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EVALUATION A CITY EMERGENCY MANAGEMENT EXERCISE FOR ORGANIZATIONAL LEARNING

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ABSTRACT

All relevant emergency management services are necessary for a Smart City to achieve public protection and property safety in response to a major disaster or an unplanned event, including simulated flooding exercise measures. It is the first time that a Safety through Organizational Learning-methodology has been used for Evaluating a City Emergency Management Field Exercise. A city's ability to respond effectively to a natural disaster e.g. flood defence heavily depends on emergency management's preparation for successful responses. An efficient way to test the level of preparation of City Emergency Management is to hold a Field Exercise in a vulnerable city. Analysing with Safety through Organizational Learning allows the identification of concrete alternative corrective actions/measures by which the probability that similar events occur in the future can radically be reduced. Furthermore, such measures help organisational learning, thereby contributing to the development and maintenance of a long-term, safe organisational culture.

KEYWORDS

city emergency management, exercise, SOL methodology, public safety, evaluation

CLASSIFICATION

JEL: C10, C83, H84, Q54

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INTRODUCTION

The Disaster Management trains and exercises in order to develop our ability to handle disasters and crises, both individual organisations and local emergency management authorities. Qualitative methods of evaluation increase opportunities for identifying and utilising the lessons learned in exercises [1].

After the exercise, there must be time to take a step back and reflect on what has gone well and what has not. What are the ways and means by which improvements might be made? An evaluation reviews initiatives, operations and action, for example, in order to ensure and maintain or improve their quality. With this definition in mind, it is clear that all organisations should conduct evaluations. The basis for an exercise such as this is a more open and experience-based methodology, in which exercise participants are made to respond and take action in a situation rather than merely discuss it.

The framework of the analysis was given by the event-analysis method called Safety through Organizational Learning (SOL), through which the partakers could explore the safety gaps of a certain event or activity and had the opportunity to make suggestions for improvement. This event was one of the actions of the international field exercise, called EUWA [2].

The most frequently mentioned organizational safety gap was communication and its connecting areas, while the most important factors were those in connection with responsibility and regulations.

After identifying the problems, the partakers – on the second day of the analysis – formulated their improving suggestions that support the future organizational learning process, thus leading to developing a more effective way of handling real disaster and exercise situations.

ANIMA Polygraph Psychological Consulting Ltd. has already applied SOL analysis with several organizations to carry out organisational diagnostics and improve their organizational culture. The method has also been successfully used in different practical contexts, such as examinations of accidents happening during rescue activities and deliberate damages.

During the planning and preparation phase, it was important to gain a comprehensive picture of the process of the field exercise. It was also important to choose employees who were either present at the exercise or at least have a comprehensive picture of the process so that they can effectively promote cooperation and information-gathering. One of the main principles of SOL-analysis is to have leading employees of the company involved as they are the ones who are able to formulate and introduce effective management actions for the sake of successful exercises.

For SOL-analysis it is inevitable to have an event (a part of the exercise) which can be divided into components so that the contributing factors to be developed can be identified. Thus, the subject of analysis was not the whole field exercise, only the events of 5th April 2017. The 2-day-long analysis required the presence and continuous work of 7 experts, so it was also important to choose experts who are able to take part in the whole process and be present on both days.

APPLYING THE SOL-METHODOLOGY

The SOL method was initially developed by a research group under the guidance of Bernhardt Wilpert at the Berlin University of Technology [3] in 1997.

It was initially developed for the nuclear power industry; however, a version for the chemical industry also exists and a computer supported version was later developed as well in

1999 0. The SOL method has been adopted by the Swiss and German nuclear industries as standard procedure for their in-depth event analyses 0. SOL aims at facilitating organisational learning from events by supporting the process of analysing events, ensuring its standardised conduct and mobilising expert knowledge and creativity in the analysis 0 The SOL method is based on the so called socio-technical system model (Fig. 1) and covers the identification of critical human factors as well as safety relevant technical, organisational and management factors.

As the very first step of the analysis of the selected event, a situational description is constructed 0, and after that all the relevant and available objective data are collected concerning this event, without questioning its significance. Later the analysed event is decomposed into smaller elements of the event. These elementary events or sub-events are called "event building blocks", as individual actions performed by the personnel, organisational units or technological systems [8].

An event building block is describing one particular action of one given actor. Actors can either be persons, group of persons or technical components. The building blocks are arranged in an actor-time diagram and the available data are interpreted at the level of these building blocks. These elements are added to the actor-time diagram, thus facilitating the progress of the investigation and the further collecting of information [6].

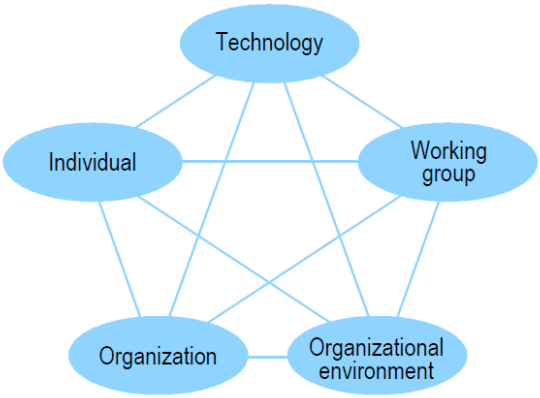

Figure 1. Socio-technical system model of event genesis **Error! Reference source not found.**.

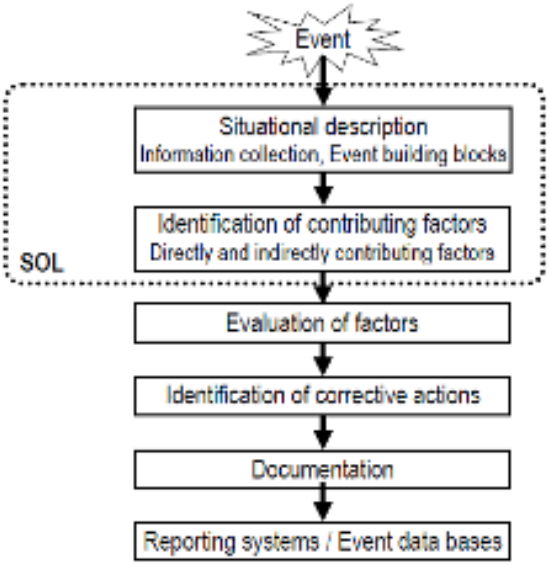

Figure 2. SOL & SOL-VE Analysis Procedure [6].

Analysing an event with SOL is conceptualised as a backward oriented problem-solving process which is presented in Figure 2. The SOL analysis means going through the steps indicated (Fig. 2) and usually takes three subsequent working days, requiring very intense and focussed work from the participating evaluators. While the pencil and paper version of SOL had already been successfully used also in civil aviation and in chemical process industry, SOL-VE has meanwhile been adopted by the Swiss and German nuclear industry as the standing operating procedure for event analyses [6].

AIM AND OBJECTIVES OF CITY EMERGENCY MANAGEMENT EXERCISE

Cities worldwide are placing increasing importance on building up resilience to natural disasters, such as flood protection situation, caused by climate change. Smart cities can use rescuers and analytical capabilities to enhance and coordinate the information flow between emergeny management and multiple actors, such as govermental authorities, emergency services and rescuers as a first responders, and citizens 0.

All relevant emergency management services which are necessary in a Smart City, in response to a major disaster, or unplanned event, including a simulated flooding exercise measures to public protection and property safety. Floods are the most common and widespread of all natural disasters–except fire. Most cities in Europe can experience some kind of flooding after spring rains, heavy thunderstorms, or winter snow thaws. Floods can be slow, or fast rising but generally develop over a period of days 0.

Disasters resulting from natural and man-made disasters, can have serious effects on cities and the areas they live in. It is therefore essential to ensure that emergency management systems are at all times ready to respond to crises in the most efficient manner, saving as many lives as possible and limiting damage to the environment and property. Emergeny management exercises as part of the civil protection exercises are fundamental to prepare rescue teams to react fast and in a coordinated manner when disasters occur. Exercises at European level, involving a number of countries at a time [10]. Emergency Management, Themanagerial function charged with creating the framework within which communities (cities) reduce vulnerability to hazards and cope with disasters.

The goal of the EUWA exercise was to practice the process of requesting international assistance and responding to such a request after large scale floods in Hungary via the Union Civil Protection Mechanism. The following objectives were to be achieved:

- Verification and improvement of the procedures (alert, mobilization, deployment, etc.) of the participating intervention teams.
- Increased understanding of the Union Civil Protection Mechanism (including Host Nation Support Guidelines) deepened;
- Enhancement of the operational and coordinative cooperation amongst the intervention teams.
- Testing of the provision and receipt of civil protection assistance via the Union Civil Protection Mechanism (including communication and coordination with Emergency Response Coordination Centre).

In line with the aim and objectives of EUWA, the terms of reference of the Senior Exercise Evaluator, the provisions for exercise evaluation in the exercise instructions and in discussions with the Core Planning Group (CPG) of EUWA, the following areas have been preliminarily defined as the focus areas for the evaluation of EUWA. The evaluation focussed on three areas:

- existing coordination and cooperation tools, processes and procedures amongst the exercise participants, the exercise instructions and exercise information materials [9][9];

- systemic gaps, weaknesses and bottlenecks in the system of bi- and multilateral cross-border cooperation, interoperability and compatibility with special focus on floods within river basins [12]; and
- EUWA organisation and conduct (post-evaluation, i.e. after the end of the exercise).

The methodologies utilised are observation, analysis and recommendation (OAR), which enable the capture of 'significant sub-events' – using SOL terminology: "event building blocks" – with consideration of causal factors, responding actions and consequences providing outcomes for further development.

On-site and remote observation and interviews: Evaluators carried out physical and remote observations of organisations, modules, teams, staff and individuals undertaking their roles during the exercise. Evaluators assessed and documented the overall exercise structure and exercise conduct as well as the coordination and cooperation performance of the exercise participants based on the main objectives of EUWA without pinpointing individuals or specific organisations (unless explicitly requested to do so). Therefore, the focus was on processes and procedures.

USING THE SOL-ANALYSIS FOR EVALUATING EXERCISE

FIRST STEP IN SOL-ANALYSIS

SOL-methodology, as a proven tool for supporting organizational learning from safety relevant events means that an organization conducts systematic analyses of accidents, incidents or near misses and feeds the resulting experience back to its members using an appropriate reporting or management system. It was the first time that SOL-methodology was used for Evaluating a City Emergency Management Field Exercise by European Project Partners.

The conceptual framework of the analysis was that of the SOL as described in Section 1. For carrying out a SOL-analysis in our case it was inevitable to select an important, critical event (a decisive part of the exercise) the detailed analysis of which promised valuable experiences and learning possibilities. This selected event (situation) must later be decomposed into event building blocks so that the contributing factors belonging to these building block could be identified.

A short description of this selected event (situation) is as follows. On the 4th day of the whole exercise – on the 2nd day of the field exercise – at 13.00 hours a task was given to all the rescue teams (Hungarian, Slovakian, Serbian and Croatian team-members – about 200 persons altogether) to take part in the exercise: they had to prevent the BoO (Base of Operation) from being flooded using the method of building a sand-bag dyke-system. Due to the lack of effective protection, however, the BoO was "flooded" at 17.00 pm. Based on the experiences of the event, we were able to formulate development suggestions in the field of international assistance, to strengthen the EU Civil Protection Mechanism (EUCPM).

The 2-day-long SOL analysis required the presence and continuous work of seven selected experts as evaluators, so it was also important to select experts who are able to take part in the whole process and to be present on both days. The most frequently mentioned organizational safety gaps were found in the communication and its connecting areas, while the most important factors were those in connection with responsibility and regulations. After identifying the problems, the partakers – on the second day of the analysis – formulated their improving suggestions that support the future organizational learning process, thus leading to developing a more effective way of handling real disaster and exercise situations.

COMPONENTS IN TIME CONTEXT AND CONTRIBUTING FACTORS OF THE EVENT

On the 1st day of the SOL-analysis the event (situation) chosen for analysis (problems rising during the process of international Base of Operation protection task) was decomposed into its components (event building blocks). Having identified these components, concerning each event building block we were seeking the answers to the following questions:

- WHEN? – The time of the event building block,
- WHERE? – The place/scene of the event building block,
- WHO? – The (main) actor(s) of the event building block,
- WHAT? – The action done by the (main) actor(s) during this event building block,
- HOW? – Description of the event building block, textual remarks on the actions.

At this early stage dealing with the WHY question was still definitely not allowed. As stemming from SOL method basic principles, it was an important criterion that all the way during the analysis consensual decisions be reached. This way the end product reflects the common and unanimous opinion of the seven evaluators. When recording the components, emphasis was put on the documents (log-book, end-report, photo and video documentation, radio conversation recordings) connected to the exercise. On the 2nd day the factors and the components of the event chosen for analysis were matched. The main question to be answered already was: WHY a certain event building block happened. All the participants were given a list of factors, which were grouped.

At this early stage dealing with the WHY question was not allowed. WHY questions are particularly relevant in the phase of analysis designed for identifying factors. The function of the early phase is description of events and situations. Following the basic principles of the SOL method, it was an important criterion throughout the analysis that a consensual decision be reached. This way the end product reflects the common and unanimous opinion of the seven evaluators. When recording the components, emphasis was put on the documents (log-book, end-report, photo and video documentation, radio conversation recordings) connected to the exercise. The seven participating evaluators of the analysis included the head evaluator, the Exercise Control (EXCON) of the exercise, organisers, heads and subordinates of the local commanding staff and the head of operations.

The phase relies heavily on earlier description of the situation, events. “One of the most important elements in identifying contributing factors are questioning data related to each and every event block. We need so-called “WHY questions” (Why he/she? Why then? Why there? Why that? etc.) because they help uncovering the extent to which events in event blocks occurred according to planning. When mismatch occurs compared to the planned or a more logical and safer solution, you have to find the contributing factor that most precisely covers the cause for the mismatch” [9].

IDENTIFYING CONTRIBUTING FACTORS AND EVALUATION

The event building blocks finally were shown in chronological order in the actor-time diagram together with the contributing factors and their scores paired to them. After some debates the participants finally consensually decided to decompose the whole event into the following nine event building blocks.

1. European Union Civil Protection Team members were selected based on curriculum vitae template provided by the EU.
2. After communication nothing has happened for a long time.
3. Local Emergency Management Authority had not received information about spare capacity of international forces for 41 minutes.

4. The Slovak rescue team was not aware of the evolution of the situation on the base.
5. The danger the situation represented for the base, and the scale of the danger.
6. International forces did not start building the temporary protective system.
7. They considered that the information they received from the On Site Operational Coordination Center (OSOCC) was not credible.
8. Part of international teams did not bring standard protective gloves, so they requested protective gloves for 16 persons.
9. The Croatian team quit executing the task before completion.

The event building blocks finally were shown in chronological order in the actor-time diagram together with the contributing factors and their scores paired to them. After some debates the participants consensually decided to decompose the whole event into 9 event building blocks. For example, see 9th event in Tables 1 and 2.

Table 1. 9th event building block with 4W questions (BoO – Base of Operation).

WHEN?	WHO?	WHERE?	WHAT?	REMARK
17:00 05.04. 2017.	Flooding	BoO	BoO flooded	BoO flooded because of inappropriate system of flood defence (lack of sand bag dyke system).

Table 2. Evaluation of 9th event building block with weight numbers (E – Event, O – Organization, S – Summa).

CONTRIBUTING FACTOR	FACTOR	REMARK	E	O	S	Means	
The task given out by the LEMA was not carried out fully	Rule violation	Up to the time of the forecast floodwave (17:00) the sand-bag dyke system to protect the Base of Operation was not completed. It was not possible to relocate the Base of Operation (due to lack of time and space).	5	3	8	**Event** **Org.** **Sum.**	**5** **3** **8**

Table 2 shows the analysis of the final critical event. It also shows that the exercise concluded almost without results because the simulation made it clear that in a real situation the base of operations would have been thoroughly flooded because of deficiencies in the structure of the protection system, thus endangering the lives of rescue teams and producing material damage. Teams refused to complete the given tasks because of deficient leadership. Instead of fulfilling their tasks, they continuously looked for objections and excuses on professional grounds.

ANALYSIS OF THE CONTRIBUTING FACTORS AND THEIR VALUES

The participants matched 40 contributing factors to the 9 events building blocks, which means that to one event building block belonged 4,4 contributing factors on an average. Most often (11 times) it was the Communication factor, see in Table 3, which was chosen from all the factors by the participants. This means 27,5 % of all choices, which suggests that the identified problems most frequently are connected to certain kinds and forms of communication during the exercise. Responsibility and Organisation and management were also relatively often (4 times) chosen. The value of the event (E) indicates how much the factor in question contributes to the event itself. The organisational value (O) indicates how urgent the organisational measures to be taken are.

Table 3 depicts that – according to the opinion of the evaluators – although one can most often find Communication in the background of the problems, the average value of Responsibility

Table 3. The number of occurrence frequency and percentages of some main SOL-factors.

FACTORS	FREQUENCY	PERCENTAGES, %
Communication	11	27,50
Responsibility	4	10,00
Organization and management	4	10,00
Information	3	7,50

and Rules, regulations and Documentation is much higher. From the organisational values one can see that the latter 2 factors are very important organisational measures to be taken, so they will be reflected among the organisational development suggestions.

SUGGESTIONS FOR MANAGEMENT MEASURES

City emergency management agains flooding plays a vital role in overall flood protection. It can be divided into three stages:

- preparedness: pre-flood measures to ensure effective response;
- response and protecion: measures to reduce adverse impacts during flooding;
- recovery: measures to assist the affected city to rebuild itself.

Preparedness includes the issuance of timely and effective early warnings and the temporary evacuation of citizens and property from threatened cities. Training in Exercise and public awareness; coordination among governmental and rescue teams (Fig. 3); effective stakeholder participation; and early warning systems are key components of preparedness planning [12].

Flood protection can be defined as the implemention of pre-planned activities during flooding to reduce the adverse impacts to the population at risk. Protection of critical infrastructure mean, to remove citisens from facilities at risk, such as hospitals, schools, industrial sites, bridges, or houses of citizen (Figs. 4 and 5). City emergency management are expected to assess the immediate needs of affected cities, evacuate population in high-risk areas, mobilizing local rescue teams, take immediate measures to repair or restore damaged infrastructure 0.

Figure 3. International participants on EUWA field full scale exercise at Flood risk village of Szabolcsveresmart (Photo by DG ECHO).

Figure 4. Simulated Flooded House in virtual City and water resuers as first responders (Photo by DG ECHO).

Figure 5. Map of the area after the dam failure at Simulated City of "Hunoria" in City Emergency Management Plan. Area for Field Exercise.

CONCLUSION AND SUMMARY OF EVALUATION OF THE ANALYSIS

Using the method of the SOL-analysis, several hidden deficiencies of the exercise have been identified. They reported communication and the distortion of information as the most frequent reasons for problems. Besides these, they also identified the lack of responsible work as an even more serious problem. Bottlenecks regarding certain rules were also revealed.

The SOL-analysis as an evaluation technique in case of EU exercises, as it well serves the organisational learning of EU member states, thus contributing to safer living conditions of EU citizens. According Socio-technical system model, the purpose of the event analysis is to identify the real key individual, group or organisational human reasons for, and key technological factors of, the events that occurred. The SOL-methodology allows the identification of concrete alternative measures by which the probability that similar events occur in the future can be radically reduced.

The first time that SOL-methodology was used for Evaluating a City Emergency Management Field Exercise by European Project Partners. A city's ability to respond effectively to natural disaster as a flood protection heavily depends on emergency management preparation for successful responses. Efficient to test the level of preparation of City Emergency Management holds a Field Exercise in vulnerable city. City emergency management requires understanding different flood scenarios that may require adaptive situational management actions 0. City Emergency management requires cooperation across different responders and administrative levels horizontally and vertically.

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