

Evaluation of Simulation Programs Applicable to the Support of Decision-making Processes in Crisis Management of Critical Infrastructure

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Abstract: - This article deals with an assessment of the simulation programs usable to the support a decision-making processes in crisis management. Education and practical training of crisis management members is a topic issue of nowadays. On the market, there is a wide range of simulation tools which proclaim to be suitable for practical training of management. Simulation is often used for the training of civil as well as military employees. This paper characterises and selects simulators and special programs for simulating of solution of extraordinary events.

Key-Words: - CAX, Computer Simulation, Crisis Management, Practical Preparation, Simulation Software, WASP, XVR

1 Introduction

In general, a crisis management is a continuous process in which all individuals, groups and communities manage hazards in an effort to avoid or ameliorate the impact of disasters resulting from the hazards. It is the creation of plans through which all individuals, groups and communities reduce vulnerability to hazards and cope with disasters, crisis situations or emergency events. Crisis management is sometimes also called disaster management [1].

The risk of various extremist actions is very serious in the present time. This topic became a much discussed subject in professional and general community.

But there is not just the threat of terrorist attacks, there are also high risks of natural disasters or industrial accidents, to which the population and crisis staffs have to be prepared.

Crisis management is a specialization that involves preparing for a disaster, disaster response and supporting and rebuilding of the society after a natural or a human-caused disaster occurs. Effective emergency management relies on the integration of emergency plans at all levels of government and non-government participants. The activities at each level (individual, group, community) affect the other levels. Their basic parts consist of the activities covered by contingency and

emergency planning which are based on the analysis and assessment of risks and of threats [2], [3].

Important role in emergency management plays an educational and practical preparation of intervening units and verifying emergency plans [4]. These are verified through practical exercises and simulations. As frequently as possible, techniques of modelling and simulation should be used as they enable to interpret the data from individual areas better, from the point of view of geographic distribution and concentration [5].

This is the reason why the paper concentrates on the selection of the appropriate software support for modelling and simulation of the dealing with emergencies and crisis situations. The article investigates the possibilities of implementation the outcomes of these programs into the education as well as practical training of the intervening units during emergency situations [2], [4].

2 Problem Formulation

Software, that support crisis management are very specific instruments and should be treated comprehensively. For an application in emergency management it is appropriate to use the methods of processing approach

Process management is a field of combining management and technology focused on aligning

organizations with the requirements and needs of clients [6]. It is a complex management approach that promotes effectiveness and efficiency while striving for innovation, flexibility, and integration with technology. Process management attempts to improve processes continuously [7]. It could therefore be described as a optimization process to dealing with emergencies and crisis situations.

The preparation for solving extraordinary events and crisis situations is not treated systematically. There are plenty of laws and regulations that crisis management staffs have to study. This is not the way, how they can become experts in dealing with extraordinary events and crisis situations. For the complex preparation is necessary to get knowledge in the field of crisis management and to complement it with the experience from dealing with emergencies.

These experiences can be obtained by taking part in dealing with extraordinary events and crisis situations. But this method is not very suitable, because the amount of onlookers (training) is very limited. There is a risk of disruption to the proper solution to the crisis situation.

Another alternative for obtaining experience are practical exercises. In their course is simulated extraordinary event and learner solves an event based on their knowledge. A great benefit for the practical exercises is the use of CAX (Computer aided exercises), or computer simulations.

Simulation is an imitation of some real thing, condition or process. The act of simulation of something itself generally means displaying some key features or behavior of selected physical or abstract systems[5].

Simulation is used in many contexts comprising modelling of natural or human systems with the aim to obtain knowledge about their behavior. Other contexts comprise technological simulations for optimizing the performance, security engineering, testing, training and educating. Simulation can be used for visualization of possible real impacts, alternative conditions and ways of acting.

In this way of practical training can be simulated various emergency situations, models of development of emergencies and it is also possible to record the whole process of simulation. The record can be then analyzed and evaluated done activities.

This is a great benefit for practical training as a feedback of evaluators to help to improve management processes in a real solution of

extraordinary events. Another advantage is that possible mistakes in dealing with an extraordinary event have no significant impact on society –it means that they do not cause human casualties, property losses or environment.

3 Classification of Simulation Approaches

This chapter presents approaches and methods used in the research. Based on the analysis of the individual approaches, their individual features, possibilities and outputs were assessed for the evaluation in the proposed simulation tools for the support of practical training in dealing with emergency events or crisis situations.

3.1 Process Framework for Emergency Management

It is a new progressive view on process support of organizations in the private and public sector [7]. It is created for the purpose of better understanding of issues that are connected with process deployment in the specific area of interest (e.g. emergency management, education). The general purpose of the model is given by two main views, which are Methodology view and the global Architecture view. The paper [7] shows that education, simulation and practical exercises are the main elements of the emergency management processes.

3.2 Dynamic Vector Logistics of Processes

The Dynamic Vector Logistics of Processes method was chosen to process support in the research project [5], [8]. The Dynamic Vector Logistics of Processes is friendly computer assisted language for the analysis, evaluation, heuristics, modelling, simulation, scenarios and engineering of any entity's relationships in a Blazon on a scene [8].

It is created for the purpose of better understanding of issues that are connected with process deployment in the specific area of interest (e.g. emergency management, education). The general purpose of the model is given by three main views, which are the emergency management, the participating Entities and the Processes [5], [8].

In Fig.1 is, by using the method of Dynamic Vector Logistics Processes, expressed the basic relationship between expertise and experience, and their position in the process of the emergency staff.

4 Practical Exercises

For the training preparation, instructors can use various computer programs which enable better graphic visualization of the solution, practice different ways of dealing with the different situations and the way of command. And what more, they can represent a tool for the various roles in the process of solution of the emergency situation. The environment of these programs increases the effect of preparation, which results in being more realistic and the trainees will better memorize the trained actions [2], [4].

4.1 The place and role of simulation programs

Simulation is often used for the training of civil as well as military employees. It is used in the case when it is too expensive or too dangerous for the trainees to use the facilities in the real world. In such situations they spend time by learning valuable experience in the “safe“ virtual environment. The advantage is also represented by mistakes which the system, during the training enables in safety-critical systems.

The basic role of simulators and of simulation programs lies in the application of the knowledge

and skills gained from studying and professional experience to practical use in dealing with emergencies. An important role is played by the initial analysis of real intervention in dealing with emergencies. This can identify the required level of preparedness, define management processes, and then work on improving the level of preparedness.

Big roles also play technological improvements that facilitate the work of managers. But we must not forget the main principle of simulation of crisis management processes. "Training crisis team do not have anything else than what it has at its real workplace." This means that the training crisis staff is equipped with hardware (PC, laptop, mobile phone, communication technology ...) and documentation (plans, manuals SOP ...) which will be available in the real situation. However, during the simulation some equipment can be either removed or disabled to use (defects, broken links, etc.).

The process of improving the skills of crisis staffs is in Fig.1, which shows the basic relationships and ties of individual trainees entities in computer aided exercises followed by individual entities closely specified in Table 1.

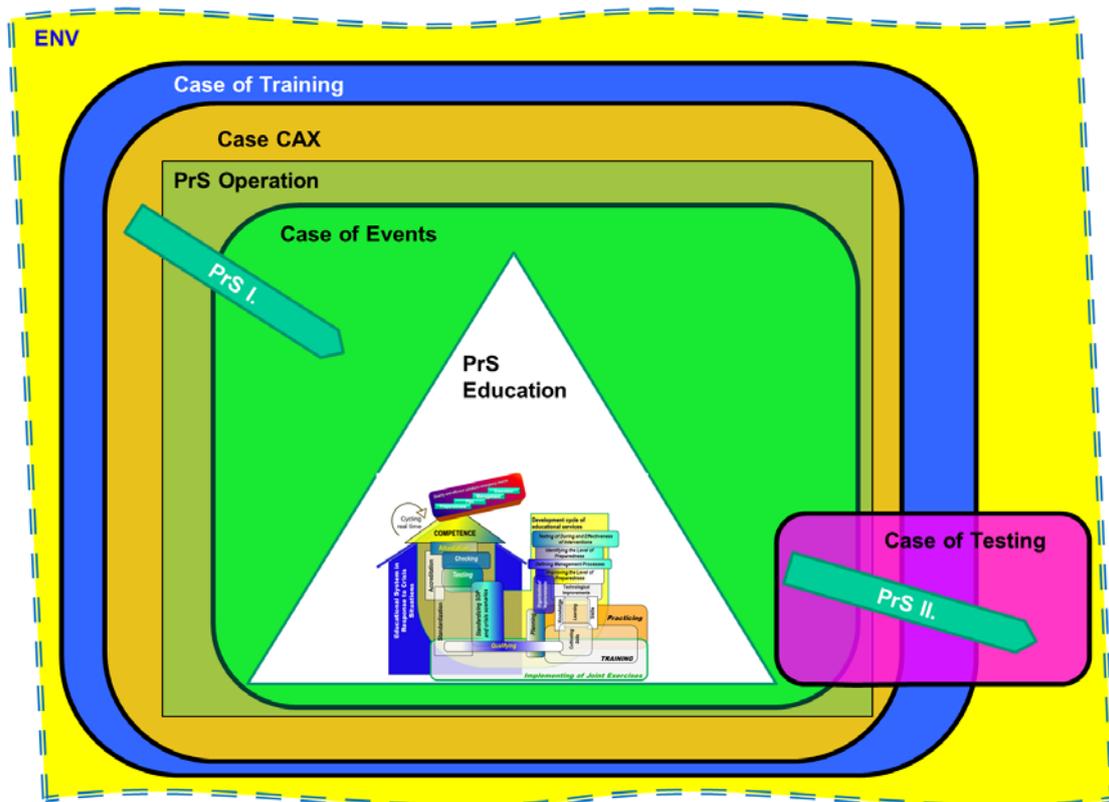


Fig.1 Education Process of Crisis Management Staff

Table 1 Entities Blazon of Education Process

Entities		
Title/Symbol	Semantics	Determination
ENV	Environment of improvement capabilities crisis staff	Educational environment
Case of Training	Training of crisis staff members	Training
Case of CAX	Computer aided exercises	Simulation
PrS Operation	Process system of special software operation	Software
Case of Events	Training of emergency events type floods, leakage of dangerous substances, fires, etc.	Real environment (workplaces) of crisis staff
PrSEducation	Knowledge vs. Skill	Requirements
PrSI.	Requirements of better capabilities for crisis staff	Logistics flow
PrSII.	Training of capabilities for crisis staff	Logistics flow
Case of Testing	Testing of capability of crisis staff.	Controlling

The basic element, where there is a whole improvement process of crisis staff capabilities. In this environment, it is necessary to realize the basic requirement and the need to increase the practical skills of members of the crisis staff. On that basis, it is necessary to choose the method to increase practical skills. In our case it is the computer aided exercises. In this case of use, it helps to practice a pre-selected or developed software. It is displayed in the RC Operation.

The fundamental part of the educational process is the Case of Events, where is decided the purpose of practical training. Depending on the purpose of the training is a modeled different scenario of extraordinary event (floods, leakage of dangerous substances, fires, etc., for the simulation in PRS Education program.

In the process of education are all included processes of determining the scope of required experience and tested knowledge. In more detail, the entire system of determining the required competencies and their acquisition and practical exercises is presented in the book Crisis

Scenarios [8]. The most important role is played by practical experiences, which are obtained by applying knowledge in practice or in simulated practice.

Logistic process control systems reflect the essential requirements for the capacity of the members of crisis staffs in dealing with extraordinary events. PRS II expresses outputs of practical training, which are controlled by the Case of Testing and evaluate the whole learning process.

Due to the large number of simulators and simulation software it is very difficult to choose the right one. In the best case it is the most appropriate to determine the characteristics and functionality we request for the simulator and let to prepare simulator "tailored" that will precisely meet the needs of the organization.

To ensure the required functionalities were chosen simulation programs that are available in the Czech Republic and meet the essential requirements for the training of members of crisis staffs in preparation for dealing with extraordinary events.

4.2 Programs of Computer-aided Exercises

In the area of education and practical training of the rescue services are several software tools which use computer simulation – CAX. In this chapter are selected simulation software tools that are concentrating primarily on education and training of crisis staffs and units components in the civil sector [4].

From a large number of simulation programs which were analyzed from tools concentrating on the education and practical exercises were selected to the final selection of these programs:

- Emergency;
- Virtual Battlespace 3 (VBS3) or Virtual Battlespace 2[8],[9];
- Virtual Reality training software for safety and security (XVR) [10], [11];
- One Semi-Automated Forces (OneSAF) [11];
- WASP simulation system [12];
- RESPO - Blackout Protection [13];
- Emergency and Disaster Management Simulation (EDMSIM) [14];
- Masa Synergy [15].

From the tools for simulations, modelling and support of decision-making processes in crisis management, only those programs which met predefined criteria, which were analyzed and

included in the shortlist. These criteria were determined based on the experience of the research team from the area of information support and after consultations with experts in the area dealing with development of simulation tools.

The basic criteria were:

- Functionality;
- Usability in solving emergency events;
- Practical training of the teams and individuals;
- Possibility of implementation of outputs from other tools;
- Possibilities of editing scenarios.

During the analysis of available simulation tools, some criteria were reconsidered and complemented with other characteristics which were required from the simulation tools. These added characteristics specified in more detail the choice of suitable simulators and made the original characteristics about what the simulator should meet, more accurate. Results of the evaluation can be seen in Table 2.

Table 2 Evaluation Criteria of Simulation Programs

Simulation programs	Scene Editor	Implementation of External Data	Simulation Level (Teams or Individuals)	Communication Possibilities	Continuity in Relation to the Surrounding Environment
EMERGENCY	NO	NO	Individuals	Voice	NO
VBS3	YES	YES	Individuals and Teams	Voice and Text	YES
XVR	YES	YES	Individuals and Teams	Voice and Text (integrated)	YES
OneSAF	YES	YES	Teams	Voice	YES
WASP	YES	YES	Teams	Voice (integrated)	YES
RESPO	NO	YES	Individuals	Voice	NO
EDMSIM	YES	YES	Teams	Voice	YES
MASA SYNERGY	YES	YES	Teams	Voice (integrated)	YES

Other important factors which influence the usability of software applications and simulation programs are their own functionalities which enable practical training of more activities which are later

integrated into the course of the simulation. Individual utilities extend usability of the simulators and their application range in Table 3.

Table 3 Additional Important Criteria of Simulation Programs

Simulation programs	Informing	Training	Practical Exercises	Testing other Programs	Controlling	Management
EMERGENCY	NO	YES	YES	NO	NO	NO
VBS3	NO	YES	YES	YES	YES	YES
XVR	NO	YES	YES	YES	NO	YES

OneSAF	YES	YES	YES	NO	YES	YES
WASP	YES	YES	YES	NO	YES	YES
RESPO	YES	YES	YES	NO	-	YES
EDMSIM	YES	YES	YES	YES	YES	YES
MASA SYNERGY	NO	YES	YES	YES	YES	YES

5 Conclusion

In analyzing the functionality requirements used in simulators for training of crisis staffs have been very difficult to define what skills are needed for crisis staffs to practice. Different levels of governance need to practice different qualities and professional skills. Basics, which are the same for all levels of crisis management, are practicing communication and management skills. On this characteristics is focused and evaluation of individual simulators.

During the analysis of the simulators it has been found out that any of the producers does not provide a testing version of its simulator for verification of all its characteristics and functionalities. Therefore it was very difficult to carry out the evaluation of practical, as well as utility characteristics of individual applications. Information was taken both from the sources provided by the producers of individual simulators and from the publications and evaluation provided by the users using the given software.

The results showed that most of simulators have guaranteed external communication program like Skype etc. Only simulators XVR, WASP and Masa Synergy have an integrated communications program that records all communication in the simulation.

Choose the best simulation tool to increase the competencies of the crisis staffs in dealing with extraordinary events is very difficult and it will be necessary in dealing with development or upgrade simulation program further.

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