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SIMULATION SYSTEMS IN SUPPORT OF THE ORGANIZATION AND IMPLEMENTATION OF CRISIS MANAGEMENT EXERCISES

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Abstract

Simulations and simulation systems are effective tools for training, verification and analysis. They protect the environment, and they do not have many restrictions. They enable exercises to be carried out in irrelevant of the location of the trainee, they save resources, and they enable training in an international environment with the aim of achieving compatibility and joint interoperability and allied cooperation. The aim of this paper is to explain the possibilities offered by modelling and simulation systems in the process of supporting the organization and implementation of exercises, as well as the way of planning and organizing computer-aided exercises, the ultimate goal of which is to train training groups in solving problems caused by various crisis situations.

Keywords: simulation systems, crisis management, examples, education of crisis management teams.

1. Introduction

Timely and complete information is defined as one of the key factors for the successful resolution of problems arising from various crisis situations. The complexity of the interplay between key information, human resources, and techniques for effective crisis management has always been a challenge for crisis management; therefore, training processes in crisis management situations are critical to their effective management.

Training processes must be as challenging and realistic as possible so that the training group can experience being in a real situation. The use of simulation systems that replicate the actual situation in the field is one of the most effective and economically viable ways to train personnel involved in crisis management. The increasing power of IT systems and the faster turnover of information are elevating the capabilities of simulation systems to previously unimaginable heights, but simulation systems have their limitations and will never be able to fully replace training activities at specialized training sites or training ranges.

The main purpose of simulations is to prepare training groups to implement training content on the training site. When the training group has reached a satisfactory level of training, which is tested by the simulation system, the trained group is ready to conduct the main event. This is conducted on specialized training areas and polygons. The Armed Forces of the Republic of Croatia (OSRH) have been using simulations and simulators in training for decades.

Recently, the number of crisis situations and events on the territory of the Republic of Croatia has increased, which has led to an increase in the intensity and challenges of training personnel in the field of crisis management. Simulation systems are a logical, economically justified and cost-effective solution. OSHR are also one of the key factors of the crisis management system, so the connection of all stakeholders involved in this process is extremely important for its effectiveness. The connection and interaction of all stakeholders in the crisis management system are a guarantee of success. Tactics, techniques, and procedures in the decision-making process are targeted through training with simulation systems. OSRH, with its simulation systems and infrastructure, as well as its vast experience and knowledge in organizing and preparing simulation exercises, supports civilian institutions that are an integral part of the homeland security system and are aimed at management in crisis situations. This type of cooperation is extremely useful for the Armed Forces, as in this way the members of the Armed

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Forces become part of the training group and gain new knowledge and experience. Such exercises are organized with the aim that all elements and actors of the crisis management system are trained together, making the whole system interoperable and decisions in the crisis management process easier, faster and more efficient. In addition, it is important that all actors receive information on how parts of the system work, what their capabilities are, and what their role is in the crisis management system so that the resources of specific segments of the system can be used efficiently. In addition to training at the national level, simulation systems, because of their linkage capabilities, also allow for the training of larger international coalitions to achieve compatibility and joint interoperability with other nations. In this way, they create better international relationships and sometimes alliances with other countries. This type of international cooperation in conducting joint training as part of the crisis management system has become a necessity, as has training at the national level, because crises know nations and international borders, so international cooperation in this regard is extremely important. During the pandemic COVID 19 it has been shown that only cooperation and coordination at the international level can bring effective results in managing crisis situations on an unimaginable scale

2. Simulations

2.1 Virtual space

The virtual space in which certain activities take place is a digital simulation, generally created by inserting various factors, events, or situations into a digital environment using various mathematical functions that define relationships in space and time - a so-called model.

To set the scene, the term "war games" is explained: The war game is briefly defined by the arrangement of two foe enemy forces on the field. The goal of the “games” is to make a decision on the engagement of forces through a version of action. The process of making military decisions is defined by certain steps, and the war game is only one of the steps. This kind of decision-making process is not necessarily reserved only for war operations, with minor changes and adaptations to the user, it is applicable in almost all areas when it is necessary to manage people and resources with defined goals. To make the implementation of the "war game" understandable to the users and to visualize the distribution of forces as easily as possible to the user, in 1958 Charles Roberts invented the first war game on the board and a set of models that were used throughout the American military schools, academies and colleges. Such didactic aids proved to be extremely effective and useful in the development of the war games and therefore had a positive effect in the process of making a military decision.

The accelerated development of computer equipment and communications systems initiated the development of commercial computer games, which contributed greatly to the development of military simulations, and military simulations in turn influenced the development of military-themed computer games. This symbiosis led to the development of tiered games - arcade games. The development of computers in terms of hardware and software and the possibility of connecting several people to one system (game) led to the development of new generations that grew up playing computer games. This was one of the ways to connect young people in the virtual world with the help of computers. Thus, the so-called digital natives were born. One of the games that pioneered the playing of computer games in a networked system is called Battlezone, whose theme was military in nature, more specifically the training and deployment of armed forces.

As we noted in the text above, training activities must be as realistic as possible, and simulations are the tools used in training. Depending on the type and level of training, there are three main types of simulations: live, virtual, and constructive, so the type of simulation used is determined by the level of training being conducted. The aforementioned types of simulation can be networked, i.e. connected, and used individually or simultaneously, depending on the type and scenario of the training event.

Virtual simulations are a type of in which living actors control the simulation system, i.e., the simulator. Simulators are replicas of a specific real device used to simulate the most real conditions using computers and mechanical systems. They put the user at the center of the training, training psychomotor skills, communication in a team and independently, quick reaction and decision-making skills. The use

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of virtual simulations reduces operating costs and provides more latitude for risk-taking. Simulations are more environmentally friendly compared to real training, as users can cross rivers, destroy buildings, put out fires, rescue victims, and generally act in situations that would be too dangerous in live simulations.

Live simulations are operated by real people with real systems such as tanks or infantry weapons equipped with laser devices that simulate the effects of weapons in combat. Such systems vividly convey the difficult conditions of combat and the demanding way of life and work on the front line. Organizing and conducting training content using live simulations is logistically and organizationally very demanding.

When people, with their actions and decisions, initiate a certain situation that, within the simulation system, changes a certain sequence of events, we call such simulations constructive simulations. Constructive simulations, known as war games, got their name from the fact that the operational actions on the battlefield would not be conducted by a single tank or aircraft, but rather an array of different weapons or equipment that different units are composed of.

Virtual and live simulations are used to train people who supervise leaders, who see the battle in a more abstract form at the command post, or who perform various more complex tasks during protection and rescue in crisis situations, while constructive simulations allow commanders or other personnel in the role of leaders to analyse the current situation, its analysis and decision-making under time pressure, certain human and material resources, and any other issues that may arise in the given situation. Constructive simulations can put commanders and leaders in unpredictable situations and require them to solve complex problems.

The goal of simulation system is to create an artificial environment that allows unlimited integration of all three types of simulations that are interoperable, and such systems can be interconnected by simulation type, but also by user (alliances, international cooperation, etc.).

At the centre of each simulation is a machine or engine that "generates" different situations. It contains a model of the terrain, the weather, the workforce and the equipment. It changes the situation according to the reactions of the trained group to a particular event, so that mathematical algorithms execute commands, creating situational events and their consequences.

2.2 Technical organization of simulation exercises

For the simulation engine to work, data must be processed and manipulated. We call this type of data manipulation a "scenario". The team that creates the scenarios is responsible for defining this data in a form that can be used by the simulation engine.

At the end of the exercise or an exercise phase, a post-exercise analysis (RND) must be conducted to provide information about the consequences of the trained group's response to a particular event or incident. The analysis can be done in several ways, either through a simulation system only or through a discussion between a trained group and a supervisor or supervisee (controller). RND allows understanding what happened and adjusting the course of the exercise so that the trained group learns as much as possible from it, i.e., trains for the task.

Controllers are experts in their field who start and stop the simulation, control execution times, and steer the training group with the goal of making the right decision. They record and evaluate the key reactions of the training group. During RND, controllers explain to the training group how to react to a specific event or incident, and give them advice and suggestions on how to better solve the tasks they are given.

2.3 Exercise support in the form of models and simulations

Exercise support in the form of models and simulations is more than just setting up and implementing a constructive simulation system. Models and simulations and their tools should be included in all stages of the exercise process to automate processes, avoid duplication of effort, improve the exercise environment and ensure that the exercise process is focused on achieving the objectives.

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2.4 Developing a database for simulation exercises

In computer-based exercises, a computer simulation model is used to systematically represent physical activity in terms of time and space. Physical aspects related to movement, resource use and perception are represented in the simulation model. However, the definition and properties of the body are not part of the simulation model. The collected data about the environment, the bodies and the resource characteristics have to be defined as data for the simulation model. The data collected in this way is called the simulation database. To define the database, a common approach is required. Bodies must be defined, their descriptive data must be collected and verified, and their behaviour must be confirmed through simulation. The Database Management Team (DMT) is responsible for carrying out this task.

Simulation data for the computer-assisted exercise (CAX) can be obtained from a number of sources, including other electronic files. The data includes terrain information, group and unit descriptions, modelling parameters, target descriptions, logistical parameters, prototype descriptions, force command and logistics structures and threat data. Terrain is represented in different formats in the various simulation systems. Terrain data includes data on terrain constants, hexagonal conversion constants, terrain features (open terrain, city, mountain, sea, etc.), obstacle features (dry riverbed, river, thin pavement, etc.), terrain permeability, obstacle permeability and obstacle permeability capacity.

The information on groups, units and facilities includes the names of the systems they operate, their characteristics (losses, weight, speed, supply category, etc.) and probability of effectiveness tables. Modelling parameters are represented by weapon, tool and system effect times and response assessment times. Target information includes repair time, target category, name, location and size. Logistical data consists of the number of supply categories, convoy speed, various lethality probabilities and damage categories.

The database management team collects data that is identified as high value data. Low-value data is usually collected in advance and stored in a database. However, some low-value data may need to be modified, such as the creation and modification of basic tactical unit characteristics, the creation of weather fronts, the modification of terrain data and the creation or specification of a type of technique or system.

2.5 Organization and implementation of simulation exercises

The simulation exercise consists of five parts: Programming, Planning, Implementation, Evaluation, and Reporting. To get the most accurate picture of the complexity of organizing and conducting simulation exercises, we need to emphasize that the preparation and execution time of an average joint international simulation exercise is rarely shorter than two years, with the planning part taking eighteen months.

Once we have clearly defined the objectives of the future exercise, we begin programming. Programming runs through the entire process of planning, preparing, and conducting the exercise. Planning an exercise involves determining the objective, participants, host, and resources of the exercise, as well as the area of interest.

Planning an exercise is the process of developing exercise specifications that define the objectives of the training group and, when done well, result in a successful exercise. The planning process is accomplished through the work of planning bodies, namely the exercise schedule and content team, the exercise execution team, the exercise organization team, and finally the planning conferences and workshops.

Well-planned and executed planning conferences are the foundation for the success of the exercise. Planning conferences are conducted in a specific order based on their content. The first is the preparatory planning conference. Here, the elements of interoperability between participants and organizers are agreed upon (time for conducting subsequent planning conferences, financial and other necessary support, distribution of roles). This is followed by the initial planning conference, where participants are identified and the scenarios of the exercise are additionally defined and reviewed. And

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the final planning conference, which serves primarily to fine-tune the documentation and the presentation of the exercise to the media and the public.

Usually, the work of the various working groups takes place in the context of planning conferences, but sometimes they are convened independently when necessary. Especially when the composition of the team, e.g. for the preparation of a scenario or MEL / MIL (Main Event List/Main Incident List) teams, consists of different units, institutions and bodies, or in the case of international exercises and participants from different countries. Workshops are usually organized in the following areas: Management, Deployment, Technical, Evaluation and Support.

The success of the exercise is directly related to the exercise planning process and the success of the planning conferences. Larger and more complex exercises typically last five to ten days in their execution part, and activities are usually conducted around the clock, which has significant organizational and work implications. Recently, many exercises are organized in such a way that some of the forces or personnel being trained are dislocated; they are usually located in special exercise areas for the activities for which they are being trained. Such exercises are extremely demanding from an organizational and technical point of view, as additional efforts have to be made to provide the training group with timely information and data, which of course increases the cost of the exercise itself and places an additional burden on all logistical capacities.

After-action analysis (RND) or analysis is a process conducted for the purpose of evaluating the training of exercise participants and gathering data that will provide a clearer picture of what needs to be done to address identified deficiencies, whether they arose during the preparation phase or the execution phase of the exercises. The end result of the RND or the analysis of the organization and execution of the exercise are the lessons learned that will be used as input material for the next such or similar exercise in the future. It is important that the objectives of the exercise are clearly defined in a timely manner so that the control and monitoring apparatus can be staffed with professional and competent personnel.

The event and incident list development team workshop (MEL /MIL) is used to define event and incident development scenarios to initiate the training group and its response. The personnel involved in the work of the MEL /MIL workshop must have a high professional and technical level, because if the events and incidents are not prepared logically and in accordance with the training objectives, they can take the exercise in an undesirable direction and lead to the failure of months of effort in the process of preparing and planning the exercise.

3. Simulations as used in the Armed Forces of the Republic of Croatia

The simulation models currently used by OSRH are JTLS - Joint Theater Level Simulation (joint simulations at the global level) and JCATS - Joint Combat and Tactical Simulation, and these simulation models are currently used in modern helicopters around the world. The aforementioned models are of U.S. production and have become the most widely used simulation models deployed in large and small defense systems due to their universality and adaptability. The OSRH is equipped with the above systems, donated by the Americans and fully integrated into the training system.

JTLS is a simulation model for training forces operating on a global scale. However, as potential threats and hazards change, and with them the doctrines for responding to potential threats, such a global system allows specific forces to be deployed on an almost individual level. According to simulation system and model users, JCATS is currently the most advanced and versatile simulation model that can train forces from the individual to the joint operational level. Both systems are "alive," constantly evolving and improving, and providing more and more opportunities for training and force demonstration.

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4. Examples of simulation exercises

The following exercises were organized mainly by OSRH, members of the Ministry of Interior and Civil Protection, firefighters, representatives of the Ministry of Health, and other organizations and institutions involved in the system for protection and rescue and crisis management.

Conducting national and international simulation exercises is an irreplaceable tool for training multinational coalition forces, institutions, and personnel in the protection and rescue system, and any other way is almost irrational, as it requires significant resources and usually only serves to convey clear political messages (large live exercises of multinational forces). Exercises that are not organized exclusively for a specific task are aimed at gaining experience in working in an international environment, convergence and harmonization of procedures and standards, mutual understanding, and interoperability. Large international simulation exercises require a great deal of effort from both the host and the organizer and are not often held, but when they are organized they serve as a promoter of one's goals and achievements.

4.1 SEESIM initiative (South Eastern Europe Simulation Network)

The most important exercises on crisis situation management and protection and rescue in which the Republic of Croatia actively participated were SESIM 02, 04 and 06, which in many ways represent progress for the OSRH and the protection and rescue system in the Republic of Croatia and the entire region. In the recent past, the Republic of Croatia was affected by a series of catastrophic events such as floods, fires and earthquakes, so the training with using simulation exercises proved to be a necessity.

Disasters and threats in peacetime in the modern world, which are increasing exponentially, and in the last decade the number of disasters and the number of victims and even more the material damage, require from every organized state the establishment of an active integrated protection and rescue system. Experience shows that it is necessary to link countries to create a network of national structures with the task of carrying out joint planning, actions and procedures in disaster management, joint education and training of rescue teams, the establishment of international teams for operations, the development of material and technical resources and the establishment of a joint IT network to support national disaster planning, mitigation and reconstruction. By joining the SEDM (Forum of Defense Ministers of Southeast Europe - Albania, Bulgaria, Greece, Italy, Macedonia, Romania, Slovenia, Turkey and Ukraine), the Republic of Croatia has gained the opportunity for better cooperation in the field of defense and protection, but has also committed itself to actively participate in SEDM initiatives.

SEESIM, one of the main SEDM initiatives, stands for the creation of a network of national simulation centers with the aim of conducting computer simulation exercises.

The exercise was organized as a computer simulation based on the JTLS model with the support of a commercial communications system and focused on international protection and rescue operations. extraordinary) situations. The general scenario included major flooding, landslides, and terrorist threats to the countries of SEVEN due to the use of SEEBRIG in Operation NATO ISAF in Afghanistan. The scenario resulted in thousands of casualties, and the disaster severely damaged the transportation network, leading to further complications at all levels of defense. Observations of exercise participants during the analysis pointed to deficiencies in the overall preparedness and defense system, as a result of which the amendment of legal regulations in the system of protection and rescue and crisis management was initiated with the aim of creating a law that precisely defines the roles of all participants in the above system.

4.2 BAKLJA 2013

Exercise "Baklja 2013" was held in May 2013 for the Armed Forces of the Republic of Croatia and the Republic of Croatia. The exercise was conducted entirely using the JCATS simulation system. The exercise was hosted by the Directorate of Civil Protection of the Ministry of the Interior (MUP RCZ), and the representatives of OSRH - SIMS were involved in conducting and supporting the exercise. The objective of the exercise was to prepare participants to conduct complex activities to be carried out in

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the field in cooperation with other civilian structures. The primary exercise group consisted of regional fire chiefs, while the secondary exercise group consisted of county fire chiefs. The exercise scenario was set up in the Ravni Kotar area in such a way that two fires broke out in the Ravni Kotar area. The county headquarters in Zadar and the fire department commands "Sjenokos" and "Bubnjari" were formed. The fire was extinguished by fire brigades on the ground (16 DVDs (volunteer fire department) and JVP (public fire department)) with the possibility of using air forces.

4. Conclusions

To effectively and vigorously meet today's security challenges in developing and procuring modern equipment and systems, training and education are the foundations of success, and simulations and simulation systems in particular are the simplest, least expensive, and most effective tool for achieving training and education goals. To achieve such standards, it is necessary to invest in the development of new knowledge and skills among personnel in the security system, as well as in society at large. Clearly, keeping up with the evolution of global technology and knowledge is difficult and costly, but falling behind in knowledge, equipment, and training in crisis situations will ultimately be much more costly. The price of ignorance during disasters is paid in human lives and material damage. Continued investment in training, education, and equipping with new systems at a given time will pay for itself many times over, and using and developing new simulation systems and models is just one of the ways to create an efficient and energised safety system.

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