face of hypothetical events of an emergency nature. It allows the operator to generate and simulate all parameters of the test environment for the purpose of research and exercises.

The generator allows to generate scenarios of crisis situations for the administrative level: municipality, poviat and voivodship. In addition, it enables editing, adding and defining new scenarios by the teaching staff, e.g. Crisis incident – a single incident occurring in a designated place and time and Crisis situation – a group of crisis events occurring dependently or independently of each other at a specific time and place.

The depiction of these scenarios is carried out using spatial projections. It enables to locate the event on the GIS map, marks the nearest elements of spatial database and generates suggestions about forces and resources as well as possible additional threats. It also allows to determine event parameters depending on its type (amount of leakage, time of occurrence and duration, number of injured persons).Based on these data, information (reports) is generated for the participants of the exercise. All action within the scenario is recorded in the event log and are the basis for the assessment of the exercises and the participants. The main elements of the Module:

- the database that stores all the necessary elements generated by the module;
- map application based on which the lecturer introduces the elements of the script in a spatial way;

- the mechanism for changing the graphically introduced elements into a description sent to the student;
- the mechanism and algorithm allowing to create a scenario in the module;
- the mechanism for sending messages from the content of a particular scenario to the posts the students are given when implementing the scenario;
- the mechanism managing the duration of the scenario;
- the mechanism and algorithm for managing the scenario's time path;
- the user management mechanism along with the necessary database;
- the mechanism to assess the student or teams implementing the scenario;
- the mechanism generating reports on the course of the scenario.

Visualization and Simulation Module (Mod WiSZ)

The module of visualization and event simulation is integrated with the Crisis ScenarioGenerator module. Thanks to the application of Augmented Reality (AR) 3 D + technology, it enables realistic visualization and modelling of various types of crisis events, e.g. fire progress (when introducing parameters determining wind speed and direction, type of fuel and terrain). It also provides support for using different types of map bases (in particular OpenStreetMap, Google, Bing, Geoportal).

In addition it enablesthe visualization of the following:

- administrative units;
- the facilities and places under threat and areas where evacuation is planned;
- population evacuation routes;
- the areas of distribution of the evacuated population and its number.

In addition, it allows you to determine the capacity of the reception areas for people and determines the route between the objects on the map as well as estimates the time of arrival, completion of evacuation and distance.

Furthermore, the module enables:

1. To determine areas affected by simulated events (i.e. flood plains, contamination areas, evacuation areas, etc.) in a dynamic manner (including the time and change in atmospheric conditions), depending on the analytical module.
2. To enterthe goal and purpose of evacuation.
3. To make a list of people directing the evacuation process (integration with the communication module).
4. To manage forces and resources needed for the process of evacuation,

The module's software is integrated with mobile applications installed on tablets (information about events, information on evacuation routes presented on maps, etc.). The main elements of the Module are as follows:

- the tools for downloading and presenting analysis results;
- map layer presentation;
- the library of tactical symbols – compatible with OC;
- the tools for simulating weather conditions based on parameters introduced to the scenario or for downloading weather forecasts;
- he tools that record the course of a scenario played in **Mod WiSZ**.

Duty Officer Panel (PD)

The main task of the PD Panel is to support the user's work. Primarily, itshould assist the dispatcher of the crisis management centre in the daily work, as well as all other users from other services using the system.

The user has access to the window with the digital map presentation. The scope of the spatial information presented can be

modified by the user in the way of enabling and disabling additional layers, e.g. an orthophoto map, or data from the base of forces and resources. The map presents the events that were entered by the user in a selected time bracket (e.g. from the last 24 hours or from the last week).

The user that inputs the data has the option of defining the following parameters for the event:

– Institution or person reporting the event.
– Priority of notification.
– Nature of the event.
– Time of the event.
– Type of the Event.
– Category of the Event.
– Information on the number of people injured in the event.
– Description of the event.

Main elements of the Panel are as follows:

– the database of categories and types of the threats;
– map application that enables entering and visualizing the event on a spatial-layer;
– thetool enabling users to enter their own procedures and assign them to individual categories and types of threats;
– thetool that generates the required reports from the process of entering events into the system using the module;
– thetool that sends visualization parameters to the Mod WiSZ (after the analysis).

The Register of Hazardous Locations module (Mod RMN)

This module is integrated with other GSK modules and enables entering, viewing, editing and storingthe information on the location of High-risk Plants (ZWR) and Increased Risk Plants (ZZR), the data on hazardous chemicals used and stored in them,as well as how the release of those chemicals, in case of a crisis situation, could have negative effects on the environment. It has an implemented database of chemical agents with UN codes (identical to the ERG module database) as well as a map application that allows entering the location and attribute information of ZWR and ZZR objects.Together with the library of symbols, it hasthe built-in spatial and attribute search mechanisms. It also allows to generate reports and statements from spatial and attribute queries and to store information about hazardous events by categories and sub-categories identical to the catalogue of threats.

The main elements of the Module are as follows:

- the database of chemical agents with UN codes (identical to the Mod ERG database);
- map application that allows entering the location and attribute information of ZWR and ZZR objects;
- the libraries of symbols;
- the structures of spatial layers;
- the mechanisms of spatial and attribute search of objects;
- the mechanisms for generating reports and summaries from spatial and attribute inquiries;
- the tool that sends visualization parameters to the WSB Panel (after analysis).

Evacuation Plans Module (Mod PE).

This module is integrated with the rest of the modules in the system and it enables to generate (develop) a standardized evacuation plan in a given area, when considering following aspects:

– the characteristics of types of evacuation;
– the indication of units obliged to partici-

pate in activities related to evacuation and stating their tasks (integrated with the database of forces and resources);
– the indication of the types of activities that should be carried out;
– the indication of mechanisms within which the coordination of activities should be carried out in the terms of preparation, maintenance and securing the logistics of the evacuation,

In addition, the module has the ability to create evacuation plans for individual hazards broken down into 1st, 2nd and 3rd degree evacuation;

The main elements of the Module are as follows:
– the database that allows to properly save the evacuation plan;
– map application supporting the creation of plans, including the editing of spatial data;
– the libraries of symbols – compliant with the Civil Defence guidelines;
– the text editor that allows to enter descriptive information into the database;
– the management system of created plans and the mode assigning them to appropriate administrative units;
– the mechanism of combining the module with data from hazardous location register modules as well as forces and means;
– the formatting toolof a created plan in order to print it;
– the tool that sends visualization parameters to the WSB Panel (after analysis).

Flood Terrain Analysis Module (Mod ATZ)

This module allows to quickly determine (based on received information) the number of locations at risk situated in a given area,with a given level of probability of flood. The module's user has access to themap with the option to display particular layers from the Database of Forces and Resources, Evacuation Plans and the Register ofHazardousLocations. The map also provides information about address points and buildings from the PESEL database in order to determine the number of people in the need of evacuation from the indicated area. The main functions supported by the module:
- the visualization of the probability of flood in a given area based on IMGW data;
- the ability to choose to display and analyse the particular flood zone, based on theparameters entered in the generator;
- the change in the time brackets of a particular flood zone according to the schedule defined in the scenario (e.g. the change of 10-year-old water to 100-year-old water);
- creating the lists of objects from the database of forces and resources (in particular, critical infrastructure facilities and ZZR I ZWR) in order to secure or evacuate them.

The main elements of the Module are as follows:
- the database of chemical agents with UN codes (identical to the Mod ERG database);
- map application that allows entering the location and attribute information of ZWR and ZZR facilities;
- the libraries of symbols;
- spatial layers structure;
- the mechanisms for spatial and attribute search of objects;
- the mechanisms for generating reports and summaries from spatial and attribute inquiries;
- the tool that sends visualization parameters to Mod WiSZ (after the analysis).

Emergency Response Guidebook Module – Chemical Contamination (Mod ERG).

This module is integrated with the GIS server software and the Crisis Scenario Generator. It allows to determine the warning and evacuation zone for a chemical event using the ERG 2008 rescue methodology. The calculations are based on the parameters defined for each particular chemical substance defined in the methodology. In addition, after correctly inputting parameters of the chemical event, the module automatically marks warning zones and evacuation zones on the map. It also lets the operator generate reports based on the information about the chemical event and the particular zone (warning or evacuation). The generated report includes an overview map with the location of the event, a list of parameters used for analysis and a list of objects in selected spatial layers (e.g. a list of address points located in the zone). There is also a possibility to save the report in PDF format and export it.

All conducted analyses are archived and available in the form of a list. The module enables the user to select an item from the list of archived analyses and present that event using the visualization module on the map, with previously calculated warning and evacuation zones.

In addition, it contains a chemical base with UN codes integrated with the application.

The main elements of the Module are as follows:

- the database of chemical agents with the necessary parameters (enabling the generation of warning and evacuation zones according to the methodology) and the necessary UN chemical codes;
- the database of procedures for dealing with chemicals;
- map application that allows to visualize the calculated areas;
- map application that enables toconduct spatial analyses;
- the mechanisms for generating relevant reports from an analyses;
- the tool that sends visualization parameters to Mod WiSZ (after the analysis).

Database of Forces and Resources Module (Mod BSS)

The BSS module is used for entering, viewing, editing and storing information on forces and resources used by relevant services in case of a crisis event or situation. It allows the operator to conduct and update the Database of Forces and Resources and Elements of Critical Infrastructure. It is integrated with the map environment (spatial nature of information) and the Crisis Scenario Generator. In addition, it allowsto generate reports and statements from the information available in the database and to editelements in the database of forces and resources (introducing new, editing existing, deleting objects, editing descriptive data). It also offersvisualisation of the facilities of the forces and resources database in the map environment.

The module has a database divided into four basic categories:

- Protective structures.
- Warehouses.
- Decontamination facilities.
- Forces and Resources.

The main elements of the Module are as follows:

- the spatial database for particular categories of the Database of Forces and Resources;
- map application that enables displaying, viewing and managing of spatial

objects entered into the Database of Forces and Resources;
- the mechanism for searching, editing and managing content of the Database of Forces and Resources;
- the mechanism for generating reports from database queries;
- the mechanisms of spatial analysis that allows for spatial query in a map application;
- the mechanisms for adding new spatial objects in a map application along with the necessary attribute information;
- the list of chemicals (in terms of disposal);
- the tool that sends visualization parameters to Mod WiSZ (after the analysis).

In addition, the Crisis Scenario Generator has three additional panels:

Communication panel

This panel is integrated with the communication simulation system in the HF, VHF, CB range. It consists of applications that enable the simulation of basic types of radio communication devices currently operating in the crisis management system and VoIP telephony / digital telephony.Moreover, it is integrated with a dispatcher console simulator (voice communication of simulated devices in both applications depending on device settings, remote control simulation). The system in which the simulated devices work allows for establishing „radio communication" in „peer-to-peer" relations both when stations are equipped with applications of a given type of radio station, and by cooperating with radio applications of other types. The transmission and reception frequency and the type of modulation must the same. The module simulates typical HF and VHF radios and CB radios used by crisis management services.

Mobile application panel

The MSSK module installed on a tablet enables, inter alia, the following issues:
- the visualization of all events, POI areas, points and evacuation routes available through the event visualization module;
- voice communication with the communication system via a dispatch console;
- it provides its own geographical position (via the GPS module) and sends it to the visualization module.

Lesson panel

It can be compatible and fully integrated with the e-learning system in use and includes an application for Android that allows you to use the module on mobile devices. In addition, it allows you to summarize the activity of individual participants of classes and exercises and creates a summary of activities correctly and incorrectly performed by the participants of each exercise. It allows to record the grades of each participant of an exercise and offers registration of participants and instructors that provide training. It determines participants of trainings and exercises, assigns roles to them, generates relevant messages and prepares all conditions related to the course of a particular event.

The product of Nowatel is an example of the implementation of the Polish simulation system.

In recent years, Nowatel has installed its system at Gdynia Maritime University, as an „Integrated simulator for commanding and conducting operations in situations of military and non-military threats on sea areas". The simulator is used for training in the field of command and conducting activities in situations of military and non-military threats at sea. The system is a col-

lection of applications with an extensive database allowing to generate scenarios of crisis situations with the use of spatial visualization. The Educational Centre for Crisis Management at the Pomeranian University in Slupsk also uses Nowatel's Laboratory of Crisis Scenarios. It is used as an element of the didactic structure ofNational Security course at the Faculty of National Security, and to conduct research on the effectiveness of procedures in crisis management.

Summary

Nowadays, crisis managers and other decision makers have a much greaterchance to face a large-scale crisis that exceeds the potential for a regional solution. Natural disasters and man-made disasters do not respect regional or national borders, and their consequences are not solely the responsibility of a single organization. To prepare for such challenges, decision makers need better understanding of the impact of each crisis, as well as the availability and benefits of cooperation between different organizations. The Laboratory of Crisis Scenarios has been developed to enable the crisis managers and others to model and simulate complex crisis scenarios and alternative responses in a realistic way. The laboratory can be used to solve many problems encountered in the crisis management preparedness phase, such as: planning, land use and infrastructure in the long-term perspective; emergency planning; optimization of crisis management plans; support in the preparation, implementation and evaluation of the results of stationary and field exercises.

Simulation systems are of course expensive, but they are not expensive enough to risk the effectiveness and efficiency of rescue operations. The presented solutions are dedicated to support the processes of Crisis Management, at the levelsof municipality-poviat-voivodship, because it is at those levels that the lack of knowledge and experience is most often prevalent.

To conclude the thoughts on this subject, it is worth noting that appropriate simulation systems bring two kinds of benefits.Firstly, the use of simulation and visualization systems in augmented reality technology that operate in very realistic environments, allows to experiment on laboratory simulators in situations that would be too expensive and sometimes impossible to replicate in real life. This also allows us to predict, with credibility, how emergency services would operate in a given situation. Secondly, the system allows for presentation of realistic visualizations that help to explain real riskto the decision-making bodies. It also offers a chance formany people to analyse an event at the same time, which improves realism and effectiveness of decision making[6].

The author is convinced that the boundary between simulation systems and the reality will be increasingly difficult to distinguish as sensors become ubiquitous in the environment. They are connected into a network via mobile infrastructure. The availability of a large number of data sources that can be used by simulation systems, powered in real time, is becoming standard. One can assume that the implementation of the Digital Poland program, the expansion of high-speed broadband Internet, the rapid development of 5G mobile infrastructure and the implementation of the Internet of Things will significantly affect this trend and increase the potential of real-time simulation systems. They will enable participants to experiment when making decisions in realistic environments during real-time crisis management operations.

[6] Walker, WE, Giddings, J. & Armstrong, S. Cogn Tech Work (2011) 13: 163.

Bibliography

Clément Judek, Abla-Mimi Edjossan-Sossou „Crisis and emergency situation Simulation considering cascading effects methodology", s. 1-2

Beroggi GEG, Waisel L, Wallace WA (1995), Wykorzystanie rzeczywistości wirtualnej do wspierania procesu decyzyjnego w zarządzaniu kryzysowym. Saf Sci 20: 79-88.

Falecki J., (2016), Dylematy zarządzania kryzysowego w Rzeczypospolitej Polskiej, Oficyna Wydawnicza „Humanitas", Sosnowiec ISBN: 978-83-65682-31-4, s. 1-5.

Kleiboer M. (1997), Metodologia symulacji dla wsparcia zarządzania kryzysowego. J Conting Crisis Manag 5 (4): p. 198-206.

Walker J.A., Ruberg G.E., O'Dell JJ (1989), Symulacja zarządzania kryzysowego: wykorzystanie automatyzacji w gotowości na wypadek awarii. Symulacja 53 (3): 95-100.

Walker, W.E., Giddings, J. & Armstrong, S. Cogn Tech Work (2011) 13: 163. https://doi.org/10.1007/s10111-011-0176-5

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