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Search & Rescue

Emerging technologies for the Early location of Entrapped victims under Collapsed Structures & Advanced Wearables for risk assessment and First Responders Safety in SAR operations

D3.1 Requirements to knowledge management and SA Model

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Partners

	NATIONAL TECHNICAL UNIVERSITY OF ATHENS (NTUA) Co-ordinator	Greece
	AIDEAS OÜ (AIDEAS)	Estonia
	SOFTWARE IMAGINATION & VISION S.R.L (SIMAVI)	Romania
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Executive Summary

This deliverable produced in the scope of WP3's D3.1 "Requirements to Situation Awareness and SA Model". D3.1 describes methods for finding the information requirements that first responders need to achieve a level of situation awareness, in order to develop disaster emergencies. Situation Awareness (SA) is the accuracy with which people perceive, understand and anticipate changes in their environment that are relevant to achieving operational goals. But first, a Knowledge Management System is required, in order to capture, develop, share and use organisational knowledge to finally enable SA, as Emergency management requires a Knowledge Management System that can adaptively respond to the uncertainties inherent to crisis and manmade disasters. The Knowledge Management System requires components, both human and hardware, that must pursue a variety of operational goals (time of response, time of deployment, rescue victims etc.).

The focus of the deliverable D3.1 is the definition of the technological requirements of the Knowledge Management functionality in order to enable situation awareness, more efficient context-aware data sharing and presentation to the emergency responding actors, and subsequently more efficient decision-making support.

The requirements to be collected should address different aspects of the SnR system functionality such as:

a. knowledge models and information elements required to represent various types of resources used in SnR operations
b. the support required for various types of decision making and decision points during SnR operations
c. the requirements to the overall knowledge management infrastructure to support the achieving of situation awareness.

These needs will support the risk awareness in decision-making, related to both victims as well as staff on the field.

Moreover, WP3 will develop the requirements to SA with respect in the emergency domain standards such as EDXL (the Implementation of EDXL standards aims to improve the speed and quality of coordinated response activities by allowing the exchange of information in real time).

Finally, the effective implementation of this deliverable will enable a stronger situation awareness and it will reinforce the preparation of D3.2 Situation Awareness.

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ACRONYMS

API	Application Programming Interface
AR	Augmented Reality
APP	Application
CBRN	Chemical, Biological, Radiological, And Nuclear
D	Deliverable
DSS	Decision Support System
EDXL	Emergency Data Exchange Language
EMS	Emergency Management System
ESSID	Extended Service Set IDentification
EU	European Union
GA	Grant Agreement
GIS	Geographic Information System
GPS	Global Positioning System
ICT	Information Communication Technology
KM	Knowledge Management
KMS	Knowledge Management System
KT	Konnektable
WP	Work Package
MVC	Model-View-Controller
NGOs	Non-Governmental Organisations

OGC	Open Geospatial Consortium
PSAP	Public Safety Answering Point
SA	Situation Awareness
SnR	Search and Rescue
UC	Use Case
Wi-Fi	Wireless Fidelity

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1 Introduction

1.1 Objectives

The objective of D3.1 aims at the analysis and definition of the requirements for knowledge management functionality, in order to enable Situation Awareness to SnR operations. As a result, knowledge models and information elements will facilitate the sharing of information for more effective decision making.

A first attempt has been made concerning the collection of data, information and knowledge regarding the requirements to knowledge management functionality, the requirements to the management of various and heterogeneous types of resources and decision making and the requirements to overall knowledge infrastructure.

The first assessment is made, and the challenges and the needs for further development are identified. As a next step, the D3.7 "Requirements to knowledge managements and SA model v.2" will further include updated requirements with technical specifications (waiting for the first version of deliverable D7.2 "Architecture and Design Specifications of SnR platform" by SIMAVI) and EDXL paradigms. The requirements will be further evaluated based on technical criteria of the feasibility of implementation and practical considerations on training pilots.

1.2 Scope

The scope of D3.1 "Requirements to Situation Awareness and SA model" deliverable is to provide the logic (e.g., rules) and models for storing, sharing, notifying and presenting information to various stakeholders, based on their roles of disaster response.

The definition of the technological requirements of the Knowledge Management functionality shall enable situation awareness, more efficient context-aware data sharing and presentation to the emergency responding actors, and subsequently, more efficient decision-making support.

The requirements to be collected should address different aspects of the SnR system functionality, such as:

a. knowledge models and information elements required to represent various types of resources used in SnR operations
b. the support required for various types of decision making and decision points during SnR operations
c. the requirements to the overall (semantically enhanced) knowledge management infrastructure to support the achieving of situation awareness. These needs will support the risk awareness in decision-making, related to both victims as well as staff on the field.

1.3 Relationship with Other Documents

Deliverable D3.1 is the preliminary document addressing the specification of the requirements to knowledge management and Situational Awareness. The deliverable provides inputs to other SnR components and tools; for example, the knowledge management types of data are useful for the DSS support while it will receive inputs from pre-large-scale incidents analysis conducted within WP4 Task 4.1 and more. This deliverable is therefore linked to the following deliverables:

- D3.2 - Situation Awareness Model – specification
- D3.5 - Data-driven analytics applied on UAV imagery using deep learning

- D3.6 - Multi sensors data fusion and Object detection algorithms for in-disaster scene situation awareness
- D3.3 - BIM based services and applications - review and service design
- D3.4 - BIM based visualisation support integrated with VR interface
- D4.1 - Data aggregation
- D4.3 - Design of SOT DSS components
- D4.4 - Design of PHYSIO DSS component
- D4.5 - Development of SOT DSS components
- D4.6 - Development of PHYSIO DSS component
- D7.3 - Component interface specifications for interoperability within SnR
- D8.1 - SnR Pilot guidelines and User's Handbook
- D8.2 - SnR Use Case 1: Victims trapped under rubble (Italy) - Pilot plan
- D8.3 - SnR Use Case 2: Plane crash, mountain rescue, non-urban (Greece) - Pilot plan
- D8.4 - SnR Use Case 3: Earthquake / heavy storms between Vienna Rail Station & Kufstein railway station heavy damages in the rail station (Cross-border pilot, Austria-Germany) - Pilot plan
- D8.5 - SnR Use Case 4: Forest fire expanded and threat to industrial zone (Kineta, Agioi Theodoroi, Greece) - Pilot plan
- D8.6 - SnR Use Case 5: Victims trapped under rubbles (France) - Pilot plan
- D8.7 - SnR Use Case 6: Resilience Support for Critical Infrastructures through Standardised Training on CBRN (Romania)- Pilot plan
- D8.8 - SnR Use Case 7: Chemical substances spill (Spain) - Pilot plan
- D8.9 - SnR Evaluation Framework
- D8.10 - SnR Pilot Implementation and Evaluation Report 1st version
- D10.1 - Project Handbook, Quality Plan & Risk Management
- D10.2 - Data Management Plan 1st version

2 Knowledge Management System

2.1 Situation Awareness in SnR

In modern society, situation awareness (SA) is critical for decision making at various levels. Its use widely expands from an organisation to rescue operations and more. For instance, during a harmful incident, SA is needed to make more informed and well-prepared decisions to overcome difficulties in operations. In addition, decision making requires good situation awareness to maintain and improve the existing operational performance. Situational information can be conveyed via monitoring systems or other people, so it is important to study the most critical elements in providing SA. [1]

According to Endsley, situation(al) awareness is the perception of the elements in the environment within a volume of time and space, the comprehension of their meaning and a projection of their status in the near future (Endsley,1988). [2] For example, there are three general questions which can enable the SA for a disastrous incident. "What has happened?", "When did it take place?", and "Where did it happen?". These questions are not enough to supplement the initial information. [1] There are more questions and levels of questions and requirements to be followed. Endsley divided the SA into three different levels, in order to facilitate information gathering:

Table 2-1 Levels in Endsley's Model

Level	Description
Level 1: Perception	Perception of the elements in the current situation
Level 2: Comprehension	Understand and form decisions
Level 3: Projection	Prediction and forecasting for events that may occur

The level 1 SA consists of the perception of the elements in the current situation. This is the lowest level of SA where the actors perceive information, in order to estimate the situation. The level 2 is the comprehension that is followed by the gathered knowledge of the level 1, in order to understand and form decisions. Lastly, the level 3 is based on the gathered and analysed information of the previous levels, with the main purpose the prediction and forecasting for events that may occur.

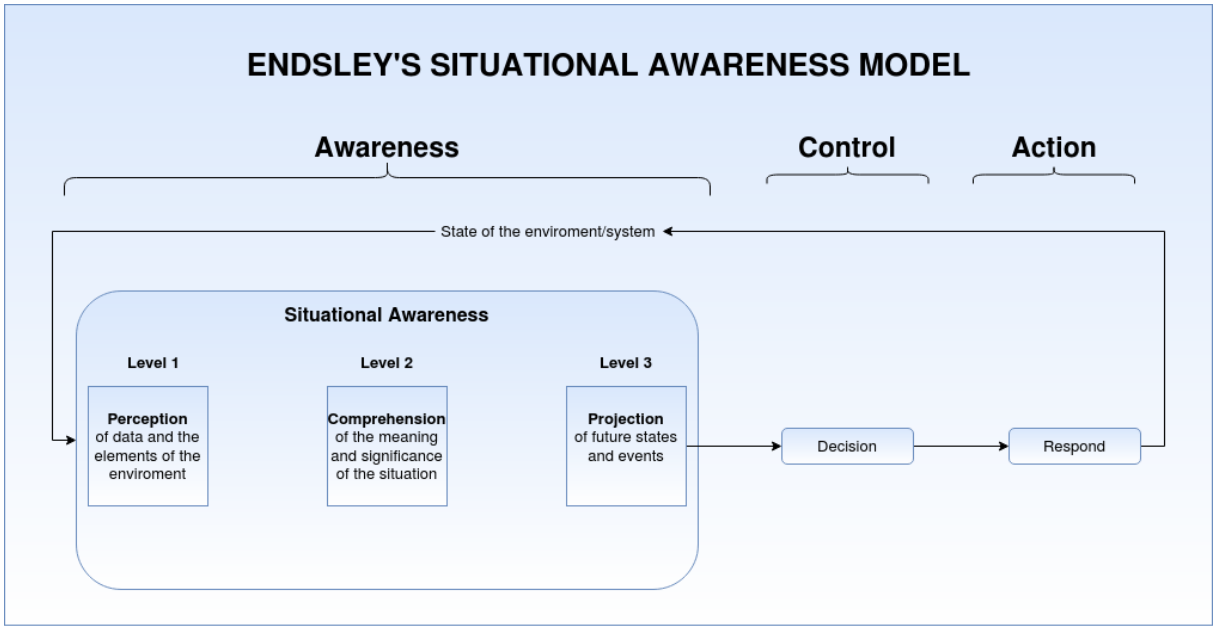

Figure 2-1 Endsley's Situational Awareness Model

The Search and Rescue Project (SnR) will find all the knowledge and information needed, in order to gather all the necessary requirements and build a strong Situation Awareness starting from the Endsley Model's basics. The SnR operations consist of actors such as first responders and control center, hardware devices such as wearables, sensors and other existing technologies, software components such as Decision Support Systems (DSS), communication web services such as the Emergency Communication System (CONCORDE). More specifically, SnR shall filter the data from the available resources to the emergency communication system and turn them into better decision making in order to synchronise and prepare for the greater all the SnR's actors through the SA. [7]

As a result, the SA process is in great need of a well-structured Knowledge Management System consisting of knowledge models and information elements as well as strong support of various types of decision-making during SnR operations is also required. [3]

2.2 Definition of Knowledge Management in SnR

Knowledge management (KM) is the process of capturing, developing, sharing and using organisational knowledge. [5] In the Information System perspective, KMS refers to an effective tool for enabling the KM processes. The Knowledge Management System can be composed by tools such as knowledge-based systems, document management systems, semantic networks, object-oriented and relational databases, decision support systems (DSS), expert systems, as well as simulation tools. Anyone or combination of these tools can be designed as an effective KM system. For instance, DSS is among the tools of choice for SnR. Drones, robotics and other SnR hardware components should gather the data from the disaster's environment. Then, the emergency communication app should integrate with the above devices and fuel the DSS with every possible information, in order to prepare the first responders and the stakeholders of the SnR operation.

Figure 2-2 Knowledge Management in SnR

Creating a Knowledge Management (KM) Strategy presents a holistic approach to leveraging knowledge and implementing technology to improve access to correct and timely data, information and knowledge.

The KM Strategy should provide a consistent nationwide template to enable federal, state, tribal, local governments, non-governmental organisations (NGOs), and the private sector to work together to prevent, protect against, respond to, recover from, and mitigate the effects of incidents, regardless of cause, size, location, or complexity. The KM Strategy for first responders and the other actors will specifically address disaster preparedness, response and recovery, including the technology that must be leveraged to support this strategy. In order for any technology initiative to be successful, it must identify the knowledge needs of first responders and determine the communication needs between national, state, and local entities and their corresponding first responder organisations (such as Fire, Police, EMS).

In determining a suitable knowledge management strategy for First Responders a determination must be made on the way they serve their clients, the types of knowledge that must be shared, captured and available for reuse, and should align with the strategic direction of the operation.

First Responders must have a KM strategy that supports the following:

- Quick and Decisive Decision Making
- Knowledge Recognition, Needs Assessment and Allocation, Feedback and Evaluation
- Expertise Coordination Practices
- Command and Control Structure
- Learning and Knowledge Transfer

As it was mentioned earlier, Knowledge Management is the process of capturing, developing, sharing and effectively using organisational knowledge. It refers to a multidisciplinary approach to achieving organisational objectives by making the best use of available knowledge from heterogeneous sources. [3]

The three fundamental concepts in the KM are:

- **Data** comprises the basic, unrefined, and generally unfiltered elements and facts
- **Information** comprises additionally refined data evolved to the point of being useful for some form of communication and/or analysis
- **Knowledge** comprises meaningful information (for a user, organisation, a machine or other entity). Knowledge is closer to the user, and it exists only when human experience, expertise and insight are appended to data and information

There is a great need to identify critical information sources that exist in emerging situations, and the support means to capture this information. Real-time information from the field, historical documentation (e.g., past decisions in same situations), guideline documents are important sources of information. However, in order to make the collected knowledge useful, it needs to be categorised with other related information. This move will help the SnR operations in achieving fast, accurate and context-aware searching, discovery and representation knowledge.

Moreover, the presence of various actors, various devices and heterogeneous information infrastructure as information providers and consumers require balanced interoperability support. In addition, an information awareness model based on the roles, tasks, equipment and the context of SnR operation and information sharing have to be set.

More specifically, the scope of knowledge management in the SnR Project must provide:

- Consistent modelling of information and knowledge from heterogeneous sources
- Capturing, accessing and sharing information and knowledge from heterogeneous sources depending on the role and the operation
- Accessing domain-specific knowledge, such as types of emergency, disaster and their characteristics
- Transforming data to useful knowledge for first responders and other actors
- Supporting the interoperability of data and information in the emergency response context

Following the above basic concepts, the knowledge management system will be more structured and well-prepared to enable the SA for SnR Project.

2.3 Emergency Communication App in SnR

The Emergency Communication App of the SnR Project will be a customised and empowered CONCORDE (accompanied by more external resources and software components). New hardware devices such as sensors, drones, rescue robots etc. (D1.2 "SnR_D1.2 Report on the functional specifications of SnR") will protect the first responders, as well as deliver data to the Emergency Communication App, in order to new algorithms and Decision Support Systems strengthen the decision making.

CONCORDE [3] is a successful emergency management system with an accurate knowledge management system that SnR can be based on, in order to collect data from resources and as a result help the first responders and the other actors proceed with the SnR operations. It is strongly recommended to SnR to adopt CONCORDE's glossary, (as the emergency communication app is actually the CONCORDE) which is already accepted and made with respect to the EDXL vocabulary.

To understand better the requirements to SA structure in Chapter 3, a brief definition of CONCORDE's knowledge management system and functionality has to be made.

The CONCORDE platform consists of a sequence of interactions between the system and a set of external actor(s), one of the actors actually being an end-user of the system. In general, an **actor** is a

person, another software system or a hardware device that interacts with the system to achieve a useful goal. [3] CONCORDE provides **a use case analysis template** (recommended by Wiegers and SnR can adopt this) which consists of essential elements such as:

- A unique identifier
- A name that states the use objective, e.g., "Update status".
- A list of actors involved
- A short description of the use case, e.g., "victims under rubble"
- A list of pre-conditions - conditions that must be satisfied
- A list of post-condition - conditions describing the state of the system after the use case is successfully completed
- A numbered list of steps that show the sequence of interactions between actors and the system

A great variety of actors (such as first responders, robotics, chemical sensors) will participate in SnR operations. These actors can be easily categorised as the identified **actors** of CONCORDE as shown in Table 2-2:

Table 2-2 Identified Actors from CONCORDE

Actors	Description
High Commanders	These are people responsible for the higher-level decision making and communication at regional, national, international levels, that may not use the system for operational needs. However, they are called to make higher-level decisions during large-scale incidents that, e.g., require upscale for resource allocation as well as to provide the link to the higher level and wider boundaries
PSAP Operators	PSAP is the space, which takes the initial call for an alert. The person who takes the call may be referred to as the call handler/operator. PSAP also hosts the dispatch operators who are responsible for making the initial decision for the dispatch of EMS units to the incident field (incident field stands for the disaster's location)
EMS en route staff	After an alert for an emergency incident, EMS vehicles are dispatched to the field via road, water or air. The vehicles have a task to provide emergency medical care to the victims/patients. The people who attend the scene are first responders e.g., firefighters, ambulance personnel, doctors, nurses etc.
Field Staff - Field/Incident Commander	It is the first arriving EMS en route staff on the field which becomes physically involved in control and command. The incident field commander will have higher commanders, usually in control rooms (not on the field).
Field staff - Triage Runner	It is the responsible person for running towards the victims on the field and tagging them according to the severity of injuries, in order to prioritise the most serious cases.

Field Staff - Retrieval Runner	It is the person on the field who is assigned an area or specific patients and retrieves them to transfer them to the medical area setup of the field.
Field Staff - Field medics	They are the medical and para-medical staff of the temporary field treatment, usually, they are medical staff performing the tasks and communicating with the incident commander.
Transport Crew	It is the crew of any vehicle, which takes patients from the incident field to the first receiver
First Receiver Staff	It is the staff at the place the patients are transferred for hospital care after being triaged and treated on the field. Usually, a first receiver is a hospital, appropriate to the situation. In disasters where infrastructure is damaged, a first receiver can be an adapted environment, such as a field/tent hospital, a school etc.
Bystander	They are people close to the incident field, who do not require emergency medical help and want to assist in emergency management. They can support the EMS units by providing information by undertaking some tasks depending on the needs of the incident commander. Usually, a bystander acts like a Caller, but he/she can also be a victim.
System administrator	It usually refers to a super-user who can access all parts of the system and offer operational support to the actors.
System	This is the CONCORDE platform itself. It is considered as an actor, responding appropriately to user actions and requests and performing pre-scheduled tasks.
Victim/Patient	These are actors of the incident not of the system who require emergency medical help, usually for the treatment of injuries.

The above actors undertake different tasks in an emergency response incident, according to their role. The SnR's actors can be categorised with the above definitions since the emergency communication app is CONCORDE which categorised the actors like Table 2-2.

Moreover, the CONCORDE knowledge management system architecture adopts the Model-View-Controller (MVC) architectural approach [3], and this is suggested to SnR to follow in order to address application and technical requirements for SnR needs for information awareness, data access and sharing mechanisms. [3] This model contains a set of conceptual models, as shown in Table 2-3:

Table 2-3 Set of Conceptual Models from CONCORDE

Conceptual Model	Description
User Model	Represents the actors
Context Model	Represents location, time and sensors readings
Incident Model	Defines the information elements to store, the incident information from the field
Resource Model	Represents the definition of the available resources from the actors
Domain Model	Represents the model that brings domain-specific knowledge to the system and facilitates the decision-making process
Expert Knowledge Model	Presents the information related to various procedures and processes, which are necessary to be performed in case of disaster management.
SocialNet Model	Aims to store and process the information from social media as an additional source of information
Metadata Model	Facilitate the knowledge search and delivery, assisting content management functions

All the above models are connected to each other e.g., one model may belong to another. The requirements to knowledge management for the SnR Project can be based on Tables 2-2, 2-3 as a guide and mindset.

2.4 Requirements' Collection Procedure

One way to approach the management of knowledge in the SnR project is to consider the emergency response tasks at different levels. [4] The emergency response management tasks (or functions) are divided into three levels:

1. Strategic such as historical data, study and analysis
2. Tactical such as system requirements and the scope of the domain
3. Operational such as system requirements and the scope of the domain

The requirements' collection procedure is made by the following steps:

- Analysis of the seven use case scenarios defined by the Grant Agreement (GA), from a knowledge management and data exploitation point of view (incident, type of disaster, actors, hardware, software)
- Release of questionnaires for additional details about the UC [Annex II Annex II: Questionnaire]
- Study and analysis of WP1 submitted deliverables, WP2 available resources meetings, questionnaires and templates (for D3.7 (the second version of D3.1) looking forward to D2.1 "PIA report for the SnR design and development, pilots and platform" in June 2021), WP7 technologies and capabilities questionnaires (for D3.7 (the second version of D3.1) looking forward to D7.2 "Architecture and Design Specifications on SnR platform" in the end of December 2020), WP8 and D8.1 "SnR Pilot guidelines and User's guidelines and User's Handbook"
- CONCORDE deliverables and documentation
- Literature review, focusing on technological solutions and better decision making on the emergency response.

Great attention has been paid to the type of information elements needed to support SnR Project and especially in the decision making required to support information access, sharing and representation e.g., semantic level of content (location, description, etc.), functional (who, where, whom to access). The requirements have also been assessed from the end-user's perspective and the possible support that may be required.

It is pointed out that the requirements collected are still of a broad nature and they are an attempt to address the needs for knowledge management of SnR. Accordingly, these requirements will be further evaluated and narrowed down based on several aspects, such as the technical criteria of the feasibility of implementation, as well as practical considerations.

Finally, the requirements to knowledge management will be further considered during the SnR iterations and milestones, in order to fulfil a more sustainable and accurate deliverable D3.1 in its second release.

3 Requirements for Knowledge Management

3.1 Information Elements and Knowledge Models

SnR needs to keep access to a variety of data and information items, in order to support the emergency response and the decision-making process of the project. A key piece of knowledge required is the actual resources of the project. For instance, an emergency incident forms a specific demand for resources (depends on the incident, e.g., the UC1 has different requests for resources than UC2), while the response is the deployment of the incident.

Moreover, the knowledge models need to follow the overarching terminology and core building blocks from the domain of civil protection. These building blocks apply to any kind of incident and threat and relate to any response structure (e.g., EMS, fire, police, others). [3]

The following are points of convergence between the responder's teams, which form the foundation for shared situation awareness:

- Incidents and hazards
- Command, Control, Coordination, Communication sites (C4 sites)
- Assets
- Infrastructures
- Cordons, Zones and Areas

3.1.1 Actors and roles of actors

The SnR's Use Cases (emergency response scenarios) involve several actors with different tasks and roles. During the response, the actors become responsible for various tasks requiring a variety of views of the situation. The decision support system will help these actors with views of information useful to them, providing custom decision-making support for each actor.

However, not all actors are the same or have the same role or involvement in the incident. A classification of the actors into categories is required. Such categories might be: Primary Actor and Secondary Actors (they can be considered as secondary to the emergency, as they will not have active participation in executing the response). Also, the actors can be a person or a device.

Moreover, the actors can be characterised in CONCORDE terms such as PSAP, EMS, etc.

Primary Actors:

- First Responders, such as firefighters
- Hardware Devices, such as drones
- Software Components, such as DSS

Secondary Actors:

- Government Offices
- EU Departments
- International Actors

In SnR operations, the first responder's primary actors could involve the healthcare-related actors, the firefighters, the police, the PSAP operators, the EMS units, the field management staff, the triage and retrieval runners, the field medical staff, the transportation staff, the patients, the callers and the volunteers (bystanders). [3] All the other actors are the secondary actors, as mentioned before.

Moreover, actors can be involved in more Emergency situations, they can communicate with other actors-roles, they can change the hierarchy, they will have specific resources and equipment in their

possession, in order to deliver specific services. Finally, it is clarified that a hardware device can be an actor, for instance, a rescue robot.

Actors and their roles are a critical knowledge item, and they are involved in all SnR's operations and Use Cases. (In Annex II there are the actors who will participate in each Use Case, according to the answers of the Use Case Leaders) [Annex II]

Actors are also involved in the **technical use cases of the emergency communication system**. According to CONCORDE, the technical use cases of the emergency communication system are:

- Registration and access to CONCORDE
- Viewing and sharing available information through the available resources
- Create and update information on the field roles' responsibilities
- Notifications and signals
- Check available resources
- Provide resources
- Documentation
- Communication
- DSS

3.1.2 Emergency Incident

The emergency incident is one of the core items in a coordination and decision support system. It requires detailed knowledge about the incident and its characteristics in order to mobilise the correct resources. The location, the type of emergency, etc., will be included in the information list. For instance, the location of UC1 is the Poggioreale "Old Town", and the type of emergency is "victims under rubble" [Annex II].

During an incident's response, the situation changes through time and this needs to be communicated to all the involved actors in the field. Therefore, the system should store, create and update information about triage results and the location of patients.

Each triggered incident should have a separate record with meta-data and dynamic situation assessment, resources deployed, etc.

Moreover, the emergency incident is linked to many other concepts and knowledge elements such as a number of patients, priority level, liquid gas leak and more.

[hasNumberOfPatients50]

[hasPriorityLevelmediumToHigh]

[involvesLiguidGasLeak]

The above instance is an example of how the current knowledge links to other knowledge and information elements. This does not comprise the final knowledge management model yet (SA model).

3.1.3 Patient

Information about patients is essential for SnR operations. Depending on the injury of the patient, his/her blood pressure, etc. (figure 3-1), first responders will adopt their decision making such as the way of patient's transportation to the available hospital. Therefore, it is necessary to keep track of the patients' medical profile and general status.

An example of information that needs to be collected about a patient, can come from a CONCORDE's associated tool called MIST. [3]

Figure 3-1 The MIST handover tool in Clinical Guidance for Operation

Figure 3-1 shows the basic requirements to describe the status of a patient. This knowledge requirement is linked to all UCs and it is related to first responders, the Triage, the emergency communication app of SnR and more. There are also the vital medical signs containing a list of the vital signs of a patient such as the blood pressure, heart rate, the body temperature etc.

It is important to mention that a patient's status can change in any given moment, and its evolution can be predicted based on new and updated information (vital signs) from the field, as well as on the effects of the treatments administered. Unfortunately, there is an adverse condition when a first responder gets hurt during his/her duty. In this case, thus if a first responder gets injured, he/she changes the role of an actor and becomes a patient for the operation and the system.

3.1.4 Resources

Every SnR operation, except for actors, requires specific resources. Resources are knowledge required by decision-makers in general. The collection of data, knowledge and information and finally the decision support can be achieved if the resources are codified and mapped between the profile of incidents and the profile of response.

Resources must be categorised in:

- **Resources relevant to first responders:** Personnel such as firefighters, police, nurses, doctors, medical staff.
- **Resources relevant to first receivers:** Ambulances, hospitals, hospital beds, hospital locations, shelters, offices, training camps and more.
- **Supplies:** Tents, boards, contact information sheets, maps, reporting forms and consumables such as medicine, food, drinking water, first-aid kits and clothes.
- **Equipment (Assets):**
    - Wearable devices such as AR helmets, smartwatches and tough phone
    - Communications Equipment like Wi-Fi Spots (Ambulances that make hotspots), routers, GPS, GPS-tracker, mobile telecommunication equipment (e.g., mobile base stations)
    - Transport Vehicles such as ambulances and vehicles with capacity in terms of carriage, medical equipment
    - ICT tools and services to support data collection, analysis and visualisation for the coordination of decision making during the emergency response. These services are GIS, alert and rapid map systems, collaboration and sharing, collecting data from sensors, early warning systems, internet, training and simulation, triage app, weather and traffic retrievers, social media analysis tools, etc.
    - flashlights, sirens, portable power generators and another first responder's equipment

Upon the triggering of an incident and the subsequent deployment of an SnR operation, the **PSAP operators** will be able to elect a list of specific ICT tools and services from the available resources. For instance, UC3 elects different resources from UC4 (Annex II). A detailed guide with the SnR existing resources is included in D1.2 "Report on the functional specifications of the SnR".

All the above mentioned are physical resources, and with the help of virtual resources (e.g., topological, meteorological, social, operational resources) SnR will be able to provide a strong knowledge base system with a better SA model.

3.1.5 Data Type

Different types of structured and unstructured data formats need to be managed, in order to feed the integrated tools and services and extract useful information, knowledge and visualisation for the decision making of several actors. Therefore, a critical piece of information is the type of data, for the system and all the hardware devices.

The data types of SnR operations include images, videos, internet links, voice, text and more. These data are important for the annotation of the Emergency Incident and the Patient, as well as for the situation awareness about the status of the disaster, the effect of the critical infrastructure and finally the decision making of the involved actors.

All the SnR operations and UCs have a type of communication and data exchange between the first responders, other actors on and out of the field and the system for the disaster situation, patient situation, transport capabilities, need of additional resources etc. D4.1 "Data aggregation" will enlighten the consortium with more detailed information by the end of 2020.

3.1.6 Communication

A successful search and rescue operation requires well-structured and synchronised teams interacting with other teams during the incident. The internal communication is a key piece in achieving this crucial goal. [4]

The SnR Project has on its possession the Concorde platform as the emergency communication app, in order to facilitate the decision making from the collected data and synchronise the actors' roles and tasks through the operation. The internal communication will be achieved with the help of:

- Wi-Fi
- Bluetooth
- Wi-Fi Network with ESSID
- Network created by victim's side
- Wireless Communication
- Voice Communication
- GPS
- A-GPS

The above means of communication will connect all the hardware devices, the software component with each other and the emergency communication app (CONCORDE), in order to exchange data and information about the incident, the roles and the tasks during the emergency response.

3.1.7 Location

The first piece of information after an incident alert is the reported location of the incident. The exact location of an incident is essential for all levels of a SnR operation, from actors and patients to time, resources and more. Moreover, there is a great need for information about the access points to incident fields or any obstacles. This location can be shown on a map (e.g., on the dashboard of CONCORDE platform).

For this knowledge item, the SnR can integrate a location ontology as CONCORDE did, such as the Open Geospatial Consortium (OGC). This will support GIS services. An instance of this knowledge model could be "room in the 12th floor, main entrance of the airport, etc.". These can be included in the list of entities. Patients, human actors, resources and infrastructures can be considered as map layers, since they can affect the incident map. For instance, SnR has a GPS tracker, in order to track first responders' and hardware devices' position. This may be considered as the location of operators.

These location's information elements can be used for the description of an emergency incident, resources, as well as traffic data.

3.1.8 Time

The time is one of the most critical factors in an emergency situation. Every move of the actors, every problem of the available resources can affect the emergency response. In the operational, first responders must move fast, the hardware devices and software components must work as expected. Another instance is the time required for a resource to be moved from one location to another. Any waste of time may be crucial for human lives.

The time can be divided into the following categories:

- **Time of response:** This is the average time of the emergency response from the initial call of the incident, the operation's preparation, the transportation time and finally when arrived on the field
- **Time of deployment:** This is the average time of an operation deployment. There are many factors that influence the time of deployment, since the emergency responders operate in dangerous environments where they are at high risk.
- **Time of Traffic:** The average transportation time until the actors, the resources and the system are ready to operate on the field. Time of traffic can also be concerned at the transportation time of a patient to a hospital.
- **Time of Dissemination:** The average time to spread the incident on the news, the locals and the social media. In other words, the time needed to be aware of a disaster incident.
- **Datetime**: This is the time during the day. The datetime may affect the above-average time and in many cases, datetime will require new resources on the field. For instance, if it is evening the first responders will need extra resources like flashlights. The average time of traffic will be smaller since the roads are usually emptier when the night comes.

It is clarified that this knowledge model is an estimation of time (average) since no one can be one hundred precise. These Time categories will also serve as key indicators for the evaluation of the SnR solution when it will be evaluated in the context of the different UCs.

It is concluded that the orchestration of SnR operation, the tasks and their execution must be accurate. Time is related to all requirements of knowledge management and depends on the actions of all the actors involved.

3.1.9 Country

The emergency incidents are related to specific geographic locations, which belong to specific countries. In order to initiate and coordinate a cross border-action, the SnR operations need this information.

For instance, the use cases will take place in Italy, Greece, Austria-Germany, Romania and Spain [Annex II]. This information element is mostly linked to actors and roles of the actors and the resources, but it has a strong dependency on the **laws** of every country where the training pilots will take place. The laws of a country can affect the other information elements, so SnR must comply with these laws, in order to execute the emergency response with success.

3.1.10 Incident Place

An effective response to an incident is strongly related to the place where it takes place. The exact type of place where the incident happens is essential information for the SnR operators to deploy the proper response. For instance, a plane crash on a mountain requires different resources from a terrorist attack in an airport.

The incident places that SnR will operate in the UCs are:

- Town in Italy (UC1)
- Mountain, non-urban in Greece (UC2)
- Railway Station between Austria-Germany (UC3)
- Industrial zone in Greece (UC4)
- Training area in France (UC5)
- Airport in Romania (UC6)
- School in Spain (UC7)

This knowledge item includes the aforementioned incident places, and it strongly depends on country, laws and other knowledge items described before.

3.1.11 Incident Types

During the emergency response, the type of the incident helps decide the type of actors, resources and others to operate. It is undoubtedly understood that different types of incidents require different emergency responses.

This knowledge item should host a growing list of types of incidents from the past such as traffic accidents, explosions, attacks to Critical Infrastructures, earthquakes and more. For instance, it can host a list of the UC's types of incidents such as air crash, chemical substances and more.

These types are strongly linked to the Emergency Incidents, the actors, the resources, country knowledge models. It contains key information on the actions that the actors must take, and the resources needed. Moreover, Incident Types can have different levels of emergency or can be more frequent in one country than another. For instance, Greece is more fire sensible than a northern country whose climate is rainier. This knowledge item will be filled with the information gathered in the context of task T4.1 relating to the analysis of past large-scale disasters.

3.1.12 Health Impact

Unfortunately, some incidents leave behind them a health impact. For instance, a chemical explosion may cause asthma, air pollution, etc. This impact may affect the first responders and the population who resides near the specific incident.

This knowledge model can include a list of the health impacts of an emergency incident. For instance:

Health impact as a result of a chemical explosion:

- Traumatic cardiac arrest
- Breathing problems
- Burns
- etc.

The health impact can be a part of an emergency incident, as it is a key piece of information that affects emergency response deployment. PSAP, field commanders and the medical staff will be related to this model. This knowledge model is also linked to the DSS, with the PHYSIO component, where each patient/victim is described in terms of lesions (Health impacts) suffered.

3.1.13 Levels

The types of emergencies may have different likelihood and different impact levels depending on the properties of the incident. The SnR operations may support a simple categorisation of levels, e.g.:

- low
- low to medium
- medium
- medium to high
- high

This knowledge item is linked to all other items that require a description in terms of levels. For instance, the size of the incident, the health impact levels, etc.

3.1.14 Safety

An important step before the arrival on the scene of the incident is the set of control and safety in the location of the incident. It would be important for SnR operations to include a list of needs for the first responders and the other resources' safety.

As a next step to this list, first responders should have the chance to renew this list during the operation, in case they need anything more. This list can be considered as part of the Emergency Incident further description. [5]

3.1.15 Traffic Data

It is critical for the SnR operations to identify optimal routes toward a specific incident's location. Traffic flow can be time-consuming, and as it was mentioned before, the time has to be minimised in any case.

This knowledge model is linked to GPS devices and maps, and it is related to the first responders, resources and first receivers, as well as the decision-making functionality. The shortest path (route) may be life-saving for many.

3.1.16 Weather Data

The weather is a crucial factor that can change the situation of an emergency response. The SnR operation must be informed about the weather phenomena, in order to correct decision making in and out the field.

For instance, if the weather that an incident happens is rainy, then this would demand extra tents on the field (resources) or it might be helpful with a fire incident.

Local or national meteorological stations, weather API can provide the weather data SnR needs.

3.1.17 Triage Types and Classification Levels

According to CONCORDE, the triage is a key task in emergency response. The system supports the first responders in understanding the triage labels and tagging the patients, moreover, there is a need for the classification levels of triage and kept as knowledge.

The figure below shows classification levels of triage divided into colours depending on the type of injuries (patients in subchapter 3.1.2) and the groups (levels in subchapter 3.1.13), as well as this knowledge model may also include types of triage and their objective (Figure 3-2).

Group	Color	Type of Injuries
Priority 1 / Emergent	Red	Critical; may survive if simple lifesaving measures are applied.
Priority 2 / Urgent	Yellow	Likely to survive if simple care is given within hours.
Priority 3 / Nonurgent	Green	Minor injuries; care may be delayed while other patients receive treatment.
Priority 2 or 3	Blue	Catastrophic: Patients unlikely to survive or those who need extensive care within minutes.
None	Black	Dead or severely injured and not expected to survive.

Figure 3-2 Categories and identification in Triage

types	objectives / methodology
PRIMARY TRIAGE (FIELD TRIAGE)	EARLY TRANSPORTATION "START" & "SAVE" DISASTER SCENARIO
SECONDARY TRIAGE (ED TRIAGE)	TIMELY & APPROPRIATE INTERVENTION COLOUR CODING
TERTIARY TRIAGE	Specialist Care

Figure 3-3 Types of Triage

3.1.18 Status of Critical Infrastructure

The status of critical infrastructure can be listed as e.g., fully operational, lack of service, etc. For instance, knowing that there is lack of electricity (e.g., on a mountain) or lack of water supply, then the SnR operation should find other ways to provide electricity or water to the emergency scene.

According to SnR UCs, the most critical infrastructure may be characterised as non-fully operational, since the incident types that occur make the situation more difficult. [8]

This knowledge item may be linked to the Emergency Incident description, as well as to the Locations.

3.1.19 Notifications

A number of notification types will be used to quickly inform the actors about any changes in the information, dangers, tasks, change in weather conditions, etc.

These notification types can be:

- Patient information update
- Incident information update
- Update in available resources
- Unexpected danger on the field
- etc.

This knowledge item can also be combined with the Levels knowledge item (subchapter 3.1.13). [3]

3.1.20 Complexity of Environment

This is a suggested knowledge item, since an emergency incident may have many concepts and unexpected turns during a SnR operation. This knowledge item can be divided into three categories and their steps as it is illustrated below:

Before arrival to the scene:

- Warnings of structural collapse
- Building occupancy (number and identities of occupants, based on time of day)
- Building layout and site plan (building size, construction type, floor plans)
- Location of water sources nearby (fire hydrants, fire department hook-ups for sprinkler system, standpipes)
- Routing information to the building and area map of the neighbourhood of the building
- Contact information of building owners, managers and utility contacts
- Traffic on the roads
- Hazards, location and identification of unusual hazards (above ground propane tanks, gas lines, chemicals, explosives, etc.)
- Local weather conditions and predictions, wind direction and velocity
- Location of available areas of refuge, staging areas
- Location of important objects (facilities, documents, equipment) to be saved

EMS:

- Define the scenario
- List the roles and describe their responsibilities
- Describe the decisions the actors shall make during the emergency
- For each decision, describe the information needed to pursue the operational goal
- Communicate with actors

At the emergency scene:

- Locations of building entrance/exit signs
- Location of extra disasters, such as toxic gases, fire in the building. Size and duration of the extra danger
- Sprinklers' status (number of location of sprinklers that have gone off)
- Presence and location of occupants in the building
- Location and condition of smoke

In the first category, "before arrival to scene", there is information about critical infrastructure, bystanders, location, traffic and weather data.

In the second category, "EMS", there is information about actors and roles of actors, communication.

In the third category, "At emergency scene", there is information about incident types, place, location and health impact.

All the above categories highlight some issues that first responders and the other actors may face in three different stages of an emergency situation. This knowledge model recapitulates some of the previous knowledge models in order to clarify the **complexity of the environment**.

3.2 Information Awareness Model

As mentioned previously, the disaster management context requires the timely, relevant and effective use of available information. A common space for the information sharing has to be used for all conceptual actors involved in the emergency response.

The amount of information in the previous chapter sets the requirements to the SA Model which will ensure that right information is shared and presented to the right person at the right time as the orchestration of the roles for the actors, and available resources will be concise and timely given depending on the incident situation.

Towards this objective, SA model should define a set of main concepts of SnR according to this deliverable and D1.2, D4.1 and D7.2.

In the given moment, the proposed SA model is the same (as it tested) model of the CONCORDE platform with the below concepts:

- Workspace: PSAP, EMS en route, Incident Field, etc. In these spaces, there are specific actions that need to be performed i.e., Tasks
- Actor Group: Bystanders, PSAP staff, EMS en route staff, Incident Field staff, Transport Staff, First Receiver staff. Actors undertake different tasks in an emergency response incident, according to their role. Moreover, roles will define different access rights to the content of the system.
- Role: Commander, operator, runner. Various actors may play various roles depending on the context i.e., conceptual space where they belong in a particular moment. Moreover, it should be taken into account that specific types of incidents will introduce new actors in overarching the responder service in command such as police or military.
- Task: Triage, documentation, evacuation, assessment and treatments.
- Profile: it will be developed towards the decision support and the coordination function of the system such as profile to acquire, update and view incident information (type, level, timing, location, number of injured, etc.) to fill and monitor patients and access of available resources of actor's organisations such type of resources and their location. [3]

As a next step, this SA model can be customised for the needs of SnR operations, and as a result, KT will involve an updated version of it in the D3.7.

The SA model will mostly address requirements, such as roles and tasks allocation. Also, it is strongly related to the knowledge elements of the previous chapter, and it will set requirements to metadata management model.

3.3 Support for heterogeneous types of resource management

The information elements of an incident may be collected in different forms and data types, such as images, videos, field reports, information from sensors, etc. The metadata should be structured in a domain with specific vocabularies, in order to guide the operation (e.g., sharing information on the available resources).

Moreover, domain-specific metadata such as the type of emergency can be linked to past incidents. This type of knowledge can be useful during the decision making of an operation or in the training of use cases.

On the other hand, a decision can be made from limited information. For instance, if an image that was taken on location of the field is not precise, the location (location is the desired requirement) can be found by the semantic content of this image.

Other required information is the identity of actors (firefighters, police, health retrievers) and their function (strategic, operational, tactical).

In general, a knowledge management system requires well-structured metadata such as:

- Textual information such as field reports, historical documents, notes
- Data from sensors, such as data obtained from chemical sensors
- Images, videos, maps from related hardware devices on the field

As a result, SnR will obtain metadata in order to:

- Classify incidents and their characteristics
- Describe technical information such as actors, resources, location
- Describe incident domain-specific information such as type of incident, resources and status of infrastructure
- Take guidance by similar past incidents

3.4 Support for various types of DSS

Data aggregation and visualisation are usually the most helpful components for decision making. However, the real success for the management of emergency situations comes from the beginning with well-organised planning. As it was mentioned earlier, the definition of great knowledge comes from:

1. Collecting and organising **Data**
2. Summarising and analysing **Information**
3. Synthesising and Decision-making **Knowledge**

SnR will support the coordination and decision making in the emergency management domain. In addition, there are partners in SnR who have developed algorithms in order to empower the DSS with their capabilities and functionalities.

The prerequisite for supporting decision making is the existence of valuable information for time, location, actors, data and knowledge, as well as an integrated environment to support all the involved

actors and their tasks. [6] The decision-making functionality will be enabled after collecting the valuable data, then training the intelligent engines and understanding their semantics. As CONCORDE already has, SnR will try to embed automatic intelligence in the recommendations and suggestions and will be enhanced by the adoption of mathematical models for predicting the victim physiological status, whose evolution will depend on the injury severity and on the treatments received. The DSS will be consist of:

- The functional requirements providing intelligent means of stored information and generating meaning knowledge about the incident
- Visualisation functions from the knowledge management point of view
- Estimation of the number of patients, available resources, etc.
- Recommendation support for functionality such as possible optimal routes to the incident, inferences on historical data, optimal health resources allocation, etc.

Inputs to The Knowledge Management can be:

- Operational Data:
    - First Responders
    - Commanders
    - Bystanders (callers & volunteers)
    - Social Media
    - GPS-location
    - Video from the incident field
    - Audio from the incident field
    - Data from sensors, drones and other hardware devices
    - Triage Data (patient id, type of injury, more)
- Prediction Data:
    - Weather data (heat, rain, wind, temperature, etc.)
    - Resources' arrival prediction
    - Traffic data (prediction for traffic flow)
    - Earthquake prediction
    - Patient health evolution
- Infrastructure Data:
    - Nearest Hospital
    - Number of beds
    - First aids
    - Operational status
    - Available Ambulances
    - Logistics
    - Public Services
    - Accommodation suggestions (schools, shops, hotels)

The above knowledge management types of data for the DSS support will be empowered from other SnR's partners too during the progress of the project and the D3.7 will include an updated version. [3]

Table 3-4 Datasets for Bystanders

Dataset	Feature
Emergency Evacuation	Type
	Description
	Time
	Level of Danger
	Picture/Video/Phone call
Communication	Tags
	Register as Volunteer
	Message Request

This dataset is only a paradigm which includes some decision support points. [3] These points are gathering reliable information that is going to train the DSS to make suggestions for better decision making.

3.5 Support for the knowledge interoperability

The transfer of knowledge between heterogeneous environments is able to set a powerful tool for the acquisition of new knowledge. This requires complex models representing detailed knowledge about types of incidents, their impact and the possible resources for the emergency response.

The most information will come from actors and sensors with data inputs such as:

- Structured and unstructured data in the format of documents (doc/pdf), sensors measurements, images, tweets)
- Weather data suppliers, traffic data (map routing services), availability of resources in doc/pdf format, XML/JSON data structure
- DSS will also communicate with external actors and agencies to receive data in JSON/RDF/OWL data structure
- SnR knowledge may also come from actors that exchange data format such as EDXL vocabulary

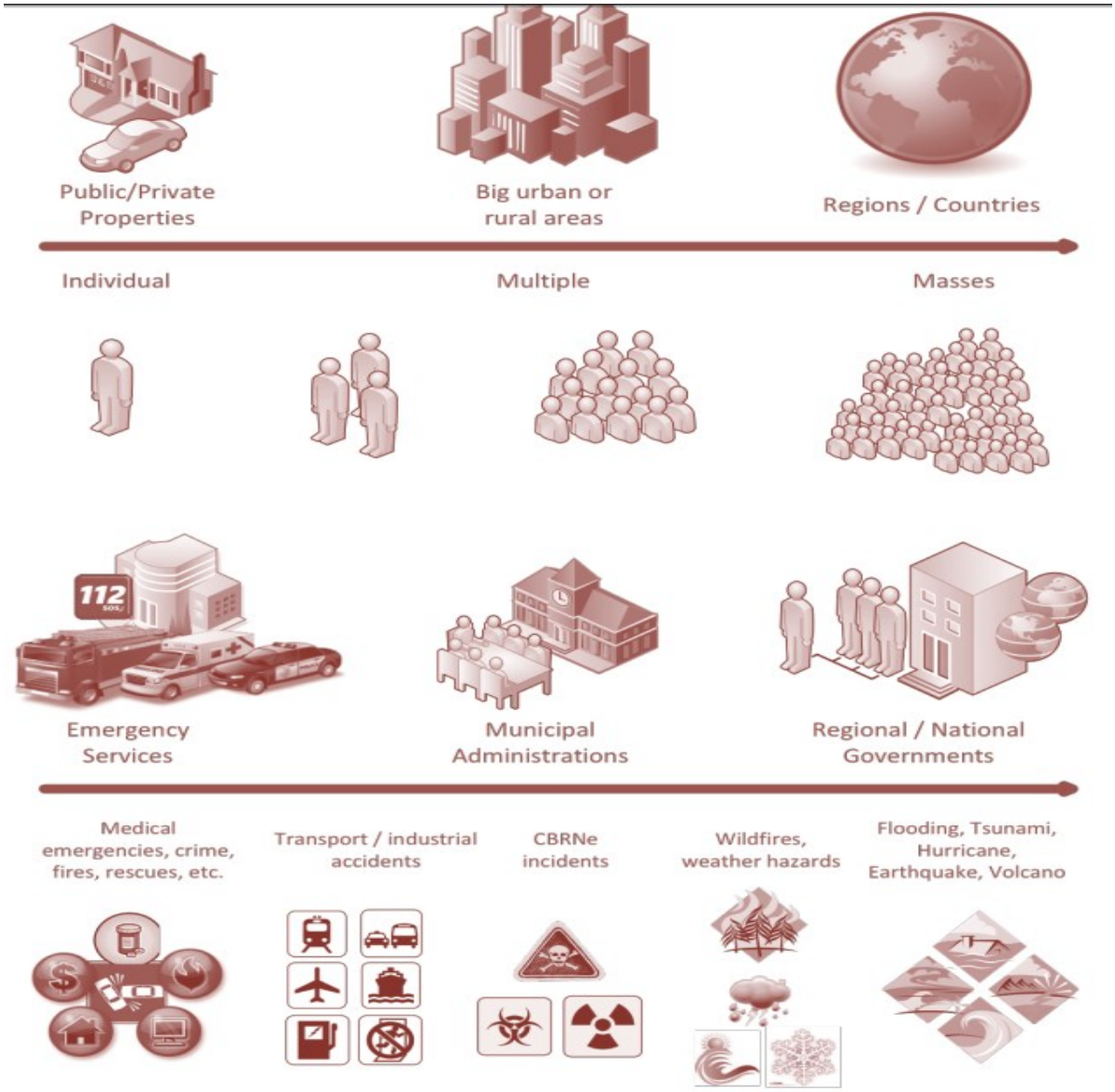

Figure 3-4 Scale of events and increased interoperability rationale-wide conceptual model

The semantic level of the overall knowledge management system creates the meaning of data elements and their relationship. In other words, the requirements will be able to describe the data exchanges in an understandable way.

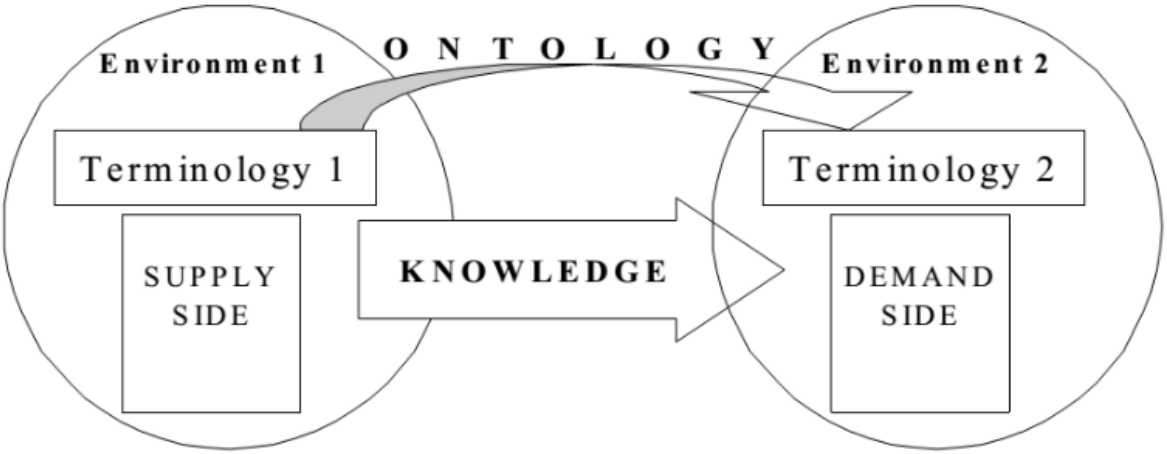

Figure 3-5 Knowledge interoperability in heterogeneous environments

However, it is not difficult to misunderstand glossaries and vocabularies, and as a result, this leads to severe consequences, even the loss of life. It has to be paid special attention to this, in order to avoid any disastrous consequences.

For this reason, a domain ontology has to be set in the SnR project. This ontology may include vocabularies where common information-sharing data space can be created.

Figure 3-5 shows the interoperability of knowledge in which an object provides its knowledge to another object. The object on the left of the picture illustrates the supply which provides the required knowledge to the right object, demand. These small parts of terminology enable a better understanding of the transmitted knowledge.

Moreover, good practice may be the use of domain-specific standards as much as possible. The existing standards on knowledge representation, sharing and reuse should be investigated further.

3.6 Requirements to the overall Knowledge Management infrastructure

Based on the requirements identified in the previous chapters, the knowledge management infrastructure should provide ways to:

- capture, store and manage metadata
- Search for the knowledge and the content
- Represent the content
- Support the knowledge interoperability
- Support for questioning and answering

There are several identified types of resources requiring to be stored, such as:

- documents, images, data from sensors
- metadata for description
- ontologies for operational data
- ontologies for domain-specific knowledge

All these requirements need the support from other WPs of the SnR. They refer to CONCORDE platform, as well as to every other hardware device and software component which will provide data to the SnR operations.

4 Conclusion

4.1 Room for improvement

D3.1 "Requirements to knowledge management and SA model" completed its first scope. D3.1 described and pointed to knowledge models and information elements, support or various types of decision making and the requirements to overall KM. However, this was a first attempt considering that the SnR project is in its first year and there are not all the required deliverables released to this day. Moreover, there is still room for improvement in several aspects, such as:

- Intelligent information filtering and meaningful data related to specific roles and actors have to be expanded
- Ways of data aggregation, searching and linking sourced by all related providers
- Coordination with ML software providers partners for the establishment of a better DSS
- Expand the requirements, datasets, the ontologies
- Upgrade the SA model depending on the first reviews of D3.1 and other discussions
- Map the seven use cases

4.2 Conclusion

This deliverable has presented the requirements to the knowledge management and the SA model. The required knowledge models and information elements have to be modelled, as long as the aspects of heterogeneous resources sharing and the various types of decision-making points.

In the next deliverable, D3.7, the acquired requirements will be used as a base to define the knowledge models and knowledge management infrastructure in close cooperation with other related WPs, in order to support the functionality of the SnR operations.

Annex I: References

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Annex II: Questionnaire for the Use Case Leaders

Questionnaire for S&R components, interconnectivity, data aggregation	
This survey refers to S&R project and every reply will be shared only among project's partners.	
	Please write your answer in this column
Company Name	
e.g: KONNEKTABLE	
Q1) What is your role in the Project?	
Please provide us with your specific role. e.g First responder (Police), Sotware Provider (components, modules, associated services), Hardware Provider (smartwatches, sensors, assets/equipment)	
Q2) If you are a first responder, do you have any equipment to provide?	
e.g ambulances, oximeter, medical devices etc	
Q3) If you are a software or hardware provider, please provide us with your services and assets	
e.g Machine learning Algorithms (Software), Drones (Hardware)	
Q4) Which Use Case are you leading?	
e.g Use case Number	
Q5) As a UC leaders, please point out if you will enroll external participants	

Figure 0-1 Questionnaire for Use Case Leaders

Company Name	**Consiglio Nazionale delle Ricerche - CNR and Regional Department of Civil Protection of Sicily - DRPC Sicilia**
e.g: KONNEKTABLE	
Q1) What is your role in the Project?	**The CNR has a dual role: it provides DSS components (Software provider) and in collaboration with the DRPC (First responders) coordinates the Use Case 1**
Please provide us with your specific role. e.g First responder (Police), Software Provider (components, modules, associated services), Hardware Provider (smartwatches, sensors, assets/equipment)	
Q2) If you are a first responder, do you have any equipment to provide?	**The DRPC Sicilia has the necessary equipment for the organization of rescue activities: equipped tents, mechanical vehicles, electric generators, personal protective equipments, light towers, in close collaboration with the Fire Brigade**
e.g ambulances, oximeter, medical devices etc	
Q3) If you are a software or hardware provider, please provide us with your services and assets	**CNR will provide Mathematical Modeling and Parameter estimation for the forecasting of the physiological status of the victims**
e.g Machine learning Algorithms (Software), Drones (Hardware)	
Q4) Which Use Case are you leading?	**The Poggioreale "Old Town" Demo - UC1, Victims trapped under rubble - jointly organised by DRPC Sicilia and CNR**
e.g Use case Number	
Q5) As a UC leaders, please point out if you will enroll external participants	**Fire Brigade, voluntary associations, Police (Prefecture), National Health Service**
e.g: first responders from other domains (please indicate the domain)	
Q6) In your use case, are you going to need extra components/assets from the S&R Partners?	**We are waiting from WP8 Leader for details relevant to specific S&R components – e.g., instruments, sensors, etc. – to be evaluated within the Demo**
e.g: I am the Use Case ... Leader and i will need the communication app from KT and drones from UHASSELT to proceed with the scenario. KT and UHASSELT are not participants in my Use Case (considering the Grant Agreement)	

Figure 0-2 Use Case 1

Company Name e.g: KONNEKTABLE	Hellenic Rescue Team
Q1) What is your role in the Project? Please provide us with your specific role. e.g First responder (Police), Sotware Provider (components, modules, associated services), Hardware Provider (smartwatches, sensors, assets/equipment)	First Responder
Q2) If you are a first responder, do you have any equipment to provide? e.g ambulances, oximeter, medical devices etc	Mobile opearational center, mobile wifi antennas to set up a local wifi network, UHF/VHF radio transmitters, drones, cameras, GPS Trackers
Q3) If you are a software or hardware provider, please provide us with your services and assets e.g Machine learning Algorithms (Software), Drones (Hardware)	N/A
Q4) Which Use Case are you leading? e.g Use case Number	Use Case 2: Plane crash, mountain rescue, non-urban (Greece)\
Q5) As a UC leaders, please point out if you will enroll external participants e.g: first responders from other domains (please indicate the domain)	We will attempt to involve the Fire Department, who would be responsible to manage such an event, if it actually happened
Q6) In your use case, are you going to need extra components/assets from the S&R Partners? e.g: I am the Use Case ... Leader and i will need the communication app from KT and drones from UHASSELT to proceed with the scenario. KT and UHASSELT are not participants in my Use Case (considering the Grant Agreement)	I am the Use Case 2 Leader and it will be good to test the communication app from KT and drones from UHASSELT to proceed with the scenario. KT and UHASSELT are not participants in my Use Case (considering the Grant Agreement). The technical support based on the DoA is NTUA, CERTH, UBI. We will be able to examine further the technologies that we will need, after the full finalilzation of the US scenario and its specifcs. A lot is also based on the maturity of the technologies at the time of the demonstration

Figure 0-3 Use Case 2

Company Name e.g: KONNEKTABLE	**JOAFG**
Q1) What is your role in the Project? Please provide us with your specific role. e.g First responder (Police), Sotware Provider (components, modules, associated services), Hardware Provider (smartwatches, sensors, assets/equipment)	First Responder (Emergency Medical Services and Disaster Response, incl. K9)
Q2) If you are a first responder, do you have any equipment to provide? e.g ambulances, oximeter, medical devices etc	EMS: Ambulance cars, medical care equipment: incl. Intubation and air masks sets, EMMA emergency capnographs, SpO2 devices, etc. Tech. Unit: generator sets (2.2 & 3kW, diesel: 4-7kW, emergency generator 8kW/9.7kVA), lights (4*400W), heaters, hot water boiler, water tanks and pumps communication unit: mobile control center, analogue radio (shortwave), digital radio Tetra, Internet hotspot, phone, fax, emergency operations center, (journal workstations), meeting room operations management Supply unit: frigde/freezer, cookng station, etc.
Q3) If you are a software or hardware provider, please provide us with your services and assets e.g Machine learning Algorithms (Software), Drones (Hardware)	**n/a**
Q4) Which Use Case are you leading? e.g Use case Number	**UC 3: Heavy storms around Kufstein railway station (cross-border pilot, Austria-Germany)**
Q5) As a UC leaders, please point out if you will enroll external participants e.g: first responders from other domains (please indicate the domain)	**Apart from our own units we tentaviely foresee participation of: fire brigade, MUSAR team, EMS from other countries (Germany and potentially Hungary or Italy)**
Q6) In your use case, are you going to need extra components/assets from the S&R Partners? e.g: I am the Use Case ... Leader and i will need the communication app from KT and drones from UHASSELT to proceed with the scenario. KT and UHASSELT are not participants in my Use Case (considering the Grant Agreement)	**In order to train the Patient Routing System and take over of Command Center we will need the emergency communications app/Concorde EMS & associated module/services from KT, which has not yet been specified in the GA.** ***Planned technology testing (as per GA)*** **: Rescue robots & autonomous vehicles by DFKI, THALIT, SYNYO --> linked to this the chemical sensors (NTUA) and MIMS need to be provided as well (which is not evident from the GA)** ***Optional testing*** **: AR Helmets (SIVECO), 6 Gas Hazmat Monitor (UniCa), GPS tracking and smart wearables for FR (UniCa), rescue system for children (UNIFI) (and others upon request)**

Figure 0-4 Use Case 3

Company Name	**Association of officers and sub-officers with university degrees of Hellenic Fire Corps EPAYPS**
e.g: KONNEKTABLE	
Q1) What is your role in the Project?	**First responder**
Please provide us with your specific role. e.g First responder (Police), Sotware Provider (components, modules, associated services), Hardware Provider (smartwatches, sensors, assets/equipment)	
Q2) If you are a first responder, do you have any equipment to provide?	**We will be utilized the equipment from the Volunteer Teams that supported the project in its submission (they are included in the proposal) in order to fulfill our duty. (see analytically on 2nd attached file).**
e.g ambulances, oximeter, medical devices etc	
Q3) If you are a software or hardware provider, please provide us with your services and assets	**N/A**
e.g Machine learning Algorithms (Software), Drones (Hardware)	
Q4) Which Use Case are you leading?	**S&R Use Case 4: Forest fire expanded and threat to industrial zone (Attica, Greece) - Pilot plan**
e.g Use case Number	
Q5) As a UC leaders, please point out if you will enroll external participants	**We will cooperate with the 14 Greek Volunteer Teams (First Responders in search & rescue, logistics, telecommunication and fire fighting) that supported the project in its submission (they are included in the proposal) in order to fulfill our duty. (see analytically on 2nd attached file).**
e.g: first responders from other domains (please indicate the domain)	
Q6) In your use case, are you going to need extra components/assets from the S&R Partners?	**we specify later**
e.g: I am the Use Case ... Leader and i will need the communication app from KT and drones from UHASSELT to proceed with the scenario. KT and UHASSELT are not participants in my Use Case (considering the Grant Agreement)	**These are the participants in my use case 4: NTUA, CERTH, UBI. The ATOS, KT, UNIFI, UCSC, UniCa, MAG, SIMAVI, THALIT, DFKI, AIDEAS are not not participants in my use case.**

Figure 0-5 Use Case 4

Company Name	**PUI France**
Q1) What is your role in the Project?	First responder - USAR team
Please provide us with your specific role. e.g First responder (Police), Sotware Provider (components, modules, associated services), Hardware Provider (smartwatches, sensors, assets/equipment)	
Q2) If you are a first responder, do you have any equipment to provide?	Yes : medical devices, oxymeter, thermometer, ECG, medical devices, defibrilator, USAR equipement, drones (X3), drinking water equipement (X2), scanner, listening devices, generator, etc…
e.g ambulances, oximeter, medical devices etc	
Q3) If you are a software or hardware provider, please provide us with your services and assets	N/A (we have drones for operations)
e.g Machine learning Algorithms (Software), Drones (Hardware)	
Q4) Which Use Case are you leading?	D8.6 - S&R Use Case 5: Victims trapped under rubbles (France) - Pilot plan
e.g Use case Number	
Q5) As a UC leaders, please point out if you will enroll external participants	Red cross (medical) - firefighters - USAR team
e.g: first responders from other domains (please indicate the domain)	
Q6) In your use case, are you going to need extra components/assets from the S&R Partners?	PUI FRANCE is UC5 leader: Victims trapped under rubbles (France) **Communication app** : between the squad leader, Command post, external USAR team, medical team, logistics team, **Chemical sensors** - Oxygen, CO2, Explosimeter, H2S, locate people trapped in the rubbles (?), artificial nose (K9), **AR Helmets:** supervision of the risk of collapse, building plan before the collapse, **Rescuer AR helmet:** building plan before the collapse, presence of gas and electricity network, information about logistics capacity of the USAR team (saerchable directory), **GPS Tracker:** GPS tracking with satellite, possibility of emergency call, GPS coordinates, possibility to send SMS and message on line, **Smart glasses**: pictures, video, information from the command post, streaming video, video from the drone or robot, **UAVs:** video, pictures, streaming video, transport of light equipment, projector, possibility of message by speaker, localisation of people trapped in the rubbles, supervision of the risk of collapse with alarm (telemeter), possibility of radio relay (wired drone), **Smart-phone / Tough-phone** App for locating victims trapped under rubbles, communication/Message SMS between USAR team members, localisation of the team members, **Wearable ECG, EMG,** **Smart textile professional uniform** - sensor for the health of the rescuer (blood pressure, temperature, etc… and presence of chemical/gas/Radioactivity, **Rescue system for children,**
e.g: I am the Use Case … Leader and i will need the communication app from KT and drones from UHASSELT to proceed with the scenario. KT and UHASSELT are not participants in my Use Case (considering the Grant Agreement)	

Figure 0-6 Use Case 5

Company Name	**PROECO**
Q1) What is your role in the Project?	**First responder**
Please provide us with your specific role. e.g First responder (Police), Sotware Provider (components, modules, associated services), Hardware Provider (smartwatches, sensors, assets/equipment)	
Q2) If you are a first responder, do you have any equipment to provide?	**No**
e.g ambulances, oximeter, medical devices etc	
Q3) If you are a software or hardware provider, please provide us with your services and assets	**N/A**
e.g Machine learning Algorithms (Software), Drones (Hardware)	
Q4) Which Use Case are you leading?	**UC6: Resilience Support for Critical Infrastructures through Standardised Training on CBRN (Romania)**
e.g Use case Number	
Q5) As a UC leaders, please point out if you will enroll external participants	**First responders: Tuzla Airport emergency response Team, Military Hospital , Emergency Response Team from Fire Fighters Department**
e.g: first responders from other domains (please indicate the domain)	
Q6) In your use case, are you going to need extra components/assets from the S&R Partners?	**I am the leader for UC6: Resilience Support for Critical Infrastructures through Standardized Training on CBRN (Romania).**
e.g: I am the Use Case ... Leader and i will need the communication app from KT and drones from UHASSELT to proceed with the scenario. KT and UHASSELT are not participants in my Use Case (considering the Grant Agreement)	**I am the leader for UC6: Resilience Support for Critical Infrastructures through Standardized Training on CBRN (Romania).** **I shall need the communication app from KT and 14** devices. Also we can use the following equipment: **Chemical sensors** - The HAZMAT monitor consists of several chemical sensors allowing for greater threat detection such as toxic gases, oxygen deficiency and carbon dioxide; **AR Helmets:** The AR helmet will be mainly used in situations where visibility is limited due to smoke, rabble or other obstacles **Rescuer AR helmet:** The AR helmet will feature an impressive list of sensors and electronics. **GPS Tracker:** GPS tracking will run even when there is loss of network connectivity (and synchronizes logged GPS track data when re-connected). Smart glasses: Create and send geo-tagged pictures/video from the field with notes, including option to stream live video/audio. **UAVs:** Using Unmanned Aerial Vehicles (UAVs) can provide a critical support to search and rescue operations. **Smart-phone / Tough-phone** including emergency notification service for alerting civilians to evacuate an area pointing them to an appropriate gathering and exit point and an emergency communication App for locating victims trapped under collapsed buildings. **Wearable ECG, EMG** – **Smart textile professional uniform** - **Rescue system for children** -

Figure 0-7 Use Case 6

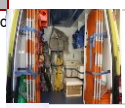
Company Name	**SUMMA 112: Emergency Medical Services of Madrid Community ESDP - Spanish School of Salvage and Detection with Dogs**	
e.g: KONNEKTABLE		
Q1) What is your role in the Project?	SUMMA 112 participates as an end user. SUMMA 112 is the emergency medical service in the Com	
Please provide us with your specific role. e.g First responder (Police), Sotware Provider (components, modules, associated services), Hardware Provider (smartwatches, sensors, assets/equipment)		
Q2) If you are a first responder, do you have any equipment to provide?	As EMS (emergency medical service) we can provide: 1.- Basic Life Support Ambulances Advanced	
		
Q3) If you are a software or hardware provider, please provide us with your services and assets	**All the Summa 112 care resources in the Community of Madrid have the computer application called SITREM (Emergency Computer System). It has the patent file number M2007571 and was requested on 22/01/1996. It is a trademark in Spain, so this registration does not offer protection outside the country. The computer application is mandatory in all emergency services of the Community of Madrid as Fire and SAMUR (Civil Protection Service of the City of Madrid)**	
e.g Machine learning Algorithms (Software), Drones (Hardware)		
Q4) Which Use Case are you leading?	**It is a Chemical Substances Spill in Madrid, Spain. Use case 7. There's been an accident at a chemical factory, resulting in a chemical leak, threatening the health of the factory´s workers. The use case includes an actual search and rescue situation of victims in a chemical hazard emergency. Scenario: Location: Rivas Vaciamadrid, 20 km from Madrid city. Site: Chemical Factory (40.327805, -3.556862). Chemical products used: Chlorine, Ammonia, Others. Risks: Nearby populated area (4km), scattered farms, protected natural area, Manzanares River (500m).**	
		
Q5) As a UC leaders, please point out if you will enroll external participants	**The stakeholders involved will be: 1.- SUMMA 112 as the EMS of Madrid Community (Emergency Medical Service) and ESDP (Escuela Española de Salvamento y Detección con perros -Spanish School of rescue and detection with Dogs). 2.- The collaborations will be with the Firefighters of Madrid Community and the Spanish Civil Protection. 3.- Invitation open to all the stakeholdres.**	
		
Q6) In your use case, are you going to need extra components/assets from the S&R Partners?	**It would be useful robots and drones with possibility of remote sensors in which could be coupled chemical sensors for chemical risk detection and the possibility also of carrying rescue material for the victim (FFP3 masks in chemical risks, tourniquet, sryingecarrier..) It would be aswell useful to have the possibility of use the communication app from KT and drones from UHASSELT to proceed with the scenario. In this case use we can value the rescue system for children, this could be tested into the ambulances . -chemical sensors communication app between chemical sensors – Gas monitor HAZMAT -Rescuer AR helmet -GPS Tracker for rescues and for dogs. -Smart glasses**	
e.g: I am the Use Case ... Leader and i will need the communication app from KT and drones from UHASSELT to proceed with the scenario. KT and UHASSELT are not participants in my Use Case (considering the Grant Agreement)		

Figure 0-8 Use Case 7