

# Disaster Management Action Plan and Integration of Robotics in existing Protection service structures

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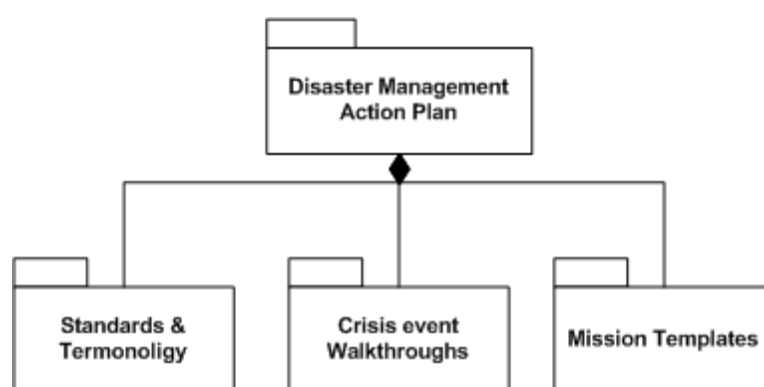
## 0 Abstract

In the emergency of a fire or in the aftermath of a disaster, the struck area is rather difficult to access and may have become hazardous, hostile or toxic. Establishing whether the ground can be entered safely by human beings is time consuming. A major challenge is to quickly acquire and gather in situ data and forward information about the actual situation throughout the entire system. The View-Finder research project develops robots and an advanced base station for inspection of a crisis ground as well as the necessary interfaces to manage the robots from the base station and tools to facilitate the crisis management to the people involved in the crisis as well as their interaction.

View-Finder combines robots for in-situ data gathering on crises situations with appropriate risk and crisis management strategies to ensure optimal exchange of information between the local forces applied at the crises ground and overall crisis management and information sources.

To reach its goals, the View-Finder project define and develop an open, flexible and generic information tool which will allow the field actors to take the right decisions, in an effective and efficient way, when the crisis arises.

The Disaster Management Action Plan (DMAP) is such a tool. It will propose to the Protection Services standards, walkthroughs and scenarios (mission templates) which will guide them along the crisis management.



**Figure 1**  
**DMAP structure**

In this article we are going to show how the DMAP has been conceived, its sources and rationale and how the DMAP integrates the View-Finder Robotics context fulfilling the needs of the Protection Services at the time of a crisis.

**Keywords:** disaster management, crisis management standards, crisis terminology

## 1 Introduction

The purpose of this paper is to explain the conception process of the DMAP, from the study of international regulations and crisis management methodologies, through the analysis of the advanced user requirements till the definition of the tools composing the concept of DMAP. The paper will also establish the role of the DMAP in the integration of robotics in the existing protection services.

This paper is structured as follows:

- Section 2 positioning the DMAP in the general crisis management context.
- Section 3 begins with the study of national and international regulation of Disaster Management Systems, follows with the application of these policies in a typical organisation of Protection Services, to show, finally, how the DMAP answers to the protection services needs.
- Section 4 shows the role of the DMAP in the Integration of Robotics Systems in existing Protection Service Structures.

## 2 The crisis management and the DMAP

A crisis or emergency [1] is a sudden and usually unforeseen event that calls for immediate measures to minimise its adverse consequences. An emergency occurs after a disaster when an immediate response is required and local capacity is insufficient to address and manage traumatic events.

In order to make the crisis management successful, there are many factors to take into account and the amount of information about crisis management can be overwhelming; the organisation of such information into a model is the first step in the choice of a crisis management model; our objective is to choose a simple model which fulfil the needs of the crisis management in the context of the Vie-Finder project.

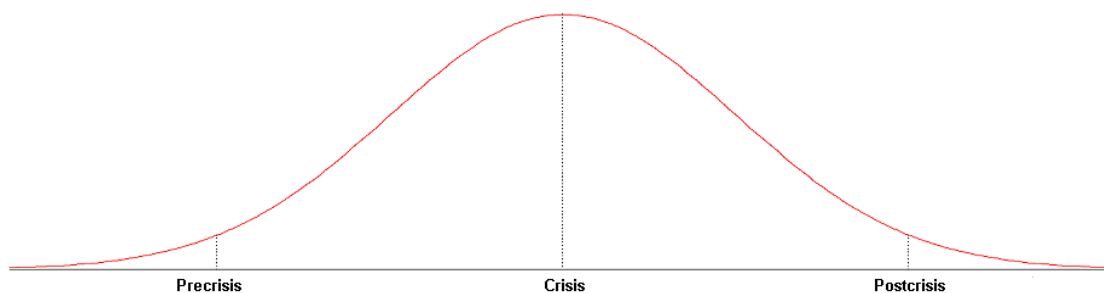
The choice of the crisis management model to be used in the development of the DMAP is explained briefly in the following paragraphs.

Some models of crisis management make the comparison of the crisis to a life cycle [2][3]. Inherent to this analogy is that the crisis has both a birth and a death. The crisis changes over time, and the cycle does not end, rather that its effects remain beyond the decline and death of the crisis.

The Crisis Life Cycle (CLC) is a concept found systematically in crisis management.

It is also commonly accepted that crises follow a sequential path through three stages: precrisis, crisis and postcrisis

The precrisis stage includes all aspects of crisis prevention – issues management, planning, and other proactive steps. The crisis stage refers to the steps taken to cope with and respond to the crisis event – crisis recognition, information distribution, message development, reputation management, and evolving developments. The postcrisis stage begins when the crisis is resolved – ensuring the crisis over, assuring publics of the security of the organization, and learning from the event.



**Figure 2**  
**Three stages Crisis model**

Coombs [4] states that the three most influential staged approaches to crisis management are Fink's [2] four-stage model of a crisis lifecycle, Mitroff's [5] five-stage model, and the basic three-stage model presented previously.

The three-stage model is unique in that no single scholar is attributed with its creation. "The three-stage model is not associated with any particular theorists, but it appears to have emerged from several research efforts as a general analytical framework" [7]. Coombs [4] describes the three stages of the model as macro-stages that can be applied to many models of crisis management.

The following tables show a comparative view of the crisis stages as well as their basic definitions:

	Precrisis		Crisis		Postcrisis
<b>Burnett</b>	Identification		Confrontation		Reconfiguration
<b>Fink</b>	Prodromal		Acute	Cronic	Resolution
<b>Mitroff</b>	Signal detection	Probing and prevention	Damage containment	Recovery	Learning

<b>Burnett</b>	
Identification	is the preparation for the crisis composed of goal information and environmental analysis
Confrontation	is the point when an organisation is involved in the crisis. Encompasses strategy formulation and strategy evaluation
Reconfiguration	includes strategy implementation and strategic control. Determines how the organisation adapts to crisis intervention

<b>Fink</b>	
Prodromal	Is the warning stage and implies a proactive approach. In this stage, crisis managers attempt to identify an impending crisis
Probing and prevention	The actual crisis event begins with a trigger. This stage is characterized by the crisis event and the resulting damage. The severity of the crisis and damage are influenced by the success of the prodromal stage
Cronic	This stage refers to the lasting effects of the crisis that can extend the life cycle of the crisis

<b>Mitroff</b>	
Signal detection	Identifies the signs of possible crises. Encompass the proactive steps an organization can take before a crisis event
Probing and prevention	Seeking of known crises and determining ways to prevent them
Damage containment	Focuses on the steps taken following the crisis event
Recovery	Facilitation of the organizational recovery. Emphasizes the facilitation of the organizational recovery
Learning	Represents the postcrisis management actions: the evaluation of the crisis and decisions taken concerning the preparation for future crises

In this context, the DMAP, as a tool intended to guide the crisis managers in the resolution of the crises, shall be capable to provide specific answers at any stage of the CLC for any kind of emergency situations.

### 3 From legal regulations to the DMAP

#### 3.1 From national and international regulation of Disaster Management Systems to the organisation of Protection Services

A comparative study of regulations on management of major hazards was made by the ISPU in 2002-2003 [8]. The objective of this study was to make an inventory of existing laws and practices concerning risk prevention, crisis management, rehabilitation, and

controls and sanctions in the field of major hazard management in the 26 states members of the EUR-OPA Major Hazards Agreement.

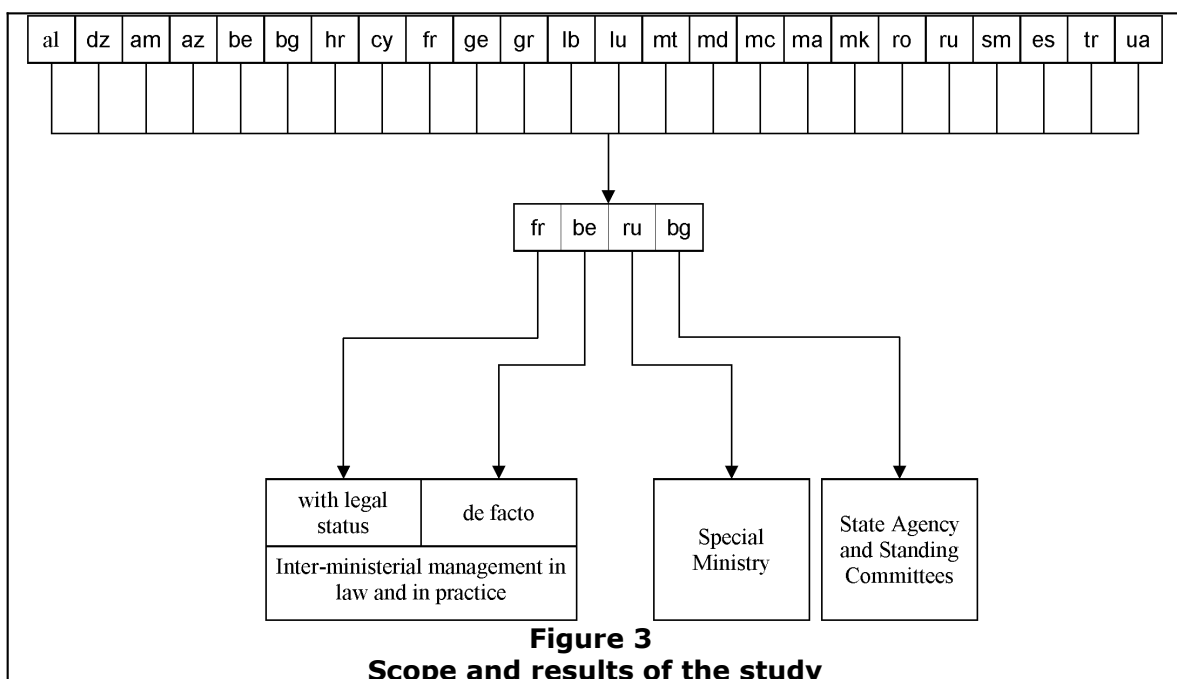
Information was requested on the systems for dealing with natural hazards (avalanches, storms, drought, earthquakes, floods, forest fires, landslides and volcanic hazards) as well as that with technological hazards (chemical and industrial hazards, transport and storage of dangerous substances, traffic accidents, marine pollution and nuclear hazards).

This survey found that, in one hand, the distribution of competences and responsibilities has become very complex and that there is a lack of a co-ordinated and integrated approach including the components of risk management (prevention, preparation, management and rehabilitation) as well as a system of controls and sanctions. In the other hand, as a positive result, the survey found that a horizontal approach and co-ordination efforts can contribute to successful preparation for the management of crisis situations.

Following these findings a question arose [9]: do legally sound models of inter-ministerial co-ordination exist that can be used to optimise major hazard management? From both, the organisational and legal standpoints, the challenge was thus to find the corresponding administrative structure and/or mechanisms at the national level.

Finally four models were established:

- inter-ministerial management as provided for in French law;
- inter-ministerial management as practised (co-ordination not explicitly provided for in the legislation): Belgium and the role of the Crisis Centre;
- ministerial management by a ministry specialised in hazard control: Emercom in Russia,
- the civil protection agency and the hazard management standing committees in Bulgaria.



These four components were brought together mainly at non-central levels (municipality, province, country, etc). These are the levels at which all the legal standards are actually applied, be they theme-specific: particular to a type of hazard; or horizontal: factors common to all hazards.

- Inter-ministerial management in law and in practice: the most common mechanism is inter-ministerial management, mainly involving co-operation between the Interior and Environment Ministry, and occasionally the Ministry of Health for emergency medical

assistance, or other ministries for their specific competences. It may have legal status or simply exist *de facto*.

- Examples with legal status include the State Secretariat for Security which existed in Belgium and the Sustainable Development Secretariat in France.
- An example of de facto co-ordinations is the role assigned to the Government's Crisis Centre in Belgium. It is a *de facto* role because the law assigns no specific powers of co-ordination to this Center in particular. It is through a series of supplementary (and voluntary) initiatives deemed necessary for it to assume its legal responsibility that the Crisis Center has imposed itself in practice as a key player in co-ordination. There is also the centre's infrastructure and the fact that the other Ministries have no crisis management structures of their own, which obliges them to rely on the Crisis Centre.
- Special Ministry: a second option is to set up a special Ministry with all the requisite powers and skills for hazard control. Russia's EMERCOM (Emergency Management Committee) is the epitome of such a ministry.
- State Agency and Standing Committees: a third option is to set up an Agency, answerable to the Prime Minister or the Minister of the Interior, to which the government delegates major hazard management. Unlike Emercom, where such an Agency exists the competent ministries keep all their powers but second representatives to the Agency, to work with staff seconded from other ministries, each in the particular field of hazard management covered by their respective ministries? There is an example in Bulgaria, where the Agency is supported by an original system of Standing Committees at every level of government.

### 3.2 Organisation of the protection services

Having identified the four main models of risk management in the most of European countries, we will show at present an application of these findings: one of the particular ways in which the Protection Services are organised in some European countries. This point of view matches the closest with the "*de facto* inter-ministerial management model"

The following paragraphs give an overview of the organisation of Disaster and Emergency Services and details the elements and organisation of these services. The contents are mainly based on the Belgian "general emergency plan" for use in emergency situations; the documentation available from the Polish and Italian organisations shows that their Disaster and Emergency services are organised in a similar manner, at least from a conceptual point of view.

Essential elements for the Disaster and Emergency services organisation are:

#### **Emergency plans**

The emergency plans set out the different intervention Levels and the general organisation of emergency assistance as well as information required to assure the management of any emergency situation.

The methodology and the principles set out in the "general emergency plan" are the same for any situation. This "general emergency plan" will be complemented with specific plans covering particular risks either within a circumscribed zone or affecting a larger zone. These are referred to as a "particular emergency plan".

In any emergency situation there are several services involved in the analysis and management of the emergency; the directives for each of these services, as well as the relationship between them, are set out in the "mono-disciplinary plan". The purpose of the "mono-disciplinary plan" is to establish the organisation in terms of raising the first alarm, distribution of tasks, communications, selection of the Level of authority, as well as the representation of the services in the Control Operational Centre (COC) or the Crisis and Risk Management Centre (CRMC).

In the case where outside organisations or companies face a particular risk, there is often an "internal emergency plan"; this plan sets out directives covering the management and actions required in the event of this particular emergency e.g. plans existing at companies regulated by the SEVESO directives.

### **Levels of management authority (LMA)**

There are three Levels of management authority – local, regional and national. Each Level is responsible for informing the next Level in the hierarchy, both upwards and downwards.

The nature and gravity of each emergency is the determining factor to decide which Level becomes responsible. The Local authority can propose that the Regional authority takes responsibility immediately. In the same way, the Regional authority can propose that the National authority takes responsibility. The inverse is also possible.

The Level in charge is responsible taking decisions in emergency situations. It is responsible for the coordination of these decisions at operational and strategic level. The objective of these decisions is the control and eradication of the emergency situation, limitation of its consequences and maintaining or re-establishing law and order.

The determination of a particular Level shall take into account one or all of the following parameters:

- the geographical extent of the emergency
- the availability of material and personnel required
- the real or potential number of victims
- the requirements in terms of coordination
- the scale and social impact of the emergency
- the nature of the emergency and its technical complexity
- the evolution of events

Based to these parameters, the responsibility of each Level of management authority covers:

- **Local Level:** This Level is activated when the threat or the emergency situation is limited to the local area; the person responsible for this Level is the head of the local authority e.g. the mayor of the town. A condition of responsibility at this Level is that the emergency situation can be controlled using local means and reinforcements such as fire fighters or police.
- **Regional Level:** This Level is activated when the threat or emergency situation concerns more than one local authority. It is decided by the head of the regional authority e.g. the governor of the province. In many cases, the head of the regional authority activates the regional Level on the basis of his assessment of the emergency situation. He will take into account the nature and impact of the emergency, its likely evolution and the material, personnel and special skills required.
- **National Level:** This Level is activated where the threat or emergency situation covers :-
  - two or more regions.
  - the means required exceed those available to the head of the region
  - the number of actual or potential victims
  - the threat of major damage to the environment or the food chain
  - the threat of or actual attacks on the vital interests of the nation or to the essential needs of the population
  - the requirement for coordination of different ministries, departments or federal organisations
  - the emergency affects the whole population

Each Level of authority is required to inform the others in the hierarchy and to keep them informed. The head of the local authority reports to the head of the region and he to the minister in charge.

### **Services**

The emergency plan must delimit and distribute responsibilities to each operating service involved. A "specific mono-disciplinary plan" is created for each service. In the Belgian case we identified five different services. The actual personnel involved will vary with the circumstances of the emergency.

- The emergency services: the fire services, aided by operational units of the civil protection.
- Medical, sanitary and psychosocial services: the ambulance service, doctors, hospitals, psychiatrists and public health & sanitation services are responsible for emergency medical aid, preservation of public health and psychosocial help for the victims.
- Police services.
- Logistical services. Logistical services will be provided by appropriate personnel; they assist other personnel and services in the provision of necessary material, provide technical coordination between services and furnish materials required to eliminate dangerous products or to decontaminate the area.
- Information services: the public relations departments at local, regional and national Level.

### **The Emergency plans, the Levels of management authority and the Services**

Each element is associated to each other at different Levels and in several ways. They are interdependent and their relationship is shown as follows:

The Coordination Operational Centre (COC) is responsible for coordination of actions taken by the various services under the "general emergency plan" with direct reference to the emergency. Strategic Coordination is handled by the Level management Authority (LMA) and it is responsible for decisions covering locations and inhabitants not or not yet directly affected by the emergency.

A COC can be convened at Local, Regional or National level. It is staffed by representatives of each of the services involved together with a representative of any organisation directly affected by the emergency and the local (regional or national) official responsible. It takes operational decisions and ensures effective communication and coordination of resulting actions. All operational personnel must be made aware of how to communicate with the COC.

The COC and LMA are required to maintain close two-way cooperation and coordination to assure effective action in relation to the emergency. The COC must ensure that the LMA is kept up to date by regular reports and the LMA will advise on the progress of actions requested by the COC.

The site of the emergency is classified by zones if that is appropriate to the emergency and the situation. Each zone is determined by the level of risk and the measures to be taken are determined in advance by the "emergency plan" relating to a particular risk. Each zone is delimited appropriately to the actual emergency.

Zones are classified as:

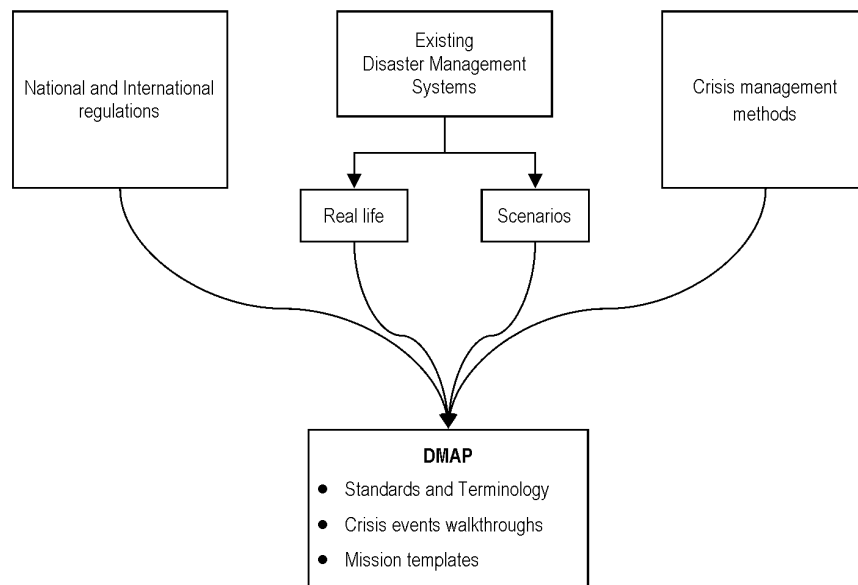
- Red zone (exclusion perimeter): only accessible to operational personnel
- Orange zone (insulation perimeter): accessible to the people who reside or work on this zone. It is also used by the logistical support services.
- Yellow zone (dissuasion perimeter): people not residing or working in this zone discouraged from entering. Media can enter this zone.

### 3.3 The DMAP

The DMAP as crisis management tool provides specific answers at any stage of the crisis, for any kind of emergency situations, from large-scale national and cross-border crises, regional disasters down to local-scale incidents. In all cases, collaboration between different organisations and units is envisaged which may include entities from the Governmental Crisis Coordination Centre down to local civil protection authorities.

The DMAP is a conceptual tool composed of glossaries containing the crisis management terminology, description of process at an abstract level in intended to help in the management of the current crisis (walkthroughs), definition of standards concerning the chemical products meet in the crisis area and, finally, scenarios (mission templates) taken from the user requirements, to guide the crisis managers and to prepare the response for future crises.

The following figure shows the process of construction of the DMAP:



**Figure 4**  
**Construction of the DMAP**

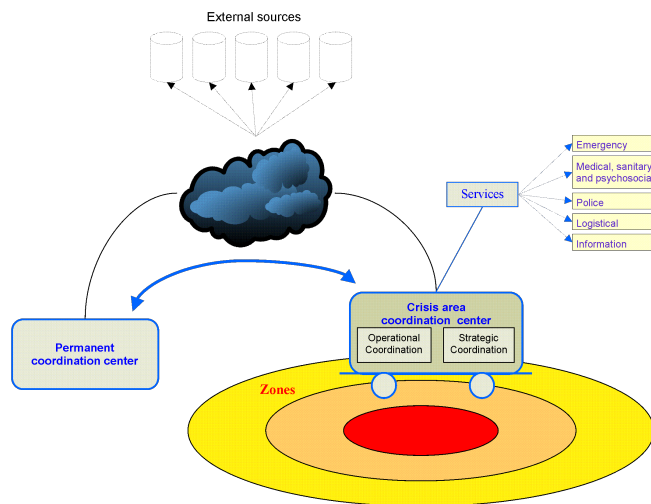
## 4 DMAP, robotics and Protection Services

The DMAP is initially a conceptual tool intended to give to the managers of the crisis a better understanding of the current situation (bringing to their knowledge information gathered from similar crisis managed in the past). The aim of the DMAP is also to facilitate the communication between the people involved in the crisis management, bringing to the crisis scene well-known standards and a common terminology.

In order to make the DMAP and its concepts useful for users in the crisis area, it will be integrated in the View-Finder Crisis Management Information System - CMIS.

The CMIS consist essentially of a first component that is installed at the CRMC and, after the initial deployment, of a second component that is installed in the vicinity of the disaster inside the COC [10].





**Figure 5**  
**Crisis being managed in the View-Finder project**

In the CMIS context, the DMAP take the form of a set of services located in the COC, in a module which covers its essential its functionalities: the "DMAP Services". The "DMAP Services" is composed of two parts: the "Mission templates and Walkthroughs" module and the "Standards" module.

#### Mission templates and Walkthroughs

This module will offer the mission templates intended to be exploited in multiple operational contexts; they can potentially be modified and saved. These mission templates are standardised guides that will orient the users in the management of a crisis by proposing pre-recorded situations of similar emergencies with the solutions provided to this particular case. This module offers also Walkthroughs

#### Standards

In this module, users will find the industrial standard of chemical products received from the robot's sensors, methods to manage dangerous products, and even recommendations concerning their manipulation.

The DMAP features are available all along the crisis management and can be invoked in particular situations. For instance, to get the habitual procedure to manage certain dangerous products, to know the list of authorities involved in such a crisis, or even, to look-up the chemical characteristics of a product present in the crisis zone. The information sources are the standards, the templates and the databases, present in the system.

## 5 Conclusions

### **Crisis context**

According with the three stages model, the DMAP covers the whole life cycle of the crisis management and provides for each stage

- precrisis: pre-recorded crisis scenarios (mission templates) in order to allow the people involved in the crisis to compare the current crisis with previous ones facilitating the decisions and making them more effective;
- crisis: standards of the habitual procedures to manage certain dangerous products, the list of authorities involved in the crisis and the possibility to look-up the chemical characteristics of a product present in the crisis area. Glossaries with the appropriate terminology will be also available in order to facilitate the communication between people involved in the crisis management;
- postcrisis: the possibility for the crisis managers to evaluate the crisis management and improve the management of future crises; the mission templates will be up-to-date, and the walkthroughs of the recently managed crisis will be saved in the system knowledge base.

## Protection services

When managing crisis situations, an emergency plan is applied; this plan delimits and assigns the responsibilities for each service involved. A "specific mono-disciplinary plan" is created for each service. There are, usually, five different services: emergency, medical, sanitary and psychosocial, police, logistical and information. The COC is staffed with representatives of each of these services together with a representative of the organisation that is affected by the crisis.

The DMAP is a generic crisis management and planning system, based on information gathered from similar situations in the past, on information about dangerous products and on the relevant standards accessible to the crisis managers; it provides also to the people involved in the crisis management with the tools to evaluate the current situation and to make the most appropriate decisions.

## 6 Acknowledgements

The Vision and Chemiresistor Equipped Web-connected Finding Robots - View-Finder is a research project Funded under 6th FWP (Sixth Framework Programme) of the European Commission as part of the action line: IST-2005-2.6.1 Advanced Robotics.

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