EMERGENCY RESPONSE MANAGEMENT – A REVIEW OF CURRENT APPROACHES

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As is commonly known, there is a tight and complex relationship between infrastructure and lifelines. In this respect, civil engineers try to improve construction methods, materials and other aspects directly related to the strength and durability of buildings. Although individual structures may be designed to cope with unexpected events, such as earthquakes of a certain magnitude, there are instances where seismic activity can exceed the specifications and cause catastrophic results. As there is no method to foresee earthquakes, there will always be a concern to prove the structures’ adequacy. When failures occur, there is the need for effective processes for emergency response - as part of the disaster management process - to control and manage available resources to save lives, property and the environment. Local authorities, rescue teams and civil engineers are called to work together to collect, analyse and assess relevant data via collaborative environments in order for an accurate picture to be pieced together. This paper reviews current approaches to emergency response management in earthquake situations and explores the extent of ICT usage. The pros and cons of existing processes are analysed and the opportunities for improvement identified. This paper concludes by presenting the problems caused by the incompatibility of data across distributed environments, the high stress of participants, the lack of common terminology between them, the breakdown of communication and information technologies, and finally the need for simultaneous interactions of decision makers for managing emergencies.

Keywords: Earthquakes, Emergency Response, Disaster Management.

INTRODUCTION

Natural phenomena are considered as normal and essential planetary actions. They are also characterised as hazardous events by the scope of people in relation to their properties and their environment. To this extent, ‘a basic distinction has to be made between extreme events in nature which are not necessarily hazardous to people, and the character of hazardous events’ (Burton, Kates, White 1978). People have set a series of parameters, based on which natural phenomena are classified. These parameters include the frequency of occurrence, the magnitude of the hazard, its nature, the location affected, the development of dynamics and finally, the impact of the hazard. In relation to the European Union, there are hazards that ‘are considered to be a risk to some or all of its Member States’ (European Commission 2000). These include avalanches, dam bursts, drought, hot humid summer days, earthquakes, floods, forest fires, landslides, tidal waves, tornadoes, and volcanic eruptions. They can be categorised according to their nature - climatic and geological hazards – as well as according to the human capability to foresee them. Earthquake is the hazard under investigation in the particular context of this work and it is considered one of

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the most dangerous geological hazards as it occurs without warning. In other words, there is not a ‘lead time between its announcement and arrival’ (United Nations 1992). The question that arises is to what extent people, their civilisation and their actions in general cause and/or assist in the occurrence of natural phenomena. Are those actions enough to interfere with nature and be held responsible for causing a different magnitude and/or affecting the timing or the area of occurrence? Some may argue that this might be the case. In particular, Burton, Kates and White (1978) point out that ‘large parts of the social system may also be regarded as operating independently of natural events. Interaction of the two creates resources. It also creates hazards or negative resources’. Although the above-mentioned questions are of great interest, they are considered beyond the scope of this paper. For the purpose of the present work, natural hazards in general and earthquakes in particular, are considered as given environmental functions, although according to Shaw et. al. (2003) disasters in recent decades are causing more deaths than in the past centuries. Therefore, the focus of this paper is to discuss the methods, which people use in dealing with them. The following sections will:

- Present disaster management as a professional discipline dealing with natural hazards
- Introduce the organisation of civil protection in the European Union (EU)
- Discuss the level of use of Information and Communication Technologies (ICT) by Civil Protection agencies during the stage of emergency response, and

Conclude with the need for further improvements within the area of investigation and the further work that needs to be done.

**DISASTER MANAGEMENT AND ITS CHARACTERISTICS**

When a natural hazard occurs unexpectedly, it causes an emergency situation in the human community. Sometimes the effects of a natural hazard are so harmful that local services are not capable of controlling the situation (Johnson 2000). In the case where the situation caused by a hazard exceeds the scale of the emergency then, it becomes a disaster. As ‘the forces of nature recognise no rule or boundary; the best that man can do is to seek protection or to exercise vigilance and use the knowledge he has acquired to defend himself from these forces or alleviate their consequences’ (Assar 1971). A sudden and usually unforeseen event ‘calls for immediate measures to minimise its adverse consequences’ (Department of Humanitarian Affairs, United Nations 1992). This need for action has led to the adoption by the authorities of disaster management, as the professional discipline to deal with disasters. The nature and the phases of disaster management concerning natural catastrophes are presented next.

**Disaster Management**

A professional discipline called disaster management has been established in order to set ‘a range of measures to manage risks to communities and the environment’ (EMA 2002). A lot of research is currently being conducted in this area in order to improve the way disasters are managed. The main aim of this is to ‘save lives, prevent injuries, and protect property and the environment if an emergency occurs’ (Nalls 2003). Although it could be argued that the actions that people take in order to cope with disasters take place after the disaster occurs, these actions have to be organised and
planned before the event. ‘Planning is the set of activities necessary to analyse and document the possibility of an emergency or disaster and the potential consequences or impact on life, property and the environment. This includes assessing the hazards, risks, mitigation, preparedness, response, and recovery needs’ (Johnson 2000). ‘Fundamental to disaster planning is the identification of the demands that characterise the disaster response environment and developing the management capabilities required to deal with them’ (Paton, Jackson 2002). Effective disaster management has to plan, organize and control the whole cycle of a disaster. Although EMA (2002) points out that disaster management ‘in a multicultural society should meet the specific and challenging needs of ALL members of our community, through the provision of a responsive and inclusive service’, someone could argue that ‘all members of our community’ are not the same. Although individual values have to be respected, these should be beyond the scope of disaster management and not to interfere with its primary goal, which is to minimize losses. For this reason there is the need for disaster management to have a generic plan, which will enable a certain set of standards to be met. This generic plan is divided into four different phases, in order to be able to ‘organize, analyse, plan, make decisions, and finally, assign available resources to mitigate, prepare for, respond to, and recover from the effects of all hazards’ (Nalls 2003). Those four phases are set and controlled by the disaster legislation, which ‘is the body of laws that govern and designate responsibility for disaster management concerning the various phases of disaster’ (Department of Humanitarian Affairs, United Nations 1992).

Phases of disaster management
The following sections describe the four phases of the disaster management discipline.

Mitigation
The first phase of disaster management is mitigation. Mitigation includes all ‘the activities that actually eliminate or reduce the probability of a disaster’ (Johnson 2000). Johnson (2000) continues by saying that mitigation also includes long-term activities designed to reduce the effects of unavoidable disaster. Mitigation is also ‘the measures taken in advance of a disaster aimed at decreasing or eliminating its impact on society and environment’ (Department of Humanitarian Affairs, United Nations 1992). These actions take place through the procedure of prevention, which according to the Department of Humanitarian Affairs of the United Nations (1992) ‘encompasses activities designed to provide permanent protection from disasters. It includes engineering and other physical protective measures and also legislative measures controlling land use and urban planning’. All the above-mentioned actions, when they are made through the scientific and professional way are able – in a degree – to ‘reduce an area’s vulnerability to damage from future disasters’ (Mileti 1999).

Preparedness
Although it is impossible for people to make disasters and in particular natural disasters stop to occur they can take ‘sustained actions’ in order to ‘reduce or eliminate long-term risk to people and property from hazards and their effects’ (Nalls 2003). Therefore, the professionals involved have to be prepared to face a disaster and its results. According to Johnson (2000) ‘preparedness are the activities necessary to the extent that mitigation measures have not, or cannot, prevent disasters’. The Department of Humanitarian Affairs of the United Nations (1992) supports this and defines it as ‘the activities designed to minimize loss of life and damage, to organize
the temporary removal of people and property from a threatened location and facilitate timely and effective rescue, relief and rehabilitation’. In order for all of these specific actions to take place and their aims to be met a lot of different bodies collaborate. The collective and collaborative work of governments, organizations, and individuals develop plans to save lives and minimize disaster damage (Johnson 2000). Preparedness also involves building an emergency response and management capability before a disaster occurs to facilitate an effective response when needed (Mileti 1999). Overall the phase of preparedness of a community for a disaster scenario takes a lot of collection of scientific knowledge and evidence; it needs collaborative management work and training of the community, in order to be able to face the real disaster when it occurs. This is clearly identified by Nalls’ (2003) definition of preparedness, which defines it as ‘the process of building the emergency management program to effectively prepare for, mitigate against, respond to, and recover from any hazard by planning, training, and exercising’.

Response
As natural disasters are not seen as controllable phenomena (Hodgkinson, Stewart 1991), communities have to be always ready to respond to them when they happen. It is therefore clear that the phase of response is the first reaction of people to a hazard/disaster and it takes place once the disaster occurs. ‘Response refers to the actions taken immediately before, during and after a disaster occurs (in order) to save lives, minimize damage to property, and enhance the effectiveness of recovery’ (Mileti 1999). CEOS (2001) supports this by pointing out that ‘response is the mapping damage extent and nature; primarily for purposes of relief’ (CEOS 2001). Although humans – by nature – avoid thinking that something bad will happen, and in particular “at least not to us”, history has revealed that hazards and disasters occur everywhere and to anyone. Therefore, activities are designed to provide emergency assistance for all potential victims. They also seek to stabilize the situation and reduce the probability of secondary damage and to speed recovery operations (Johnson 2000). In relation to the ‘secondary damage’ and to the ‘speed recovery operations’, Nalls (2003) points out that the role of response is the ‘conduction of emergency operations to save lives and property by positioning emergency equipment and supplies; evacuating potential victims; providing food, water, shelter, and medical care to those in need; and restoring critical public services’. One of the most important aspects that need to be valued through the chaotic situations of disasters is the safeguard of human life. This has been widely recognized by governmental bodies and organizations, as well as by the United Nations, which points out that ‘disaster response is a sum of decisions and actions taken during and after a disaster, including immediate relief, rehabilitation, and reconstruction’ (Department of Humanitarian Affairs, United Nations 1992). In addition to this, during the phase of response there is the need for cooperation of a lot of specialists from different disciplines, in order human lives to be saved (Kiriazis, Zisiadis 1999). The information required in the first hours after an event is not necessarily the same as that required days or weeks afterwards, e.g. mapping damage for insurance loss estimation (CEOS 2001). Although the phase of Response takes place immediately after a disaster occurs, it has a continuing action several hours or days after the event and it prepares for the activities of the fourth phase of disaster management, recovery.

Recovery
The activities that take place during the phase of recovery can be divided into two categories. The short-term recovery activities, which take place in order to restore
vital support systems (Mileti 1999), to minimum operating standards (Johnson 2000) and the long-term recovery activities, which have as their goal ‘to return life to normal’ (Mileti 1999) or to ‘improved levels’ (Johnson 2000). Those activities ‘may continue for a number of years after the disaster’ (Johnson 2000). ‘Recovery involves the rebuilding of communities so individuals, businesses, and governments can function on their own, return to normal life, and protect against future hazards’ (Nalls 2003). This statement implies that during the recovery phase, long-term actions take place considering the phase of preparedness as the first phase of disaster management. Therefore, someone could argue that disaster management works as a circle, in order to always mitigate, prepare for, respond to and recover from disasters. Figure 1 depicts a graphical representation for this four-phase chain.

Fig. 1: The four phases of Disaster Management

ORGANISATION OF DISASTER MANAGEMENT IN THE EUROPEAN UNION (EU)

A general overview of the position of the European Commission concerning the Civil Protection of its member states is presented in the next sections. The management of disasters within the EU member states broadly follows the main phases described above. The key differences lie in the specific organisations responsible. The national organisation of the civil protection departments of three EU member states, Greece, Italy and UK are discussed along with their emergency response planning philosophy.

European Union and Civil Protection

In order for the aims of disaster management to be met in the today’s human communities, a series of bodies have been established around the world. Those bodies act under the label of ‘Emergency Preparedness’ in the USA, and ‘Civil Protection’ in the EU. They provide their expertise and experience in the prevention and response to disasters through the four phases of emergency management. Civil Protection in the EU has as its primary aim ‘to support and encourage efforts made at national, regional and local level’ (European Commission 2000). The objectives of the Community’s co-operation in the field of civil protection are ‘to help ensure better protection for people, the environment and property in the event of natural and technological disasters’ (European Commission 2000). From these the EU developed a series of ‘planning principles’ for its member states. These principles serve as general guidelines that the individual countries can follow in order to come up with their own emergency plans.
Civil Protection in Greece, Italy and UK
The three member states of the EU, which have been considered as case studies for the current work are Greece, Italy and UK. Greece and Italy are neighbouring countries, and they are both located in the Mediterranean Sea. As it is known this area experiences a lot of seismic activity, very often hazardous for its citizens. Both countries have more or less, the same infrastructure and similar governmental structures. On the other hand, the UK rarely experiences seismic activity. Its inclusion to this study is because UK experiences other types of natural catastrophes including the storms in Southern England in 1990 (with over 45 fatalities) and the flooding on the Welsh coast during the same year.

Civil Protection in Greece
Greece has a common management strategy in dealing with natural disasters. At the same time, according to the specifics of each area and according to the nature of the disaster, this strategy could slightly change. The general guidelines are provided by the framework of the overall national plan namely “XENOCRATES” issued by the General Secretariat of Civil Protection (European Commission 2000). The bodies responsible for the implementation of civil protection in Greece are:

- The Inter-ministerial coordination body (S.D.O.)
- The General Secretariat for Civil Protection
- Authorities, organisations and institutions, which work together in the part of planning and rescue operations. These include the Ministries, the Fire Brigade, the Police, the Defence Forces, the Health organisations and other major partners.
- The General Secretariat of the Region, and finally
- The Prefecture

Figure 2 shows the organisation of disaster relief in Greece.

Fig. 2: Civil Protection in Greece. Source: European Commission, 2000
Civil Protection in Italy
Civil defence in Italy is organised as a coordinated resources where national, regional, provincial and local authorities work together in conjunction with local and public institutions, the scientific community, private institutions and organisations, voluntary organisations and professional associations (European Commission 2000). Each of the above-mentioned bodies assists in the creation of the emergency plans. The responsibility for the management in the case of a disaster lies with:

- The Mayor
- The Prefect
- The Department of Civil Defence, according to the extent of the disaster.

Figure 3 demonstrates the responsibilities of the peripheral bodies.

Civil Protection in UK
In case of natural disasters the local authorities and in particular, the regional emergency committees are responsible for the response. At the same time, there is no
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single national organisation responsible for formulating rescue plans (European
Commission 2000). The local authorities – guided by the government - coordinate the
preparation of the disaster relief plans in the UK. When a disaster occurs, the police
department coordinates the response.

The three levels of the organisation of disaster relief (strategic, technical and
operational level) are illustrated in figure 4.

**DISCUSSION**

As revealed by the previous sections, the Civil Protection of each country uses the
theory of disaster management in order to create and to apply emergency plans in case
of natural disasters. This theory is the process of moving from a hazards management
paradigm through a risk management paradigm through to a consequence
management paradigm, where effort and attention is directed at putting greater
emphasis on understanding and dealing with the full range of consequences (Buckle et
all 2003). Over the stages of conceptualisation, adjustment and application of the
plans a lot of different professionals get involved. Bringing in the expertise from
different parties may lead to numerous misunderstandings, as each one of the involved
parties has their own perception in a particular situation. This may lead to major
breakdowns, which in the particular field could lead to important losses, such as
human lives. Therefore, the way the professionals and specialists contribute their
knowledge and experience has to be structured carefully (CIB 2002). However, even
the best-structured technique can be proved as unsuccessful if it is not communicated
effectively. To this extent, the need to bring together the intellectual resources of the
parties involved within the same environment and to communicate effectively and
efficiently has led to the development of relevant collaborative computer-based
systems. On the other hand managers and politicians seem to want more
computerised decision support to help in both crisis planning and response. In the
context of the civil protection and disaster management, electronic based methods for
communication and management involve the process of exchanging information
digitally (Howard et all 2002). In particular, current electronic systems enable users to
communicate either via e-mail, office networks or project extranets. Although there
have been improvements in the field of disaster management, during emergency
response the historic problems are only getting worse. In other words, departments
and organisations involved purchase different software packages, which serve the
same function but cannot share data. Information and Communication Technologies
(ICT) continue to breakdown during crisis. The stress of the rescue teams and managers is high and this may lead to poor decisions. There is often the lack of common terminology between the parties involved. Edward and Cieslak (2004) support this evidence by pointing out that working together as a team is the key to success. Every group has its own set of colourful acronyms and standard operation procedures. However, it could be argued that there is still room for improvement. In particular, the need to manage expertise to support strategies through sharing, brokering and trading resources is described under the 2003/2004 Work programme of the EU Information Society. Moreover, they support approaches to exploit synergies between communities and then to join forces as well as to share common layers. Exploiting such an infrastructure involves an understanding of the needs of the individuals and the parties involved as a whole.

CONCLUSIONS AND FURTHER WORK

This paper has presented disaster management as a professional discipline responsible for saving lives, property and the environment when natural hazards occur in society. It introduced the organisations responsible for civil protection in three member states of the EU and the parties involved in each one of them. The need for simultaneous interactions of decision makers for managing emergencies and at the same time the need for improved ICT support has been highlighted. The primary aim of the present work is to investigate whether disaster managers, rescue teams and other relief workers work effectively and efficiently with current ICT methods. At the same time, the potential of current and emerging information and communication technologies will be examined to ensure maximum effectiveness and efficiency in such time-critical situations.

REFERENCES


