INFORMATION & SECURITY
An International Journal

Scenario-based Security Foresight

Edited by
Alexander Siedschlag

Procon Ltd.

Volume 29, 2013

Content *I&S*

The Way Ahead

I&S Monitor

Information & Security: An International Journal

Procházková, vol.29, 2013, 127-144 http://dx.doi.org/10.11610/isij.2910

NATURAL DISASTERS´ MANAGEMENT AND IDENTIFICATION OF PRIORITY ISSUES FOR FUTURE RESEARCH

Dana PROCHÁZKOVÁ

Abstract: Natural disasters threaten human society from time immemorial. They are caused by processes in the Earth core and Earth surface, or in the atmosphere, and by processes in the vicinity of the Planet. Various phenomena in the human system occur as a result of its own development or under the impact of other processes. This research was targeted at natural disasters such as avalanches, hot wet summer days, drought, dams rupture, floods, tsunamis, earthquakes, volcanic eruptions, landslides, rocks tumbling down, forest fires, wind storms, tornadoes, excessive rain or snow falls, and gas erosions from the core. It identifies deficits at natural disaster management from the viewpoint of the safe community concept that has been promoted by the EU since 2004.

Keywords: Human system, natural disasters, management, security, safety, disaster management

Introduction

Natural disasters are caused by the processes in the Earth core, on its surface or in the atmosphere, as well as by processes in the vicinity of the Planet. According to current knowledge, various phenomena in the human system take place, and they may be brought by its own development or by the development of systems that create it. Therefore, from a viewpoint of the modern concept of safe community, we see natural disasters as common expressions of the development of systems considered and this predefines the strategy of management and behaviour of well-aware human beings. Throughout evolution, humans tried to reduce their and their protected assets' vulnerability in order to reduce loss, damage and harm.

Based on available knowledge, humans—managing the safety of a community—try to implement measures and activities that will prevent the big impacts of natural disasters on humans and their protected assets or will reduce them so that it will be possi-

ble to stabilize the situation in case of an occurring disaster, manage the consequences and further develop the area.[2]

The research was targeted to natural disasters such as avalanches, hot wet summer days, drought, dams rupture, floods, tsunamis, earthquakes, volcanic eruptions, landslides, rocks tumbling down (rock fall), forest fires, wind storms, tornados, excessive rain or snow falls, and gas erosions from the core.

The first step for ensuring the security and sustainable development of civilization is to know the nature of possible disasters. Big natural disasters that are most important from the perspective of protection and development of civilization and its protected assets are not evenly distributed in the world, do not even occur regularly in certain areas nor evenly in time.[2] Therefore, the basic questions connected with safety management are:

- why and where do disasters occur?
- is it possible to control disasters at least in the sense of regulating their occurrence?

Understandably, from a viewpoint of knowledge and sustainable development there is a very important question, namely what exactly are the causes of disasters. Many experts sought causes of natural disasters outside of the Earth, e.g. in Sun spots (spots on the Sun surface that have a lower temperature than their vicinity). However, until now, no direct relation was proven and also no relevant mechanism of disaster origination has been discovered. Current knowledge shows that the changes in the Sun's activity really have an influence on the biosphere, human systems and disasters occurrence; however, not a direct one, e.g. it is proven that during geomagnetic storms the numbers of road accidents, heart attacks etc. rise.[2,35]

Natural disasters by their severity and extent have always exceeded the effectiveness of weapons made by man. The most dangerous natural disasters on our Planet are hurricanes. In the last 40 years they have caused more than three quarters of a million casualties. The second most dangerous are floods that have caused two hundred thousand casualties in the same time period. Earthquakes are in third place, being the cause for almost two hundred thousand deaths. And finally, more than 35 000 people have lost their lives as a result of volcanic eruptions. The biggest natural disaster in human history ever recorded was in 1887 in China, where more than 900 000 people died as a result of Yellow river's overflow in the Che-nan province. Records of natural disasters are often astonishing.[1] In Europe, according to the EU statistics, earthquake is the worst disaster. Statistics show that the serious disasters in the EU area between 1975 and 2001 were split into the following percentages: earthquakes – 78%; industrial accidents – 10 %; floods – 6 %, and windstorms – 6 %. Occurrence

of disasters and their size depend on area characteristics. Size and specifics of impacts depend both on area characteristics and its population along with its industry and infrastructure.[4]

We are not yet able to successfully predict natural disasters, despite the fact that already since the 1950's there are prognostic polygons in various countries focused on the selected natural disasters.[2] Therefore, the prevention against natural disasters is done on a complex level; big disasters cause hard social situations. Sometimes, after a disaster, a critical situation occurs when humans show recklessness, violence and loathsome behaviour, especially if panic comes about and people behave as a disorganized crowd at rage. Coping with a disaster means, from a viewpoint of a human, to survive, and social adjustment is also necessary. From analyses of various kinds of disasters it is known that the more the behaviour of people in a group is rational, the better is their chance to survive. After the disaster, usually a process of relief and euphoria sets in coming from the notion of managing to survive the dangers and traps. Critical danger usually leads to increase in social solidarity; however, after the danger is gone, there is often an asocial tendency. Groups fall apart, individuals appear that try to exploit the situation in their favour. Therefore, from the viewpoint of prevention and coping with an emergency, critical or catastrophic situation, we separate the following stages: before the disaster; during the disaster; right after it, i.e. at an emergency situation; and after the disaster has faded away, and when new relations are created. This is the stage of renovation, which is understood in the developed world as possibility to take measures ensuring higher safety in a particular area.

Experience shows that in a critical situation any activity is better than passivity. The smallest attempt at rescue is better than leaving ourselves to fate. Defence against disasters and catastrophes (often the two terms differ only by catastrophe being a phenomenon that strikes a bigger area and there are more casualties) is passive and active. Passive is mostly about building the systems securing protection against the unacceptable, and therefore, undesirable impacts of disasters (by averting impacts or at least reducing them) and educating people. Encouraging this kind of behaviour in individuals and groups of people aims to minimize the origination of disasters that are possible to avoid and if, in spite of this, a disaster occurs, to try to make losses the smallest possible. Active defence lies in systematic execution of measures that eliminate disaster occurrence or at least the occurrence of its unacceptable, e.g. undesirable impacts.[2]

At the UN public poll conducted in the most developed countries in the 1990's, the response to the question "what people fear the most?" was quite surprising. It was found out that people fear most natural disasters and big industrial accidents and that is because they have no influence over them. Hence, many agreements and conventions related to this problem were prepared under the UN. From January 1, 1990, the

UN launched the IDNDR project—the International Decade for Natural Disaster Reduction—followed by the ISDR project—International Strategy for Disaster Reduction—starting in 2000 and continuing till this day.

Natural disasters have threatened the inhabitants of our Planet since the origin of civilization. They can cause huge damages and the extent of the affected area depends not only on their intensity but also on the concentration of population, industry and transport, the availability of dangerous technologies in the affected area and, of course, on the level of preparedness to mitigate their impact.[2]

Statisticians calculated that on Earth one of every hundred-thousand individuals lose their live as a result of a natural disaster. Even though this is less than the number of casualties of the car industry (circa 250 000 a year), the number is horrifying, since natural disasters always strike suddenly and completely unexpectedly. They devastate a certain area, destroy homes, property, infrastructures and sources of food. One big catastrophe may be followed by other catastrophes such as a famine, epidemics, mass migration, release of toxic substances, omnipresent fires, networks blackouts – electricity, water, gas, heating and others.[2]

Natural disasters can be caused by movement of masses (earthquakes, landslides); energy released in the Earth core that comes along with physical and chemical processes transferred to the surface (earthquake, volcanic activity); ocean level increase (floods, overflows, tsunamis); extremely strong wind (hurricanes, wind storms, cyclones, tornados); atmospheric disorders (storms); and cosmic impacts (harmful radiation, meteorites).

After the primary impacts of a disaster, secondary impacts, related to human activity, often follow. Among the examples are:

1. After an earthquake – fires, gas explosions, dam ruptures, landslides, pipelines and electricity lines' breakdowns
2. After landslides – dam ruptures, roads and railways blockage, pipelines and electricity lines breakdowns
3. After volcanic eruptions – pasture poisoning, livestock extermination, famine
4. In parallel to or after floods – well poisoning, underground water muddying, infectious diseases
5. During or after storms – fires, blackouts of electricity.

On the basis of current knowledge, the big impacts of disasters are connected with following planetary phenomena: climatic changes and ecologic collapses; Earth collision with asteroids and comets; volcanic eruptions and earthquakes; and floods, tsunamis, big storms, droughts, and epidemics. For example, it is a fact, that the climate

of Europe has warmed up – with a temperature increase of almost 1°C, faster than the world average. Warmer atmosphere contains a bigger amount of water steam; however, new rain models significantly diverge among regions. In North Europe, snow and rainfall levels increased significantly, while to the South, droughts are being recorded more often.[3]

Studies of planetary phenomena and their impacts on humans revealed that disasters connected with planetary phenomena have occurred throughout human history. In history, the occurrence of big planetary phenomena always had an influence on the civilization and caused extinction, origination or mass migration of human communities.[2]

Geological evidence on observed planetary phenomena exists since 8000 BC. The impacts of planetary phenomena depend on their energy. Energy of big planetary phenomena exceeds hundreds of Mt TNT (1 Mt = 4.2 x 1022 erg), e.g.:

- summer storm has the energy of 1 kt (kt = 0.001 Mt)
- an earthquake with magnitude 8.7 has the energy of 100 Mt
- the eruption of Krakatau volcano had the energy of 5200 Mt
- the eruption of Mount Tambora volcano had the energy of 2450 Mt
- at the origin of Baring crater in Arizona, the Earth collided with a meteorite of 50 m in diameter, a speed of 13 km/sec and energy of 3 Mt TNT.

The overall energy released annually by earthquakes is 120 Mt, at volcanic eruptions – 25 Mt, and at summer storms – 2400 Mt. For comparison, the atomic bomb thrown down on Hiroshima had the energy of 13 Kt and the biggest hydrogen bomb exploded in the Novaja Zemlja test range had the energy of 55 Mt.[1] Consequently, the extent of damages caused by natural phenomena is huge.

It is important to note that human society nowadays is more vulnerable since the number of inhabitants of our Planet has risen significantly along with the number of technical works that increase the vulnerability of villages, cities and whole areas. Therefore, not only the big planetary phenomena but also phenomena of smaller power affect our society. It is also necessary to take into consideration the rising awareness. Increasing information flows contribute to the impression that more and more disasters are happening. However, the assessment of disasters according to energy, i.e. clearly defined physical quantity, the results of which are given above, shows that our Planet is in a stable regime. Climatic changes that have recently been in the centre of attention—in case that they surpass the capacity of adaptation of human system—can trigger a development trajectory of human system that will be unacceptable for mankind. Therefore, it is necessary to systematically exercise prevention so that the change of the current development trajectory is avoided.

As a result of a rising vulnerability of human society, the impacts of planetary phenomena on people increase. In order to effectively protect itself against impacts of natural disaster, mankind must work on their recognition, prediction and on the realization of all necessary means (technical, organizational and educational) of possible utility to reduce their impacts.[2]

Research Data and Method

The following sources were used to assess the level of EU natural disasters' management: data from the professional domain cited in relevant places and data on legislative and management mechanisms in the EU.[5] Expert responses to a questionnaire, compiled for the project FOCUS [6] were assessed in order to identify deficiencies in the EU and in Member States management with regard to disaster management. Thus, we hope to facilitate the development of a safe and sustainable European Union.

Research Results

Each of the natural disasters has characteristic physical features, e.g. it occurs suddenly, prepares gradually and affects gradually; it does or does not have the indications of an origin; extent of affection; term of affection etc. The size of natural disasters is measured according to energy or some rate that represent an equivalent of energy or according to its impacts on protected assets. In the affected site, the classification is usually done according to the size of impacts; scales with categories 1 to 3 (floods); 1 to 5 (avalanches, tsunamis, landslides, hurricanes, tornados); 1 to 12 (earthquakes) etc. are used.

On the basis of critical analyses, the fact is that the response to the big natural disasters occurrence often proves many failures of various state and private bodies, organizations and institutions (e.g. at floods, the lack of flood plans; or some other time the violation of safety prescriptions, technology is in a bad condition or failure of a warning system; underestimation of historic experience, e.g. unprotected and built-up coastal areas in Portugal, vicinity of Nice, Bretagne that was affected by harmful tsunamis in the past, etc.[2]

Responses to the questionnaire were provided by 25 university educated experts having practical experiences (first responders, safety managers in plants and utilities, designers, system engineers, operating engineers, safety inspectors, public administration officers, academic workers, lawyers, economists, PhD students (only one political scientist) and processed in relation to current knowledge [1,2,7-18] and other publications present in the CVUT registry about disasters and their management.[19-32] Five CVUT and Ministry specialists synthesised the results in a table format (see Table 1 bellow).

Table 1: Assessment of the level of natural disasters management in the EU.

Question	**Answer** (sentence + reasons for)
Does the list of disasters given above contain all disasters possible in the EU territory?	On the basis of recent analyses of critical situations [7] it is necessary to further consider: geomagnetic storms caused by the Sun activity; desertification (desiccation until parching of extensive areas in Europe that appears as a huge fall of underground water level and on the surface as a lack of water including the potable water needed by people and animals); land erosion;[15-18] soil salinization;[21] fall of a cosmic body; sand storms; ocean spreading; and sudden change of weather (cold wave or heat wave).
Which disasters are most severe for the EU territory?	The order is: fall of a big cosmic body on Europe; earthquake; floods; forest fires; and drought.
For which disasters the EU does not systematically perform prevention?	The EU has no tool that would adjust the demand for the systematic prevention of natural disasters of all kinds, in spite of accepting the principle of the All Hazard Approach.[32]
Is the prevention level sufficient?	It is necessary to acknowledge that the prevention requires finances, knowledge, technical means and qualified personnel; hence it has to be enforced by legislation.
What is the situation in the CR?	The European Commission—according to the present legislation—considers as natural disasters only earthquakes, avalanches, landslides and floods.[19]
What improvements are necessary?	Since both the EU and the Member States are affected by tornados, forest fires, tsunamis, droughts, etc., it is possible to state that the level of the prevention against natural disasters in the EU is insufficient. However, it is necessary to objectively state that the EU document [19] is targeted to a financial sector. Also in the CR, the law No 586/1992Sb. from a financial sector uses a specific definition "For the purposes of this law a natural disaster is considered an unintended fire and explosion, strike, wind storm with a wind speed higher than 75 km/h, flood, hailstorm, soil erosion, rock tumbling down, if they did not occur in association with industrial or constructional operation, slides or tumbling down of avalanches and earthquake reaching at least the 4th degree of an international scale giving the macro-seismic effects of an earthquake. The extent of damage must be proven by the opinion of an insurance company, and that including the case where the ratepayer is not insured, or by an opinion of a court expert." It is necessary to improve the prevention to natural disaster in the EU.[27,29] In the current Czech practice the basic prevention of natural disasters is treated by the construction law (law No 183/2006 Sb.) while in the original version of the previous law (i.e. Law No 50/1976 Sb.) it was given in a more enumerative way. Pre-

	vention against the worst natural phenomena in the CR, i.e. floods. in most detail is given in law No. 254/2001 Sb. and in the successive legislative. In the EU, Member States and the CR, it is necessary to implement the system of management based on integral safety.
For which disasters the EU does not systematically perform preparedness? Is the preparedness level sufficient?	For the majority of disasters in both the EU and the CR, no systematic measures for preparedness are taken. Since the European Commission according to legislation considers as natural disasters only earthquakes, avalanches, landslides and floods,[19] its preparedness may be assessed as insufficient.
Is the preparedness performed by all important society components (including the public) sufficient? What is the situation in the CR? What improvements are necessary?	It is possible to objectively observe that according to different documents, the situation in the EU is heading in the right direction. Among the specific examples in that regard are the following: - natural threats are: storms, droughts, floods, forest fires, landslides, avalanches; it has been proposed to develop respective systems of early warning and to improve the strategies for prevention and mitigation;[20] - it is proposed to create the European centre for monitoring the drought and desertification, which is mentioned also in the 7th Frame Programme for research and development, and to take measures for improving the awareness on the sustainable exploitation of water resources;[21] - cessation of desertification is demanded. On the request of the European Parliament, in 2010 the Commission already started pilot projects targeted to stop the desertification with aim to spread well-tried methods across Europe. The projects also render examples of the measures of rational and economical exploiting of water and the well-tried methods will contribute to the revision of a policy in areas of lacking water and drought;[22] - it is stated that forest areas are important for preserving the nature of a landscape and fertility of soil. They help to avoid soil erosion and desertification, mainly in mountain or semidry areas since they reduce the water drainage and reduce the wind speed,[23] - it is a fact, that—mainly in southern regions of the EU—it is necessary to introduce a common agricultural policy to avoid desertification and erosion of a landscape,[24] - Member States should have agreements for the fight against soil erosion and desertification or for the propagation of a comparable protective function of forests,[25] - it is necessary to improve the EU preparedness for natural disasters,[27,28] - the Commission has an intention to pass by the end of 2012

	a plan for preservation of water sources in Europe. This plan will be based on assessments of the implementation of the directive about water, the policy in the area of lack of water and drought and vulnerability of water sources as a result of climate change and other human influence.[22] In the CR, the preparedness to natural disasters is concentrated only on floods (flood plans – law No. 254/2001Sb.). In the EU, Member States and the CR, it is necessary to implement the system of management based on integral safety.[2]
For which disasters the EU does not systematically prepare qualified response? Is the response level sufficient? Is response prepared by all important society components (including the public) sufficient? What is the situation in the CR? Which improvements are necessary?	The EU does not follow a systematic approach for responding to natural disasters. The individual Member States have response systems on various levels. The Czech Republic has an Integrated Rescue System (law No. 239/2000Sb.) for responding to natural disaster. In the area of response, the EU has a number of tools in place:[29-31] - at earthquakes, avalanches, landslides and floods – financial help; - using rapid reaction forces, i.e. emergency reserves and key sources (mainly modules including search and rescue teams, means for water cleaning, medical teams, means to forestall fires and for detection and decontamination of chemical, biological, radiological and nuclear materials, also of temporary shelters and teams for the technical help and support); as well as maintaining the readiness civil protection reserves; - support for volunteers; - mutual help among the Member States in case of humanitarian crisis; - humanitarian assistance. In the EU, Member States and the CR, it is necessary to implement a system of management based on integral safety.[2]

For which disasters the EU does not systematically prepare qualified renovation (renewal)? Is this renovation level sufficient? What is the situation in the CR? Which improvements are necessary?	The EU does not have any systematic tool for the renovation after natural disasters; it mandates only partial measures. The EU has a Solidarity Fund for helping the countries affected by serious disasters. In serious disasters, the damage of which exceeds a relatively high threshold level, the activity of the Solidarity Fund is quite satisfying.[26] Criteria are clear and it is possible to evaluate them easily. The countries usually do not have problems preparing their respective demands. However, there is a problem with smaller disasters where the required proof of serious impacts of a lasting character on the economic stability of the affected region seems, from the start, as quite speculative, economically not very sure and in every case a hard task that is difficult to assess, in case of smaller areas in particular. Until now, it was not complied with 2/3 of demands submitted according to this rule. It is clear that the fund should be able to react and render help faster and better. Even though the fund was never seen as a tool of exceptional help, it is common to expect that its financial help will be provided as fast as possible. Delays of one year or more are evidently too long. For renovation, in the CR there is law No. 12/2002Sb. that adjusts the help to citizens and public subjects affected by natural or other disasters brought by an exceptional event in sense of law No. 239/2000Sb. and at which a crisis situation has been declared. In the EU, Member States and the CR, it is necessary to introduce a system of management based on integral safety.[2]
Which disasters can cause the critical situations in the EU? Which disasters can cause the critical situations in the CR?	Disastrous earthquakes or extreme climatic phenomena that are the cause of big economic and social impacts. There is infrastructure affected (buildings, transport, energy and water supports), which represents a specific threat for the densely inhabited areas. The situation can be made worse by rising of the sea level. Strategic and long-term approach will be necessary to the territorial planning on both the continents and coastal areas including transport, regional development, industry, tourism and energy politics.
Which disasters can cause a crisis situations in the EU? Which disasters can cause a crisis situations in the CR?	Disastrous earthquakes, extreme climatic changes or other extreme disasters, when serious mistakes are made in launching and implementing a response and there will be no qualified management since the EU or member states' governments, including the CR, will underestimate the severity of the situation and its consequences and will not provide sufficiently early resources, forces and means required for survival.

For which crisis situations caused by disasters is the level of crisis management in the EU is not sufficient?	In the domain of natural disasters´ management under the EU, there is no mechanism for unified and targeted response of all Member States to critical situations evoked by whichever natural disaster.
For which crisis situations caused by disasters is the level of crisis management in the CR not sufficient?	For example, in the CR, involving people is missing in critical situations; they have no knowledge and they are not prepared for systematic response in case of need and the responsibilities are not assigned to them for the case of dealing with extreme situations.
Where can the vulnerabilities of human society in the EU cause transition of a critical situation into an extreme situation?	Natural disasters' management requires implementation of the All Hazard Approach [32] and strategic management of integral safety.[2] It is necessary to consider the vulnerability of humans and their protected assets and to find ways allowing them to survive.
Where can the vulnerabilities of human society in the CR cause transition of a critical situation into an extreme situation?	However, the vulnerability of protected assets is site-specific and knowledge about it is only fragmental. Research in the EU and the CR should fill-in this gap. On that basis, it is possible to determine the requirements for strategic planning, spatial planning and territorial planning.[33]
Do we have reliable methods for determining the scenarios of all disasters expected in the EU?	Only in some areas, e.g. nuclear power plants, serious nuclear and chemical industrial plants, the methods for defining the scenarios for identification, analysis, assessment, management of risks and dealing with risks are defined; i.e. implementation results are comparable.
Do we have reliable methods for determining the scenarios of all disasters expected in your country?	In other areas in the EU and the CR, there are no unified methods, tools or techniques used in practice; i.e. the comparability is missing. Moreover, in many applications the methods are not stated at all, or their preconditions are neglected; e.g. used data set may not have properties required by the method; wrong preconditions are used, or insufficient knowledge of processes that trigger a natural disaster, etc. A key step to improvement is to ensure in-depth research based on data and not on just copying already-known facts; to check every result before implementing in practice, validate it by a public opponent, provide expert management (demonstrating professionalism, objectivity and promotion of public interests) and thus avoid the influence of lobbyists. In the EU, in individual Member States including the CR, it is necessary to implement the research and application of methods that support the system of management based on integral safety.[2]

Do we know successful preventive, mitigation, response and renovation measures and activities for all disasters given above? Which are the gaps in the knowledge on preventive, mitigation, response and renovation measures and activities?	The brief answer is 'NO' – there are so many professional works of high quality, but since the most efficient measures are site specific—taking into account rarities of area and its protected assets and disposal knowledge, sources, forces and means—it is necessary to direct the research so that there will be solid knowledge that allows to apply procedures that were adjusted for the CR on the basis of the real data [34] and that were tested via practical application.
Which improvements are necessary?	To implement in practice the strategic management of integral safety that is systematic and proactive;[2] to oppose projects publicly and to balance the influence of lobbyists and other activist groups. Professional procedures are elaborated in professional publications. It is necessary too implement a management system that really promotes the public interest and is designated for protection of both the EU and the CR citizens, and that is in place even after extreme natural disasters.
Which research is most effective in improving safety management in the EU? Which research is most effective in improving safety management in the CR?	Research of priority problems based on real data and performed by qualified methods, and validated by public review of project results (to avoid duplication and writing essays with no real credibility). This is valid both for the EU and the CR.
Which principles, legislation and co-operation rules in the EU are necessary for security and sustainable development?	1. All Hazard Approach. 2. Legislation on the integral EU safety management support. 3. Creating a qualified system of response to extreme situations.
Can you propose measures for averting the social crises in the EU?	1. To govern the EU with respect to public interest and with the aim to ensure security and sustainable development of the EU inhabitants. 2. Not to underestimate natural disasters of any type. 3. To create a system of the EU integral safety management. 4. To reduce the influence of lobbyists and other activist groups on decision-making.

On the basis of data in Table 1, we assess the level of EU public affairs management from a viewpoint of natural disasters management. It is visible that the EU legislation is not in accord with the professional knowledge; only some of the harmful phenomena are seen as disasters.[19] It underestimates the drought, there is a lack of a systematic approach based on professional knowledge, it only ensures some partial measures, etc. On the basis of critical assessment based on the comparison of what should be fulfilled at the ideal integral safety management and reality, basic deficiencies

have been identified in relation to natural disasters´ management, as well as domains, in which it is necessary to take measures.

There are many deficiencies. This is caused by gaps in identifying priority problems. Domains that lead to the reduction of the deficiencies are marked in Table 2, where priority areas requiring measures to be taken are marked in bold. In column "Other" **M** marks that it is necessary to execute relentless monitoring so that the management of the given disaster is efficient, e.g. ensuring of early warning, quick mapping of the situation, early start of emergency actions, etc., and **S** marks that it is necessary to seek efficient prevention since the given disaster is slow and, therefore, it is not possible to avert it with a quick response.

Table 2: Proposal of the domains of solving the identified deficiencies.

Disaster	**List of gaps**	**Type of measures and activities to close identified gaps**				
		legislation	specific management	research	education	other
Avalanches	Prevention measures are most efficient and are site specific. In planning, their systematic application is necessary. The EU should pay attention that the Member States take into account the prevention measures.	**yes**	**yes**	**yes**	**yes**	**M**
Sudden changes of weather (coldwave or heatwave)	Most efficient is a quick response. The EU should enforce that all the Member States have a contingency plan, which will be activated when necessary.	**yes**	**yes**	**yes**	**yes**	**M**
Drought	It should not be underestimated. It is necessary to have a plan for an extreme drought. The EU should enforce that all the Member States have a contingency plan, which will be activated in case of need.	**yes**	**yes**	**yes**	**yes**	**M**
Dam rupture	Prevention measures are site specific. In planning, their systematic application is necessary. The EU should pay attention that the Member States take into account the prevention measures and have efficient response plans in	**yes**	**yes**	**yes**	**yes**	**M**

	place.					
Floods	- " -	**yes**	**yes**	**yes**	**yes**	**M**
Tsunami	- " -	**yes**	**yes**	**yes**	**yes**	**M**
Earthquake	- " -	**yes**	**yes**	**yes**	**yes**	**M**
Volcanic eruption	- " -	**yes**	**yes**	**yes**	**yes**	**M**
Landslides	- " -	**yes**	**yes**	**yes**	**yes**	**M**
Rock fall (Rock tumbling down)	- " -	**yes**	**yes**	**yes**	**yes**	**M**
Forest fires	- " -	**yes**	**yes**	**yes**	**yes**	**M**
Windstorms	- " -	**yes**	**yes**	**yes**	yes	**M**
Tornados	- " -	**yes**	**yes**	**yes**	**yes**	**M**
Excessive rain or snow falls	Most efficient is a quick response. The EU should enforce that all the Member States have a contingency plan, which will be activated in case of need.	**yes**	**yes**	**yes**	**yes**	**M**
Gas outbursts from the Earth core	- " -	**yes**	**yes**	**yes**	**yes**	**M**
Geomagnetic storms	- " -	**yes**	**yes**	**yes**	**yes**	**M**
Desertification	Prevention measures are site specific. In planning, their systematic application is necessary. The EU should pay attention that involved Member States take into account the prevention measures and have efficient response plans in place.	**yes**	**yes**	**yes**	**yes**	**S**
Land erosion	- " -	**yes**	**yes**	**yes**	**yes**	**S**
Soil salinization	- " -	**yes**	**yes**	**yes**	**yes**	**S**
Fall of a cosmic body	Most efficient is a quick response. The EU should enforce that all the Member States have a contingency plan, which will be activated in case of need.	**yes**	**yes**	**yes**	**yes**	**M**
Sand storms	- " -	**yes**	**yes**	**yes**	**yes**	**M**
Ocean spreading	Prevention measures are site specific. In planning, their systematic application is necessary. The EU should pay attention that involved Member States take into account the prevention measures and have the efficient response plans in place.	**yes**	**yes**	**yes**	**yes**	**S**

Conclusion

In fact, it is not possible to avert natural disasters since they are a manifestation of the human system development. However, professional knowledge exists by which it is possible to mitigate their impacts, or at least to mitigate the impacts on humans. Disaster management must employ this knowledge in a qualified way. Currently, this takes place only in some individual cases and, therefore, it is necessary to state that the level of natural disasters´ management assessed on the basis of professional criteria for the effective protection of people and area is low in the EU; only the partial measures are taken and some of them are hard to apply (e.g. there is a lack of clarity given a request for financial help after not so big but harmful disaster). There is a lack of systematic approach, clearly goal-oriented to security and sustainable development of the EU inhabitants. Research is diffused and often of a low quality since it is not based on real data and basic research practices; essays written for officials usually do not solve the problems. Sources for research in the field of safety are diffused among European, state and regional levels and also between participating public and private parties. It is necessary to implement in practice the public professional review of solutions, which are proposed by researchers and subsequently applied into practice.

On the level of the EU, there are hundreds of projects addressing natural disasters on various levels – technical, social, organizational. However, what is entirely missing is the synthesis of partial results into one comprehensive approach.

Acknowledgement: The research was supported by the Czech Technical University, Faculty of Transport Science (Institute for Security Technologies and Engineering), by the EU – project FOCUS, grant No 261633, <www.focusproject.eu> and by the Ministry of Education of the Czech Republic, grant No 7E11072. This publication reflects only the author's views and the Union is not liable for any use that may be made of the information contained therein.

Notes:

1 Dana Procházková, "Facts for the EU Security Concept," *Transactions of the VŠB-Technical University of Ostrava* 7:1 (2012): 59-64.

2 Dana Procházková, *Strategic Safety Management of Territory and Organisation* (Praha: CVUT, 2011).

3 Commission of the European Communities, *Adapting to climate change in Europe – options for EU action*, Green Paper, COM(2007) 354 final (Brussels, 29 June 2007), http://eur-lex.europa.eu/LexUriServ/site/en/com/2007/com2007_0354en01.pdf.

4 European Commission, *Vademecum of Civil Protection in the European Union*, http://ec.europa.eu/echo/civil_protection/civil/vademecum/index.html (11 Nov. 2012).

5 For the respective official documents see http://eur-lex.europa.eu/en/index.htm.

6 Dana Procházková, *Questionnaire for Special Investigation*, www.focusproject.eu.

[7] Valentina Krysanova, Hendrik Buiteveld, Dagmar Haase, Fred F. Hattermann, Kate van Niekerk, Koen Roest, Pedro Martínez-Santos, and Maja Schlüter, "Practices and lessons learned in coping with climatic hazards at the river-basin scale: floods and drought," *Ecology and Society* 13(2):32 (2008), www.ecologyandsociety.org/vol13/iss2/art32.

[8] George Tsakiris, Harris Vangelis, Dimitris Tigkas, "Assessing Water System Vulnerability to Drought to Multi-year Droughts," *European Water* 29 (2010): 21-29, www.ewra.net/ew/pdf/EW_2010_29_03.pdf.

[9] Annegret H. Thieken, Meike Miller, Heidi Kreibich, and Bruno Merz, "Flood damage and influencing factors: New insights from the August 2002 flood in Germany," *Water Resources Research* 41:12 (2005), W12430, http://dx.doi.org/10.1029/2005WR004177.

[10] Alessandro Colombo and Ana Lisa Vetere Arellano, eds., *Lessons learnt from Flood Disasters*, EUR 20261 EN (European Commission Joint Research Centre, Institute for the Protection and Security of the Citizen, Technological and Economic Risk Management, Natural Risk Sector, 2002), http://reliefweb.int/node/21273/pdf.

[11] Amparo Alonso-Betanzos, Oscar Fontenla-Romero, Bertha Guijarro-Berdiñas, Elena Hernández-Pereira, María Inmaculada Paz Andrade, Eulogio Jiménez, Jose Luis Legido Soto, and Tarsy Carballas, "An intelligent system for forest fire risk prediction and fire fighting management in Galicia," *Expert Systems with Applications* 25:4 (November 2003): 545–554, http://dx.doi.org/10.1016/S0957-4174(03)00095-2.

[12] Francisco Rego, Cristina Montiel, and Jorge Agudo, *Towards integrated fire management: The need for a European Framework Directive on Fire,* Executive Document for the Conference on Protection of Forests, Spanish Presidency of the European Union (La Granja–Valsaín, 6-7 April 2010), www.eufirelab.org/toolbox2/library/upload/2890.pdf.

[13] Martha Henderson, Kostas Kalabokidis, Emmanuel Marmaras, Pavlos Konstantinidis, and Manussos Marangudakis, "Fire and Society: A Comparative Analysis of Wildfire in Greece and the United States," *Human Ecology Review* 12:2 (2005): 169-182. www.humanecologyreview.org/pastissues/her122/hendersonetal.pdf.

[14] B.S. Lee, M.E. Alexander, B.C. Hawkes, T.J. Lynham, B.J. Stocks, P. Englefield, "Information systems in support of wildland fire management decision making in Canada," *Computers and Electronics in Agriculture* 37:1-3 (December 2002) 185-198, http://dx.doi.org/10.1016/S0168-1699(02)00120-5.

[15] A. Gobin,R. Jones, M. Kirkby, P. Campling, G. Govers, C. Kosmas, and A.R. Gentile, "Indicators for pan-European assessment and monitoring of soil erosion by water," *Environmental Science & Policy* 7:1 (February 2004): 25–38, http://dx.doi.org/10.1016/j.envsci.2003.09.004.

[16] Michael A Fullen, Andres Arnalds, Paolo Bazzoffi, Colin A Booth, Victor Castillo, Ádám Kertész, Philippe Martin, Coen Ritsema, Albert Solé Benet, Véronique Souchére, Liesbeth Vandekerckhove, and Gert Verstraeten, "Government and Agency Response to Soil Erosion Risk in Europe," in *Soil Erosion in Europe*, ed. John Boardman and Jean Poesen (Chichester, UK: John Wiley, 2006), 805-828, http://dx.doi.org/10.1002/0470859202.ch57.

[17] Martin Volk, Markus Möller, and Daniel Wurbsb, "A pragmatic approach for soil erosion risk assessment within policy hierarchies," *Land Use Policy* 27:4 (October 2010): 997–1009, http://dx.doi.org/10.1016/j.landusepol.2009.12.011.

[18] Róbert Jelínek, Javier Hervás, and Maureen Wood, *Risk Mapping of Landslides in New Member States*, EUR 22950 EN (Ispra, Italy: European Commission Joint Research Centre, Institute for the Protection and Security of the Citizen, 2007), http://eusoils.jrc.ec.europa.eu/esdb_archive/eusoils_docs/other/EUR22950.pdf.

[19] Commission Decision of 10 December 2008 concerning State aid C 31/06 (ex N 621/05) granted by Italy on urgent measures to prevent avian influenza, *Official Journal of the European Union* L149 (15 June 2010): 20-26, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:149:0020:0026:EN:PDF.

[20] Decision No 1982/2006/EC of the European Parliament and of the Council of 18 December 2006 concerning the Seventh Framework Programme of the European Community for research, technological development and demonstration activities (2007-2013), *Official Journal of the European Union* L412 (30 December 2006): 1-41, http://cordis.europa.eu/documents/documentlibrary/90798681EN6.pdf.

[21] "Opinion of the Committee of the Regions on Natural disasters (fires, floods and droughts)," 2006/C 0206/03, *Official Journal of the European Union* C206 (29 August 2006): 9-12, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2006:206:0009:0016:EN:PDF.

[22] European Commission, *Third Follow up Report to the Communication on water scarcity and droughts in the European Union COM (2007) 414 final*, COM(2011) 133 final (Brussels, 21 March 2011), http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2011:0133:FIN:EN:PDF.

[23] European Commission, *Green Paper on Forest Protection and Information in the EU: Preparing forests for climate change*, COM(2010)66 final (Brussels, 1 March 2010), http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2010:0066:FIN:EN:PDF.

[24] "Opinion of the European Economic and Social Committee on Meeting the challenges of climate change – The role of civil society," *Official Journal of the European Union* C318 (23 December 2006): 102-108, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2006:318:0102:0108:EN:PDF.

[25] European Commission, "Community guidelines for State aid in the agriculture and forestry sector 2007 to 2013," 2006/C 319/01, *Official Journal of the European Union* (27 December 2006): 1-33, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2006:319:0001:0033:EN:PDF.

[26] European Commission, European Union Solidarity Fund, COM(2011) 694 final (Brussels, 31 October 2011), www.ipex.eu/IPEXL-WEB/dossier/document/COM20110694.do.

[27] *Communication from the Commission to the European Parliament and the Council on Reinforcing the Union's Disaster Response Capacity*, COM(2008) 130 (Brussels, 5 March 2008), http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2008:0130:FIN:EN:PDF.

[28] Commission of the European Communities, *A Community approach on the prevention of natural and man-made disasters*, COM(2009) 82 final/2 (Brussels, 4 March 2009), http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2009:0082:REV1:EN:PDF.

[29] Council Regulation (EC) No 1257/96 of 20 June 1996 concerning humanitarian aid, *Official Journal of the European Communities* L163 (2 July 1996): 1-6, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:1996:163:0001:0006:EN:PDF.

[30] European Commission, *Report on the evaluation of the application of the Civil Protection Mechanism and the Civil Protection Financial Instrument for the years 2007-2009*, COM/2011/0696 final (Brussels, 10 November 2011), www.ipex.eu/IPEXL-WEB/dossier/files/download/082dbcc53391e5ca013391fb3a170012.do.

[31] European Commission, *How to express EU citizen's solidarity through volunteering: First reflections on a European Voluntary Humanitarian Aid Corps*, COM(2010) 683 final

(Brussels, 23 November 2010), http://ec.europa.eu/echo/files/aid/evhac/COM_2010_683_final_en.pdf.

[32] FEMA, *Guide for All-Hazard Emergency Operations Planning*. State and Local Guide (SLG) 101 (Washinton, D.C.: Federal Emergency Management Agency, September 1996), www.fema.gov/pdf/plan/slg101.pdf.

[33] Dana Procházková, *Security Planning: Land-use, Emergency and Crisis Planning* (České Budějovice: VŠERS o.p.s., 2009).

[34] Dana Procházková, *Methods for Estimation of Expenses on Renovation of Propery in Territories Affected by Natural or Other Disaster* (Ostrava: SPBI SPEKTRUM XI, 2007).

[35] Dana Prochazkova, "Principles of Mitigating and Managing Human System Risks," *Information & Security: An International Journal* 28:1 (2012): 21-36. http://dx.doi.org/10.11610/isij.2802.

DANA PROCHÁZKOVÁ – see the CV on p. 108 of this volume.