LEARNING FROM PAST DISASTERS TO IMPROVE CRISIS MANAGEMENT

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Abstract

In the event of a disaster the coordinated response of emergency services is crucial for saving lives and protecting critical infrastructure. Efficient communication and access to relevant information are essential elements in the immediate aftermath and all phases of the crisis management cycle to maintain public safety. As part of the European Commission funded FP7 project EPISECC (Establish Pan-European Information Space to Enhance Security of Citizens), an inventory of past disasters and critical events was developed. Information was obtained by systematic interviews with experts active in the field of crisis and disaster management on both national and international level. They represent organisations such as first responders, emergency services and civil protection offices from 15 EU (European Union) countries. The paper will outline several aspects such as the quality of information exchange between crisis managers and the analysis of key recommendations for improvement identified during the management of past disasters.

Keywords: Crisis and Disaster Management, Critical Infrastructure, Emergency Services, Cross-Border Cooperation

1 INTRODUCTION

When a disaster strikes the possibility of exchanging information is vital for a successful management and to prepare, coordinate and dispatch the necessary resources. However, if events such as floodings, forest fires or earthquakes occur, the capabilities of communication and information are either interrupted or stretched to their limits due to wide scale destruction of critical infrastructure such as the transport, electricity or telecommunication networks. A successful management of the post-disaster phase depends on the reestablishment of communication channels between relevant emergency services and on their ability to work together. In particular the sharing of information, the ability to effectively communicate and an informed understanding of the exact content of exchanged messages are crucial when reacting to disasters. This is a particular challenge in cross-border events where stakeholders and their systems must be able to communicate effectively [1].

In order to collect information about past critical events and disasters the EPISECC inventory was developed consisting of a questionnaire, a database and a data analysis module. Altogether 49 interviews with various stakeholders in crisis and disaster management were carried out. These interviews were the basis for an in-depth data analysis and enabled the identification of areas of improvement to enhance disaster assessment and to leverage the preparation of disaster managers for future events. During the interviewing process a variety of information on standards, guidelines, recommendations, IT tools, processes and data sources of organisations involved in crisis and disaster management across Europe was collected. Based on the analysis of the inventory data the paper will outline several aspects such as (i) the role of critical infrastructure, (ii) interoperability (including quality) of information exchange between European crisis managers, (iii) individual responses from stakeholders on what would have helped in previous disasters and (iv) recommendations for improvements identified by studying the management of past disasters.

2 METHODOLOGY

2.1 Establishment of EPISECC inventory

The implementation of the EPISECC inventory was based on an already existing framework of AIT Austrian Institute of Technology EMIKAT [2] which is used in Austria for analysing emission data since many years. This framework has the ability to integrate data models of various domains. Therefore, it was possible to include the developed EPISECC inventory data model into the AIT framework and create the EPISECC questionnaire from that input (Fig. 1).

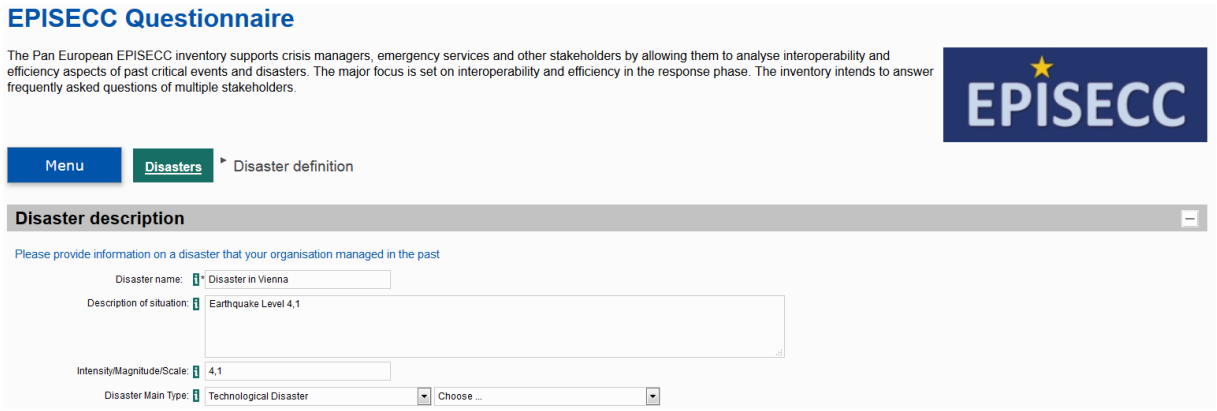

Figure 1: Extract from the EPISECC Questionnaire

The interviewed experts can enter available information about data from various categories such as the description of the past disasters. The inputs of these fields can be combined and compared with information from other interviews in an anonymised way. After applying the data analysis module the general results and the combinations of these fields can be made available via graphs or tables (Fig. 4).

2.2 Interview process

To gather the necessary information from actors involved in crisis and disaster management, it was necessary to interview stakeholders about the management of past critical events and disasters with an electronic questionnaire. This process of interviewing was carried out by the members of the EPISECC consortium with personal interviews, in person or by phone. The questions cover a broad variety of issues in disaster management and included information

on the interviewee, the organisation and the specific disaster in which he was involved. The respondents were asked about topics such as processes used, standards applied, data resources used, cooperation with other organisations and interoperability in disaster relief actions. The questionnaire was designed in such a way to gather as much information as possible from various kinds of organisations working on strategic, tactical and operational level. Currently, 49 representatives from various organisations in the field of crisis and disaster management were interviewed.

3 RESULTS

3.1 General Results of Inventory

The respondents represent a wide range of stakeholders of which the vast majority of 78 % categorized themselves as government organisations, 14 % as NGOs and the rest as other organisations. According to the type of organisation (Fig. 2) 35 % are active in the area of Civil Protection on different governmental levels. Federal Ministries account for 18% of which a big majority are the ministries of the interior responsible for disaster management in most countries. Equally important are the Fire Services with 18 % followed by Emergency Medical Services with 12 % and the Police with 8 %. The remaining 8 % belong to the category of Other which include Armed Forces, UN (United Nation) organisations or other government agencies.

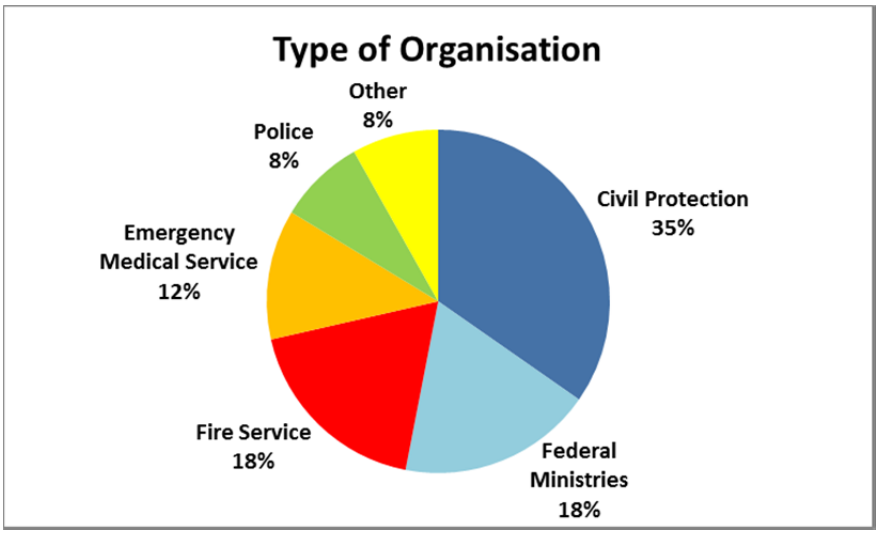

Figure 2: Type of interviewed organisation

The interviewed representatives cover a variety of organisations from 15 EU countries plus Switzerland, Norway and Israel. A considerable share of 63% of the interviews was conducted in four countries (Austria, Italy, Croatia and Germany). Due to the different governmental structures and responsibilities within these countries (federal vs. centralized systems) the balance within the survey was still maintained.

With regard to the type of disasters, the majority consist of extreme weather events and cascading effects which are common throughout many parts of Europe. The biggest natural disasters are Floodings with 28 % of all events. Landslides are closely related to floods as a cascading effect and account for another 9%. Furthermore, major Fires are the second largest category with 14 % of which the vast majority are forest fires. In addition, events related to the current Migration of refugees are equally important with 14 %. Earthquakes account for 12 % and disasters related to Snow/Ice (e.g. snowstorms or sleet) for 7%. The category of Other accounts for 16 %, which includes a large variety of events such as plane crash, traffic accident and blackout (Fig. 3).

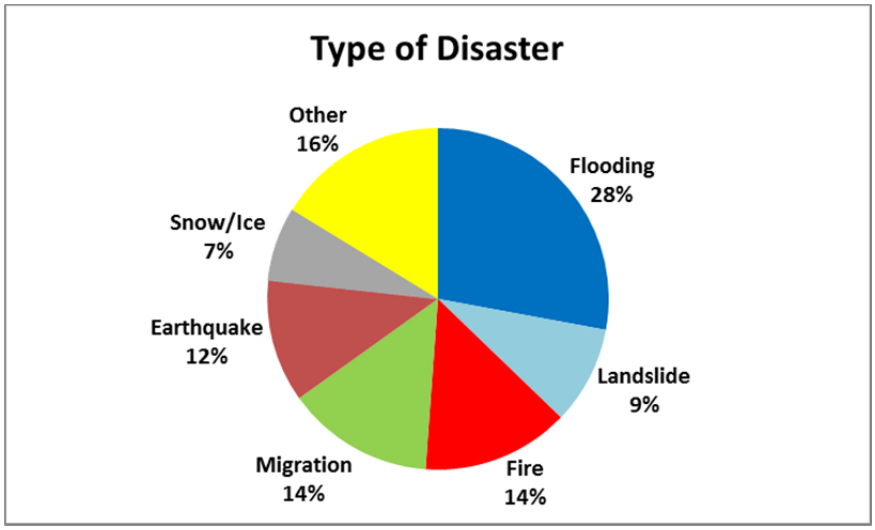

Figure 3: Type of Disasters

3.2 Critical Infrastructure

In case of a large-scale disaster, Critical Infrastructure is very often affected by the destructions caused with negative impacts on the population. This is also reflected in the results of the inventory. From a total of 45 entries to different types of disasters, infrastructure was affected 37 times. As provided in [2] Transportation was mostly affected in 92 % of all cases. In the second place Energy Supply was affected with 62% followed by Communication with 60 %. Health Infrastructure reached a probability of 35 %. The category of Other included 43 % of which damage to Buildings (44 %) and Water Supply (35%) were mostly named. If the different disasters are analysed by category (Hydrological, Geological, Climatological, Technological and Complex) Transportation dominates as most affected infrastructure [3].

It is interesting to notice that impacts on some Infrastructures seem to be related. If Health (HE) is affected the same applies to Communication (COM) in 93 % of all cases. A similar result can be observed by analysing the combination of Transport (TR), Communication and Health. In this case the probability of combined impacts reaches 91 %. If Energy (EN) is included the likelihood of all four infrastructures being affected is 77 % (Fig. 4).

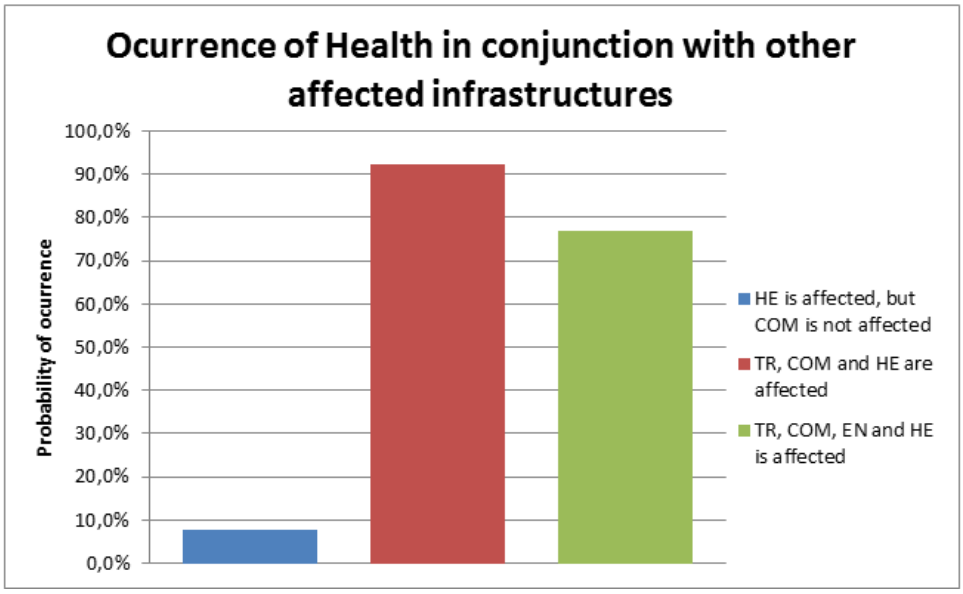

Figure 4: Combinations of Affected Infrastructures

The damage or destruction of infrastructure during a disaster has an impact on the fast and efficient operation of emergency services to provide assistance to the affected population. The quick rehabilitation of infrastructure plays a major role for successful crisis management.

3.3 Interoperability of Information Exchange

One main focus of the inventory was the establishment of methods to measure the quality of information exchange. For this purpose a key indicator for information interoperability was developed. In the following the main parameters of the indicator will be described briefly. A detailed description of the indicator can be found in [3]. The indicator can reach values between 0 (worst case, no information exchange) and 1 (excellent information exchange). The indicator consists of four parameters:

1. The time to establish a channel to communicate
2. The time required to communicate
3. The amount of data that was exchanged
4. The amount of data that was understood

All four values are normalized: DATA to the ideal amount of data exchanged or understood and TIME to the maximum acceptable time. The average indicator value of more than 160 analysed processes is 0.79 - a value that can be considered to be quite good. Only 7% of the indicators were below 0.50 showing that the majority of processes reached at least acceptable values. Nevertheless it turned out that stakeholders identified interoperability as a main requirement in order to improve disaster management (Section 3.4).

3.4 Individual Responses and Requirements from Stakeholders

The authors asked stakeholders for requirements that arose while managing past disasters and possible solutions and would have helped to improve the situation. In total 79 requirements were collected as indicated in Fig. 5.

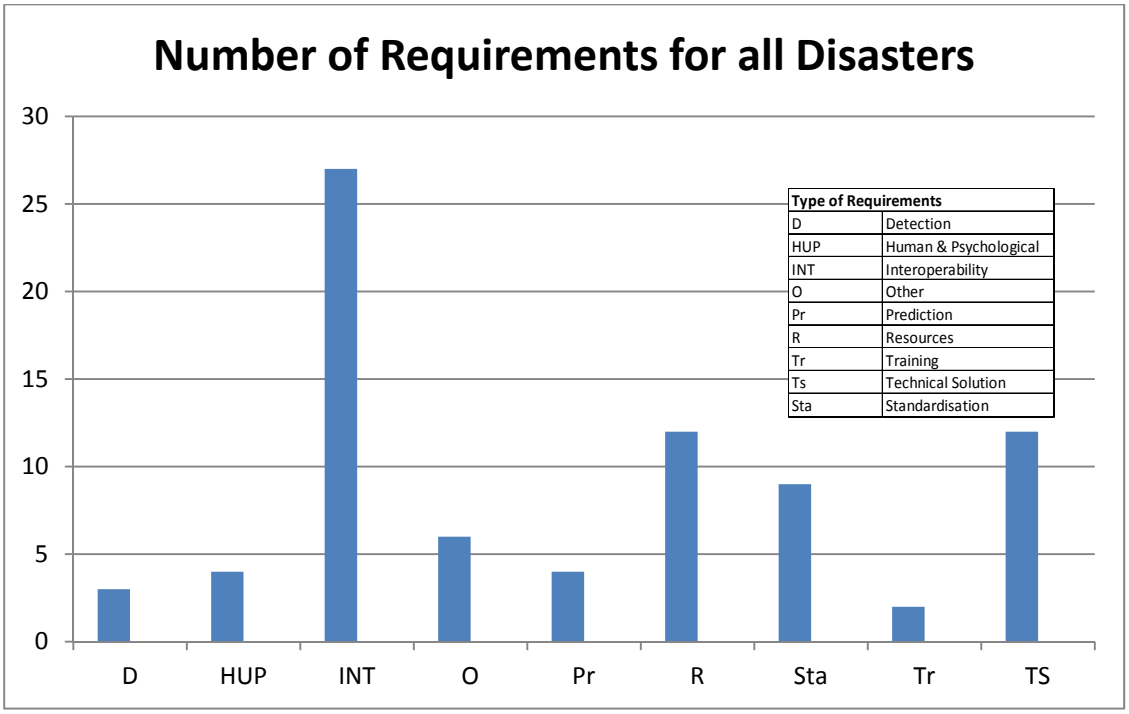

Figure 5: Requirements to improve disaster management

It turned out that the predominant requirement is Interoperability (34%). Other requirements such as Resources or Technical Solutions reached considerably lower values of less than 15 %. When comparing requirements according to the types of disasters the patterns are slightly changing but Interoperability remains the predominant category.

4 DISCUSSION

Given the fact that by the time this paper was written a considerable number of interviews had been conducted with organisations from countries located in central and southern Europe one could argue that this geographical bias will limit the feasibility of drawing general conclusions for the entire European Union. When looking closer at the public and governmental structures, the crisis and disaster management systems in place, and the exposure and/or involvement to/in transnational crisis and disasters, this group of countries (Austria, Italy, Croatia and Germany) give a fairly good representation of the “European Situation”.

The at the first glance ambivalent results between the computed interoperability indicator (medium to good interoperability) and the strong need for further interoperability improvements stated by the interviewees also require further discussion. Despite the interoperability challenges with common ICT systems and the lack of unified semantics, stakeholders and actors in crisis and disaster management found their ways to bridge the gaps. One strategy is to bypass defined (suboptimal) process steps by informal ones. Another approach is to introduce human-activity-based process steps such as using dedicated peer-to-peer sharing of data/information via email, phone or other public available channels rather than relying on already available ICT systems. Furthermore, almost every interviewee has answered the questions related to interoperability in the context of his or her sphere of responsibility. Therefore, those people have a two-fold experience. On the one hand that the challenges of information interoperability might be handled very well in their limited environment for at least their own (sub) processes and on the other the entirety of the information exchange processes and thereby the overall system performance still suffer from

effects caused by the absence or insufficient degree of interoperability in information exchange.

A detailed follow up analysis specifically focusing on the levels of interoperability may support a more detailed investigation of the reported interoperability requirements. Furthermore, these results may be compared to the research on interoperability levels of existing ICT tools for disaster management published in the EPISECC deliverable D2.1 “PPDR Information Space – Status quo of commercial, research and governmental projects and applications” [4] and in [1].

Apart from information exchange, the analysis of the type of affected infrastructures requires further attention. Independent of the type of disaster, transportation is the predominant affected infrastructure, potentially stressing the importance of optimized processes for resource provision. This is line with the second largest category of requests related to resources. Moreover, the interpretation of the combination of the affected infrastructures health, communication and energy needs further investigations. These results seem to indicate that the infrastructure health strongly depends on energy and communication.

5 OUTLOOK

The study carried out in the EPISECC project about a key indicator for information interoperability was tested on a good number of disaster situations across Europe. The developed inventory and the method implemented for adding content by questionnaires and interviews proved useful for both the practitioners and the researchers.

Since Information Interoperability has been recognised by practitioners and stakeholders as one of the major challenges in disaster management, there is plenty of scope for enlarging the inventory and refine the interoperability index, aiming at identifying both the elements in the communication chain that affect (positively and negatively) the understanding between authorities and the impact of new technological solutions and operational processes on disaster management.

The project is currently expanding the database of the inventory by performing further investigations. One focus is set on the current migration of refugees with focus on cross border information exchange as well as request of resources. Additional fields of application such as use of the inventory for analysing the way organisations managed past large scale accidents are currently investigated. Finally, the results of the inventory are used to improve the design of the Common Information Space developed in the frame of EPISECC.

The members of the EPISECC project evaluate the best course of action for making the inventory a living tool, available for being enriched with events from the past and updated with recent experiences and new solutions.

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