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

D8.8 S&R Use Case 7: Chemical substances spill (Spain) - Pilot plan

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1. Plan form for D8.5 – Use Case 4

Title of UC7: Chemical substances spill, Madrid.

1. Introduction

The Community of Madrid and in particular, SUMMA 112 as the emergency medical service in charge of the sanitary response for ordinary urgencies and emergencies as well as the crisis management of the catastrophes, has experience in CBRN incidents, terrorism attacks and natural disasters.

The aim of SUMMA 112 is to improve the operational, safety and rescue procedures for these types of incidents. -The main goal is to test the developed tools and train similar scenarios for the planning and prevention of future events. - Secondly, SUMMA 112 will practice on the interoperability of the communication systems. The scope is applicable to activities aimed at providing the service of attention to the situations of multiple victims, both by health and non-health personnel of SUMMA 112.

In addition, the Spanish School of Rescue and Detection with dogs (ESDP) is a volunteer organisation formed by guides and dogs with expertise in the detection, search and rescue of victims, as well as in the detection of explosives and drugs. It has been recognised as a Public Utility organisation by the Spanish Ministry of Home Affairs.

ESDP will be involved in the UC7, providing the point of view of the K9 teams (rescue dogs and dog handles). The main goal of the K9 teams is to detect victims in order to optimise the response time of fire brigades and medical teams in rescuing victims.

In UC7, SUMMA 112 and ESDP will prepare a CBRN incident with two separate scenarios. The pilot will be allocated to The National School of Civil Protection, Rivas Vaciamadrid, between October-November 2022. This school is a specific place for the training of both intra community and national courses. It has several scenarios where first responders can perform a joint train ad hoc: aquatic rescue, collapsed structures, fire, explosions, CBRN incidents, transport of dangerous goods...

The main objective is to delimit the working zones according to the existing risks and toxicity levels, in order to guarantee the safety of the first responders and rescue dogs, and as well indirectly to the safety of the victims of the incident. These safety zones can change due to various circumstances, both environmental and accidental, and it is expected that these changes will be recognised by CONCORDE, and chemical sensors which will send alerts to the first responders in the area warning of new dangers.

The weather conditions expected at that time will be 65% humidity and cold temperatures (5°C - Celsius degrees-). The first scenario will contemplate a collapsed structure of a residential building due to an earthquake grade 5,5 on the Richter scale.

A small approximation to the pilot can be as explained: initially, the six gas hazmat monitor will not detect any risk, so it will take place the rescue of two or more trapped victims under the rubble. Firefighters and K9 will work together in this scenario. Ten minutes later, the six gas hazmat monitor will alert of the presence of flammable gas and consequently, the gas leak of scenario 1 after radiating at 50 m will produce a deflagration -second scenario- (the ignition source is a sheet that was left hanging, falls to the ground and causes a spark, which as it is in contact with the propane in the ground produces the deflagration) there is the cistern. This explosion causes a break in an upper part that causes a gaseous leak of the ammonia. These details are under the simulation structure of the pilot.

2. Responsible End – User Organization

SUMMA 112 (SERMAS) and ESDP (K9 teams)

3. Time (*) and place

Time is not fixed yet. These types of pilots usually take between 24-36 hours, taking into account the hours before the pilot starts and the briefing afterwards. Probably by October-November 2022. The location is the National School of Civil Protection in Rivas Vaciamadrid, Madrid, Spain. A few days beforehand, training sessions on the technology will have been held, thus ensuring that the first responders involved are familiar with the technology, its use and possibilities. The final timeline will be designed in agreement with the technological partners to optimise UC7 as much as possible with the existing technology.

4. Components (*) / technologies that will be tested

SUMMA 112 and ESDP have the following confirmed technologies.

- 1) Concorde EMS & Associated module/services (KT). The S&R Emergency Management System (EMS) will be based on Concorde EMS. CONCORDE is a state of the art system of systems software platform that supports and enhances the existing coordination and decision processes during small or large-scale crises and medical emergencies, at local, regional and cross-border level.
- 2) Emergency communication app (KT).
- 3) DSS (decision support system) (KT, CNR; NTUA). Efficient real-time resource allocation. Machine learning algorithms were implemented to estimate the number of expected victims/patients in an earthquake/flood emergency incident, as well as the estimated number of ambulance units demanded, and the allocation of available EMS units to incidents.
- 4) Wearable GPS tracker (UniCa): GPS tracking will run even when there is a loss of network connectivity and synchronizes GPS recorded data as soon as it is reconnected.
- 5) Six Gas Hazmat Monitor (UniCa). The HAZMAT monitor, embedded on wearable of First Responder, consists of several chemical sensors that allow greater detection of threats such as toxic gases and VOCs derived from manmade activities such as industrial processes. This type of monitor, use hands freely, is the optimal solution for monitoring a maximum of 6 gases at the same time, for personal protection (including entering semi-enclosed or closed spaces) and for detecting possible gas leaks in the intervention area. The expected gases to be detected are: Ammonia (NH₃), Propane (C₃H₈), Carbon Monoxide (CO), Oxygen (O₂), Chlorine (Cl₂), Carbon Dioxide (CO₂)
- 6) Smartwatches (KT): Smartwatch has a built-in emergency communication application via Bluetooth that offers messaging, heart rate monitoring and alert functions (Android Wear compatible smart watches with the same features can also be used).

5. First version of KPIs

- Notification and coordination time
- Time for crisis notification call issues by the Operations Centre to reach user's communication devices
- Time needed for a user's post (e.g. text, photo) to be transmitted in other user's mobiles
- Response time
- Time for rescuer's arrival on scene
- Effectiveness in supporting the communication and coordination between first responders on the field and the Operations Centre provided by the tested devices/tools
- Effectiveness in monitoring the first responders/volunteers/victims' health vitals
- Average time until unaffected persons reach safe assembly points

- Total evacuation time for all actors
- Average time spent by victims on the scene
- Time for rescuers to reach the first/last affected/injured person on scene

6. Participating technical support partners (internal) and other members of consortium SnR as Players, Observers and Evaluators etc

KT, ATOS are the technical providers. On behalf of SUMMA 112 and ESDP any partner is invited to join the UC7 (many decisions will depend on how the COVID-19 pandemic goes along).

7. External Participants as players, evaluators, actors-guests in UC

Firefighters of Community of Madrid, Civil Protections (basic life supports), 112 and SUMMA 112 press teams, SUMMA 112 directive team (pending confirmation), SUMMA 112 coordinator of the Catastrophe department, SUMMA 112 team of psychologists (pending confirmation) health authorities of Community of Madrid (pending confirmation), NRBQ-Tedax member (pending confirmation), figurative actors simulating the victims (pending confirmation) and the speaker: team narrating the different phases of the pilot on live (pending confirmation). External participants from ESDP as NRBQ experts (to be confirmed), ESDP press team, ESDP directive team, external vets (pending confirmation) and volunteers with expertise in NRBQ from ESDP. National School of Civil protection representatives. SUMMA invites Health authorities from the Health Council of Madrid Community

8. Ethics Approval

Ethical Committee approval from Faculty of Veterinary Medicine (Complutense University of Madrid)
Regional Ethical Committee of Madrid Community

9. Gaps/ Problems that should be closed and context in which they appear

- a) Tools for time measurement as there is no device or sensor available in this UC that can measure displacements and positions of people at different points and times for ESDP.
- b) SITREM of SUMMA112, the software platform of Health Emergency Coordination Center112, is communicated with the GPS of RADIO TETRAS of all units and resources of SUMMA112. These are used in all operational assistant procedures. These devices collect the times used of all resources involved in the assistance of the chemical incident as well the data localisation. SUMMA112 has GEMA system as well to control the positioning of resources in real time. We remain at the results of the communication interoperability as if to guarantee shared information within tools of Search and Rescue.
- c) Harmonized tools for the measures of the timing KPIs. Definitions for the different status: aware, activated/going to, arrival, go to hospital, transfer at the hospital, finalisation.
- d) Definitions for the KPIs should be made to understand them and make conclusions:
 - Time for crisis notification call issues by the Operations Centre to reach user's communication devices: measure of time in minutes and seconds since the centre call receives the alert to when the first responders receive the activation from the centre call.

In SUMMA 112 the quality indicator for this time is 1 minute taking into account the historic data base.

- Time needed for a user's post (e.g. text, photo) to be transmitted in other user's mobiles.
- Response time: measure of time in minutes and seconds since the first responders receive the alert by any of the communication devices (tetra, mobile phones) to when the team mobilizes 'on the way'.
- Time for rescuer's arrival on scene: measure of time in minutes and seconds since the team mobilizes to when this team reaches the incident and stops in a safety/secure spot.
- Effectiveness in supporting the communication and coordination between first responders on the field and the Operations Centre provided by the tested devices/tools. We suggest to use a visual and quick checklist with the parameters as analysed in the article Badajoz, D; Rodriguez, A (2018). '¿Cómo medir la eficacia comunicativa? El modelo de los umbrales comunicativos'. The four efficacy/ thresholds levels are:
 - 1) The receiver's full **access** to the message.
 - 2) The unambiguous **understanding** of the message by the receiver.
 - 3) The objective capacity of the message to trigger an **internal change in the receiver**, predefined by the sender.
 - 4) The objective capacity of the message to trigger a **specific action** in the receiver, predefined by the sender.

	Recepcion	Inteligibilidad	Cambio interno	Acción	Nivel
Situación 1:	NO	NO	NO	NO	0
Situación 2:	SI	NO	NO	NO	1
Situación 3:	SI	SI	NO	NO	2
Situación 4:	SI	SI	SI	NO	3
Situación 5:	SI	SI	SI	SI	4
	umbral	umbral	umbral	umbral	

Figura 1. Niveles de Eficacia Comunicativa: Recepción, Inteligibilidad, Cambio Interno y Acción. Observamos 4 niveles en función del número de umbrales que se han superado desde 0 (ningún umbral) hasta 4 (la comunicación ha conseguido la acción deseada).

- Effectiveness in monitoring the first responders/volunteers/victims' health vitals. For this measure we suggest to use the same tool as before with the four efficacy/thresholds levels.
- Average time until unaffected persons reach safe assembly points: average time measured in minutes and seconds (between all the individual times taken from each non-unharmed victim) until their arrival is registered by the SUMMA 112 Green Vest in the area of concentration of wounded.
- Total evacuation time for all actors: time measured in hours, minutes and seconds since the alert call has been received in the command centre until the SUMMA 112 guard chief declares the finalisation of the exercise.
- Average time spent by victims on the scene: time measured in hours, minutes and seconds since the alert call is received in the command centre until all the victims have been evacuated: for these measure we will take into account the SUMMA 112 harmonized finalisation codes of each patient: *discharge in situ, by their means, pending evolution, hospital transfer, other resource, exitus*.
- Time for rescuers to reach the first/last affected/injured person on scene.

d) Gender: percentage of women and men involved in the pilot.

10. Certificates of Participation

SUMMA 112 will provide the certificates of participation through the Training Department. ESDP will provide the certificates of participation for their own volunteer participants in the case.

11. Planning Team of UC

► Use Case 7: Chemical substances spill (Spain)

This Use Case involves real life simulation of SnR of victims in chemical risk emergency situation in the area of Madrid. The area to validate the technology simulates a Collapsed Structure Building with pieces of rubble. Two areas will be considered: one of them where the chemical incident will be designed and another one, a collapse area secondary to the earthquake, where the USAR Team will work with the dogs. It is important to highlight that the K9 cannot work in the area of the explosion under real conditions.

The chemical risks will be simulated for two reasons. On one hand, to ensure the safe of the FRs and on the other due to environmental reasons. The UC7 will take place in a protected natural area. Taking into consideration the gases that can be detected by the six gas monitor and those that can be simulated, the following will be taken into consideration:

URBAN SEARCH AND RESCUE TEAM USE CASE 7 MADRID		
	MANAGEMENT	<i>Area involved</i>
1	Team Leader	Command
1	Deputy Team Leader	Planning and Coordination
1	Liaison Officer	Liaison, Media and Reporting
1	Structural Engineer	Assessment/Analysis
1	Safety Officer	Safety and Security
1	Coordinator Officer	Reception and Departure Centre/On Site Operations Coordination Centre/ Urban Coordination Cell
1	Information Manager	Administrative
1	Information Manager	Administrative from ESDP
	SEARCH	<i>Area Involved</i>
2	Technical Search Specialist	Technical Search
2	Dog Search (<i>minimum</i>)	Dog Handler
1	Hazardous Materials Specialist	Hazardous Materials Assessment
	RESCUE	<i>Area Involved</i>
14	Rescue Team Manager and Rescue Technicians	Breaking/ Breaching/technical rope
4	Heavy Rigging Specialist	Lifting and Moving
	MEDICAL TEAM	<i>Area Involved</i>
3	Emergencies Physicians	Coordination and Management of emergencies team. Including Chief physician

3	Emergencies Nurses	Care of the team and supervision
6	Emergencies Technicians	Support, with circuit of victims and mobilisation of Advance Life Supports Units
4	Emergencies Technicians	Management Basic Life Support Units
1	Vet	Management the health conditions of dogs involved in the UC
	LOGISTICS	<i>Area involved</i>
1	Logistic Team Manager	Organise Base of Operations
1	Logistician	Transport capacity and fuel supply
1	Emergency professional 112 press	Communications
1	Logistic manager from ESDP	Organise the material from ESDP
2	Press team from ESDP	Communications