ASSISTANCE

Adapted situation awareneSS tools and taIlored training curricula for increaSing capabiliTie and enhANcing the proteCtion of first respondErs

European Commission

Project co-funded by the European Union within the Horizon 2020 Programme

Project Ref. N°	ASSISTANCE H2020 - 832576
Start Date / Duration	May 1, 2019 (36 months)
Dissemination Level[1]	PU (Public)
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Deliverable D2.2

User Requirements Specification

30/10/2019

[1] PU: Public; PP: Restricted to other programme participants (including the EC services); RE: Restricted to a group specified by the Consortium (including the EC services); CO: Confidential, only for members of the Consortium (including the EC services).

ASSISTANCE

Nowadays different first responder (FR) organizations cooperate together to face large and complex disasters that in some cases can be amplified due to new threats such as climate change in case of natural disasters (e.g. larger and more frequent floods and wildfires, etc) or the increase of radicalization in case of man-made disasters (e.g. arsonists that burn European forests, terrorist attacks coordinated across multiple European cities).

The impact of large disasters like these could have disastrous consequences for the European Member States and affect social well-being on a global level. Each type of FR organization (e.g. medical emergency services, fire and rescue services, law enforcement teams, civil protection professionals, etc.) that mitigate these kinds of events are exposed to unexpected dangers and new threats that can severely affect their personal safety.

ASSISTANCE proposes a holistic solution that will adapt a well-tested situation awareness (SA) application as the core of a wider SA platform. The new ASSISTANCE platform is capable of offering different configuration modes for providing the tailored information needed by each FR organization while they work together to mitigate the disaster (e.g. real-time video and resources location for firefighters, evacuation route status for emergency health services and so on).

With this solution ASSISTANCE will enhance the SA of the responding organisations during their mitigation activities through the integration of new paradigms, tools and technologies (e.g. drones/robots equipped with a range of sensors, robust communications capabilities, etc.) with the main objective of increasing both their protection and their efficiency.

ASSISTANCE will also improve the skills and capabilities of the FRs through the establishment of a European advanced training network that will provide tailored training based on new learning approaches (e.g. virtual, mixed and/or augmented reality) adapted to each type of FR organizational need and the possibility of sharing virtual training environments, exchanging experiences and actuation procedures.

ASSISTANCE is funded by the Horizon 2020 Programme of the European Commission, in the topic of Critical Infrastructure Protection, grant agreement 832576.

Disclaimer

Executive Summary

This deliverable (D2.2) presents an inventory of the requirements for services and applications that will be demonstrated and validated during the ASSISTANCE project.

This document mainly presents requirements of the following types: functional and data, usability, performance, security and legal. Therefore, it helps to clarify the interactions and dependencies between all components of the ASSISTANCE system: describes the data and data format needed by each component, summarises the components' main functionalities and outlines the legal and security conditions that the ASSISTANCE tools must follow and accomplish.

This deliverable provides also a detailed description of the process followed for the analysis and specification of the requirements. This includes, on one side, the iterative process inspired in Volere methodology that was used for gathering technical and user requirements and for the internal review of the results. On the other side, it includes the questionnaires that allowed internal and external end-users to validate and value the requirements according to their real daily needs.

The document continues with a comprehensive and exhaustive inventory of the requirements specification, grouped into categories according to the different components or services of ASSISTANCE they mainly refer to.

Then, the results of how the end-users have valued the different requirements set by the technical partners are shown. This provides insights on the importance that different First Responders assign to the requirements previously defined.

Finally, the deliverable details the impact that this task has on other work packages. The task complements the work done in other Work Package 2 tasks (especially, Task 2.3 Reference Scenarios and T2.4 System and Network Architecture Design) and is expected to enable the activities of design and development and testing of ASSISTANCE components and services within WP3, WP4, WP5, WP6 and WP7.

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Change control datasheet

Version	Changes	Chapters	Pages	Date
0.1	Initial table of content	ToC	10	03/06/19
0.2	First contributions	Introduction and Methodology	22	17/09/19
0.3	Changes in the format	All	22	28/09/19
0.4	First draft for internal review	All	63	07/10/19
0.5	Some additions and refinements regarding the validation process and the definition of requirements	All	65	17/10/19
0.6	Second draft after internal review	All	70	25/10/19
0.7	Final draft with last contributions and refinements and integration of annexes	All	95	30/10/19

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Acronyms

ASSISTANCE	Adapted situation awareneSS tools and tAllored training curricula for increaSing capabiliTie and enhANcing the proteCtion of first respondErs
ADMS	Advanced Disaster Management Simulation
BVLOS	Beyond Visual Line of Sight
C2	Command and Control
CBRN	Chemical, biological, radiological and nuclear
CO	Carbon monoxide
COTS	Commercial off-the-self
D#.#	Deliverable number #.# (D1.1 deliverable 1 of work package 1)
DPO	Data Protection Officer
FR	First Responder
GIS	Geographic Information System
HDMI	High-Definition Multimedia Interface
HEMS	Helicopter Emergency Medical Service
HMI	Human Machine Interface
IP	Ingress Protection
IPSEC	Internet Protocol Security
KPI	Key Performance Indicator
LTE	Long Term Evolution
Mbps	Megabits per second
MTOW	Maximum TakeOff Weight
RC	Radio Control
RTSP	Real Time Streaming Protocol
SA	Situational Awareness
SAS	Sensor Abstraction Service
TCP/IP	Transmission Control Protocol/Internet Protocol
TL	Task Leader
UAV	Unmanned Aerial Vehicle
UDP	User Datagram Protocol
UGV	Unmanned Ground Vehicle
VR	Virtual Reality
WP	Work Package
WPL	Work Package Leader

1 Introduction

1.1 Purpose of the document

This deliverable provides a complete set of technical and user requirements for the solutions and technologies to be developed in the ASSISTANCE project. The purpose of this deliverable is to document the work carried out in task 2.2 (User Requirement Gathering, Analysis and Tracking). It specifies the recommended or mandatory characteristics, functionalities and legal requirements for the ASSISTANCE tools and systems.

ASSISTANCE acknowledges the crucial importance of the definition of requirements for the specification of the system as they do not only line out the detailed framework in which the system and its components are to be developed, but also help to clarify the responsibilities of all involved partners and the interrelations between all system components.

This document describes the process used for eliciting the requirements, which mainly includes:

- The collection and iterative definition of requirements done by the ASSISTANCE technical partners using the tool Volere (explained in section 0).
- Internal and external end-user's valuation of the technical partners requirements through questionnaires.

Therefore, the collected requirements were defined, classified and evaluated in a collaborative way, before being presented in this deliverable. It should be emphasized that detailed system requirements (e.g. detailed scope of the products, functional and data requirements, etc.) for the particular components of ASSISTANCE will be specified in further technical work packages on the basis of the work reported in the current deliverable.

1.2 Connection to other tasks

1.2.1 Task 2.3 Reference Scenarios, Pilot Operations Specifications and KPIs

This task is complementary to the definition of use cases done within task 2.3 and described in deliverable D2.3.

The use case scenarios defined in D2.3 provide, in the format of a story, an overview of the context, the usage and the contribution of ASSISTANCE product functionalities to the purpose of the project. Besides, the use cases had a higher degree of detail and were formalised in a way that facilitated the identification of the different actors and systems involved.

In fact, the work done by ASSISTANCE partners in deliverable D2.3 includes the correlation traceability between the objectives defined for each use case and the user requirements defined in D2.2 for the different technologies and solutions.

1.2.2 Task 2.4 System and Network Architecture Design

The production of detailed, stable and consistent architectural design is being done in task 2.4 and will be reported in deliverable D2.4. This design requires a similarly detailed and specific definition of the requirements, as done in this deliverable.

Classifying the requirements in categories -assigned to the different components of the ASSISTANCE system- facilitates the clarification of the functional scope of each product and service, thus allowing

the definition of the process view of the architecture. In addition to this, the definition of user requirements allowed the identification of dependencies of the project in terms of data inputs and outputs and interaction with external systems and equipment.

Finally, the prioritisation conducted through the validation process done by internal and external end-users will allow to prioritise the functionalities and requirements of the ASSISTANCE systems and components in the architecture defined in D2.4.

1.2.3 WP3-WP7

Technical work packages where the ASSISTANCE solutions will be developed (WP3, WP4, WP5 and WP6) are deeply based on the requirements gathered in this deliverable. The tools that will be offered to First Responders and will be demonstrated in WP7, need to be designed and developed in accordance with the specifications collected during task 2.2, in order to ensure that they properly and effectively satisfy end-users' needs and requirements.

It is noteworthy mention that those technical WPs will provide more detailed technical requirements (e.g. detailed functionalities, data models, detailed scope of the component, etc.) of the respective tools. However, this current list sets the basic functionalities and characteristics of the solutions, from which a more profound analysis and design can be conducted.

1.3 Intended readership

The User Requirements Specification is primarily aimed at:

- Technical partners of ASSISTANCE, since this document defines the basic user and technical requirements that the tools and solutions developed in the project must fulfil.
- All consortium members participating in the project, since this document sets the bases for all the technical solutions to be developed in posterior work packages.
- Industry companies from outside the consortium, since the user requirements defined here can provide a useful picture of the real needs of First Responders in regard to advanced capabilities and tailored training.
- First Responders from outside the consortium, since the document offers a clear idea of state-of-the-art solutions and tools to enhance their capabilities in the management of emergency situations.

2 Requirement analysis

2.1 Methodology

For the gathering and iterative definition of ASSISTANCE requirements, a methodology called “Volere” [1] was used. Volere provides a conceptual framework for organizing and structuring the definition of requirements, as well as some templates for their formalization and some procedural rules and pattern for the work.

A specific tool, inspired in this methodology, has been used in the project to facilitate the collaborative and interactive work between partners in an iterative and progressive manner. The Volere tool, a web-based application for requirements gathering, incorporates the concepts in the data model, the templates within its user interface and the procedural patterns in the application business rules.

Volere methodology supports multiple types of requirements. Many of these types are oriented to the functional specification of systems, with different degrees of detail, from the general-purpose to the most specific aspects. Others are useful for identifying the constraints imposed by the context of the project or the pilots, as well as the current regulations (legal requirements). Others are auxiliary elements for centralizing the specific definition of key concepts shared among multiple requirements.

For the ASSISTANCE requirements gathering, requirements were classified into different groups or categories, one for each of the applications and functionalities that are planned to be developed. Each requirement is therefore associated to the tool that must accomplish it.

The following categories were used:

- ASSISTANCE Project
- Legal and Ethical
- Robots
- UAV
- Wearable Sensors
- CBRN Hazard Evolution
- Sensors and Meteorological Data Integration
- Communication
- Communications Security
- Sensor Abstraction Service
- Mission Planner and Management
- Damaged Assets Location and Routing
- Adapted Situational Awareness Tools
- Training and Virtual Reality Platforms

The definition of a requirement in Volere includes the following data:

- A **unique identifier** automatically generated by Volere.
- The **category** to which the requirement is assigned (from the list above).
- The **description** of the requirement.
- The **type** of requirement (list presented below).
- A **rationale** reasoning why the requirement is defined as it is, for the cases needed.
- An optional text with the **acceptance criteria** for the requirement, for the cases in which the criteria are not straightforward from the description.
- An optional **comments** input containing any additional explanations or considerations

The list of **types** of requirements was obtained from the templates proposed by the Volere methodology:

- Project drivers (the purpose of the project, clients, costumers, stakeholders, users)
- Project constraints (mandated constraints, facts and assumptions, naming conventions and definitions)
- Functional requirements
- Look and feel requirements
- Usability requirements
- Performance requirements
- Operational requirements
- Maintainability and support requirements
- Security requirements
- Legal requirements

ASSISTANCE complemented Volere with an iterative approach for the definition of the requirements, facilitating the collaboration between partners and the solution of misunderstandings and disagreements when defining the requirements, and the correct identification of dependencies between the different services and applications. This approach has helped in the peer-review of the contributions among the partners in order to improve the quality of the results.

Within the Volere method, the **author** of a requirement becomes the *owner* of that requirement and is the person who is allowed to modify it or delete it. This is reasonable because permitting multiple users to make edits concurrently would not be a reasonable or efficient procedure for the collaboration between team members and would imply a high risk of inconsistencies.

In order to collaborate, members of the team took the role of **validators** and could propose improvements for requirements in the form of **objections**, **conflicts** and **dependencies**:

- **Objections** are suggestions to change or remove, totally or partially, the definition of a requirement that the validator finds unclear, unfeasible, inadequate, misaligned with the purpose of the product or invalid for the context of the application.
- **Conflicts** identify the incompatibility or inconsistency between two or more requirements defined by one or more authors.

- **Dependencies** mark the fact that two or more requirements have dependencies between them, in order to ensure that the future management of the design, implementation or deployment of the software take those dependencies into account.

The **iterative approach** consisted of the following steps:

0. During the proposal preparation, the consortium gathered information from 18 different FR's organisations through a short questionnaire (8 Firefighters departments, 3 LEAs, 2 Medical organisations and 5 112/CP organisations), in order to extract their initial end-user needs and wishes for the ASSISTANCE system and components.
1. Each technical partner received the assignment of the role of **author** for the requirements of one or more categories, where a category describes an ASSISTANCE tool, application, service or platform, which must accomplish the end-user needs gathered in the previous phase. Each category had at least one author assigned who is technically or functionally responsible to develop or use the application or system specified within the category. The authors produced an **initial set** of requirements for each of their corresponding categories.
2. After this, the first **validation** stage took place. For the validation process, the project coordinator and the task leader reviewed the whole list of initial requirements, performing a review in which they might create **objections**, **conflicts** and **dependencies** associated with specific requirements.
3. Following the validation stage, the **revision** stage took place:
    a. The **authors** took into consideration the objections, conflicts or dependencies defined by validators for each requirement and decided how to solve them. The resolution of an objection, conflict or dependency might imply some interaction between the author and the validator (clarifications, exchanges of points of view) in order to reach an agreement and decide the appropriate amendments to apply to the definition of the requirement, which might consist in editing or deleting the requirements and/or the creation of new ones.
    b. The actual resolution of an objection, conflict or dependency required two steps: the editing of the requirement by the author and the confirmation by the validator of the satisfaction with the applied revision. The Volere tool provided specific visual controls for the first (editing the requirement and marking the objection as in state 'solution proposed') and the second step (confirmation of the solution acceptance).
4. After the revision stage ended, a new **validation** stage started. In this validation phase, however, it was the end-users, both internal and external to the ASSISTANCE consortium, the ones in charge of validating and evaluating the whole list of requirements defined by the technical partners. End-users ranked, according to their expertise and daily needs, the usefulness and importance of each requirement, using a linear scale going from 0-Unimportant requirement to 5-Critical requirement.
5. Finally, the task leader and the project coordinator reviewed and validated the **final list of requirements** to check again any inconsistency or error before preparing the deliverable D2.2 according to that set of final requirements.

Figure 1 – Iterative definition and validation of user requirements

As shown in Figure 1, the Volere tool was used to facilitate the conduction of stages 1 to 3, allowing the reuse of work, the control of pending and solved issues, as well as the historical evolution of changes in the definition of requirements. On the other hand, stage 4 was conducted using a questionnaire in Google Forms, which provided easiness for the end-users to fill in the questionnaire digitally and without specific registration needed.

A detailed description of usage of the Volere tool has been included in Annex A of this deliverable.

2.2 Definitions

The requirements manual distinguishes between technical and legal requirements. The following section defines the distinction between these two types.

2.2.1 Technical Requirements

Technical requirements are understood as those that must be fulfilled by the ASSISTANCE tools in terms of functional features as well as performance-related issues, reliability issues, and availabilities.

These requirements influence the entire ASSISTANCE system affecting the functionalities to be implemented in ASSISTANCE applications (like the CBRN module, the Damaged Assets Location and Routing or the Situational Awareness tool) and the services to be supported by the ASSISTANCE Backend (like communication requirements, security or the Sensor Abstraction Service).

Functional Requirements

The functional requirements specify what the ASSISTANCE service or application is expected to do. They cover both the scope of the project and the scope of the product and are related to the actions that the system must carry out in order to satisfy the fundamental reasons for its existence. It describes an action that the product must take to carry out the work for which it is intended.

Data requirements

Data requirements regarding data flows, inputs and outputs of the system. These requirements influence the definition of the architecture and the communication between the services through interfaces as well.

Performance Requirements

Performance requirements are related to the specifications of speed and response times (the amount of time which is needed to complete specified tasks), or accuracy requirements (quantification of the desired accuracy of the results produced by the ASSISTANCE tool or service) and in addition reliability and availability requirements (the allowable time between failures, or the total allowable failure rate).

Operational Requirements

Operational Requirements focus on the analysis of needed environments for the ASSISTANCE services in physical and technological means.

Maintainability and Support Requirements

Maintainability and support requirements hold a quantification of the time necessary to make specified changes to ASSISTANCE. There may be special requirements for maintainability, such as “this system must be able to be maintained by its end-users, or developers who are not the original developers”. In addition, this category specifies the level of support that is required.

Usability and Humanity Requirements

Usability and humans-related requirements describe the ASSISTANCE client's aspirations for how easy it will be for users of the technology to operate it. The tool’s usability is derived from the complexity of its functionality, the intended use, the context for use, the frequency of use, etc. Here just a first impression on usability requirements will be given because of the strong connection to other mentioned requirements.

Project Drivers

Project drivers cover requirements related to:

- The purpose of the product: a short description of the work context and the situation that triggered the development effort. It should also describe the work that the user wants to do with the delivered product. This boils down to one, or at most a few, sentences that say, "What do we want this product for?" In other words, the real reason that the product is being developed.
- Client, customer and other stakeholders: this item must give the name of the client or customer of the product. The roles and (if possible) names of other people and organizations who are affected by the product or whose input is needed in order to build the product
- Users of the product: list of the potential users of the product. Users are human beings or other pieces of technology who interface with the product in some way.

Project Constraints

Project constraints cover requirements related to:

- Mandated constraints: The client, customer or user may have design preferences, if these are not met, then the solution is not acceptable. Description of the technological and physical environment in which the product will be installed. Description of applications that are not part of the product but with which the product will collaborate. Description of applications that must be used to implement some of the requirements for the product. Description of the workplace in which the users will work and use the product. The budget and deadlines for the project.
- Naming conventions and definitions: a dictionary containing the meaning of all the names used within the requirements specification. Select names carefully to avoid giving a different, unintended meaning.
- Relevant facts and assumptions: statements describing business rules, systems and activities in the world that have an effect on this product and list of the assumptions that the developers are making.

Look and Feel

Look and feel requirements refer to the interface of the applications or systems to be developed, capturing the interface design, the style of the product. They provide a description of salient features of the product that are related to the way a potential customer will see the product.

2.2.2 Legal Requirements

In contrast to the technical requirements that describe the technical dependencies between the different components, the legal requirements affect the ASSISTANCE systems by setting the legal framework that must be considered for the development process.

Legal requirements in this sense have a broad scope. With respect to the ASSISTANCE applications and services, thematically they might be derived from two main fields:

- Identification, recruitment and participation of humans as research participants.
- Personal data protection and privacy.

In terms of legislative level, the regulations may be rooted in EU legislation (directives, ordinances) as well as in national legislation with different binding effects and hierarchies. Within the legal system, they derive predominantly from public and, in some cases, private (contract) law.

3 Requirements specification

In the following chapter, the technical and legal requirements are listed as derived from the above-outlined process. In the first subchapter, the final requirements are listed divided in the above-mentioned classification groups. In the second subchapter, the validation and revision processes are described.

In total, 178 requirements have been defined, grouped as follows:

Category of requirement	Number of requirements defined
ASSISTANCE Project	7 requirements
Legal and Ethical	11 requirements
Robots	25 requirements
UAV	24 requirements
Wearable Sensors	5 requirements
CBRN Hazard Evolution	14 requirements
Sensors and Meteorological Data Integration	2 requirements
Communication	10 requirements
Security	3 requirements
Sensor Abstraction Service	11 requirements
Mission Planner and Management	7 requirements
Damaged Assets Location and Routing	10 requirements
Adapted Situational Awareness Tools	27 requirements
Training and Virtual Reality Platforms	22 requirements
TOTAL	**178 requirements**

Table 1 – Summary of the requirements defined in each category

3.1 Requirements for ASSISTANCE

3.1.1 ASSISTANCE Project

These 7 requirements refer to general requirements of the ASSISTANCE system, seen as a holistic solution to enhance the situation awareness of First Responders to increase their capabilities and increase their protection.

Req. ID	Description	Type	Rationale	Acceptance criteria	Comments
999_001	ASSISTANCE should produce a complete physical situation awareness for the different FR organizations connected	Functional and data requirements		The physical situation awareness created by assistance should enhance the SA for different FR.	
999_002	Access to ASSISTANCE system should be done by means of a secure authentication process	Security requirements	To prevent unauthorised use by a malevolent or untrained person that could use the system in a destructive way.	Validate during the pilots that only authorized users can access the ASSISTANCE system by means of a secure authentication process	
999_003	ASSISTANCE system should be scalable, modular and flexible	The scope of the product		Validate the system during the different project pilots with different numbers of users connected and different kinds of scenarios.	This will be done during the different project pilots with different numbers of users connected and different kinds of scenarios.
999_004	ASSISTANCE should offer simple interfaces to share data with external sources/organizations	Functional and data requirements		Different kind of data will be integrated into the system (e.g. weather forecast information) and it will be shown during the project pilots	Different kind of data will be integrated into the system (e.g. weather forecast information) and it will be shown during the project pilots.
999_005	ASSISTANCE system/applications should work in common COTS (Commercial off-the-shelf) hardware	The scope of the product		To check during the project pilots that all used hardware is common COTS (Commercial off-the-shelf) hardware	
999_006	ASSISTANCE wearable and mobile sensors should be compliant with the necessary IP (Ingress Protection) hardware protection standards for being used during emergency situations. (e.g. IP 64 Protected from total dust ingress (4) and Protected from water spray	Performance requirements		The IP (Ingress Protection) characteristics of the sensors used during the pilots will be shown in the corresponding deliverables.	

Req. ID	Description	Type	Rationale	Acceptance criteria	Comments
999_007	Project output application should give the opportunity to make changes in program like in the open application.	The scope of the product	We cannot afford a situation when due to the development of life project application don't develop.	After inventing an app there should be regular brainstorm meetings on app effectiveness and potential evolution.	To make something timeless, it should be updated in line with the development of technology in the world.

Table 2 – ASSISTANCE General Project requirements list

3.1.2 Legal and Ethical

These requirements are legal and ethical resitrctions that must be respected according to existing legislation.

Req. ID	Description	Type	Rationale	Acceptance criteria	Comments
LEG_001	Procedures and criteria to identify and/or recruit research participants should be compliant with ethics requirements	Legal requirements	To prevent an unethical use of research participants.	To be checked and fulfilled during the whole project according to existing legislation.	
LEG_002	The participation of humans in research actions should be managed by informed consent procedures	Legal requirements		To be checked and fulfilled during the whole project according to existing legislation.	
LEG_003	The research with humans should receive opinions/approvals by the local/national ethics committees of partners involved	Legal requirements		To be checked and fulfilled during the whole project according to existing legislation.	
LEG_004	The host institution should confirm that it has appointed a Data Protection Officer (DPO) and her/his contact will be made available to all data subjects	Legal requirements			
LEG_005	In the case of processing of special categories of personal data, detailed justification should be provided	Legal requirements			
LEG_006	The beneficiaries of processed data should explain the reason why the data they intend to process is relevant and limited to the purposes of research project	Legal requirements			
LEG_007	A description of measures that will be implemented to safeguard the rights of the data subjects should be provided	Legal requirements			
LEG_008	In case the research involves profiling, the beneficiary should provide an explanation as to how the data subjects will be informed	Legal requirements			

Req. ID	Description	Type	Rationale	Acceptance criteria	Comments
LEG_009	In case of further processing of previously collected personal data, the beneficiary should confirm to have a lawful and technical basis for the data processing	Legal requirements			
LEG_010	An evaluation of the ethics risks of all data processing activities should be conducted; if necessary, a data protection impact assessment will be provided	Legal requirements			
LEG_011	There should occur not only meeting with Data Protection Officer but also Data Protection Policy should be invented and sharing it to project participant.	Security requirements			

Table 3 – Legal and Ethical requirements list

3.1.3 Robots

This list defines the main characteristics and requirements that the robots (UGVs) used in the ASSISTANCE system must fulfill.

Req. ID	Description	Type	Rationale	Acceptance criteria	Comments
ROB_001	Robot should be capable to operate in a temperature range from -40C to 60C.	The scope of the product	Operation in all weather conditions, but with a safe distance from a fire.	Standard tests.	
ROB_002	Robot should be protected from the environment (dust and water) according to IP67.	The scope of the product	The robot should be able to operate even if affected by water and dust.	IEC standard 60529 IP67	
ROB_003	Robot shall have a minimum maximum speed of 4 m/s.	The scope of the product	Speed should be enough to reach the target quickly. Higher speed might make teleoperation difficult.	Speed on clear track in a straight line.	
ROB_004	Robot shall have minimum work time of 4h.	The scope of the product	Compromise between operation time and battery size.	Measured in full usage mode (sensors, move etc.)	
ROB_005	Robot should have the capability of changing batteries without tools and understanding of the technical part of the robot	The scope of the product	This should give the flexibility of long operational time (batteries can be swapped, no need to wait for charging)		

Req. ID	Description	Type	Rationale	Acceptance criteria	Comments
ROB_006	Robot should be equipped with manipulator maximum load of 5 kg.	The scope of the product	To be able to open doors and remove obstructing objects and go inside a building to raise SA what is happen inside a buildingIt will be able to open doors and to lift small objects.	It will be able to open doors and to lift small objects (< 5 kg).	
ROB_007	Robot should have the mobility to traverse terrain, like debris, stairs, etc.	The scope of the product	It should be possible for the robot to transport through hard terrain.	Using standard NIST methodology.	Using standard NIST methodology.
ROB_008	Minimal operation range 400m.	The scope of the product	This is related to the radio range. The bigger the better, but there are technical limitations.	Robot can travel up and down slopes with a gradient of x degrees and on uneven ground, such as stones with a diameter of x-y-cm.	
ROB_009	Robot control should be protected by an authentication system.	Functional and data requirements	Access to the system should be authorized and secured. This of course can be disabled if required.		
ROB_010	Robot should be equipped with a monitoring system for: battery level, radio link quality, robot orientation	Functional and data requirements	Required to assure robot safe operation.		
ROB_011	Robot should be operated by one person.	Operational requirements	One person is able to set, start and operate the system. Reduce amount of manpower required.		
ROB_012	Robot setup time should be lower than 10 minutes, from when?.	Operational requirements	As quick as possible readiness to action. Lower then 10 minutes is not reasonable.		
ROB_013	Control system should be operated in multiple languages..	Usability and humanity requirements	The user target group of the control system comes from all over the world and must therefore be able to operate regardless of language.	The operator understands instructions and what the different controls means.	
ROB_014	Robot has to be localised on the map with accuracy lower than 1m	Functional and data requirements	To aid the operator while driving the robot. To help find robot later (if required, for example after some issue)		
ROB_015	Robot should have a maximum weight of 25kg.	The scope of the product	One person should be able to lift and set up a robot. Otherwise system might be	The weight of the robot is below 25 kg.	

Req. ID	Description	Type	Rationale	Acceptance criteria	Comments
			constructed from multiple components with each of them weighing less than 25kg.		
ROB_016	Maximum Size 60x60x80cm (width x lenght x height).	The scope of the product	Size of the robot should allow navigating through hard to reach places. Get through doors.		
ROB_017	Control system should be user-friendly.	Usability and humanity requirements	To perform a complex task a lot of training is required, but system needs to be accessible in any case.	The user interface should fulfil the ten usability heuristics of J, Nielsen:	Should be evaluated with end users and lead by experts within human factors/usability
ROB_018	Control system should have low latency.	The scope of the product	Teleoperation system should have latency low enough to allow for teleoperation/telemanipulation tasks. Low latency link also can be used to transfer data from sensors.	Preferred lower than 150ms.	
ROB_019	Robot data link has to be secured.	Security requirements	Proper encryption for data connection.		
ROB_020	Robot has to have the capability to carry multiple sensors.	Operational requirements	Sensors choice should be adequate to the mission tasks		
ROB_021	Sensors can be mounted quickly without any tools.	Operational requirements	Quickly readiness to action		
ROB_022	Robot can transfer sensor results to the operator using its datalink.	The scope of the product	Better system integration.		
ROB_023	Robot has to be equipped with multiple cameras	The scope of the product	To allow for teleoperation and telemanipulation.		
ROB_024	Robot can be teleoperated/telemanipulated by remote operator or work in automatic mode.	Operational requirements	Teleoperation for working in rough terrain or in dangerous condition. Automatic mode for reducing operator workload		
ROB_025	Sensor can connect to the robot using a specified open standard.	Functional and data requirements	To have multiple sensor options and sensor providers.		

Table 4 – Robots requirements list

3.1.4 UAVs

This list gathers all the requirements and functionalities that the drones (UAVs) must fulfill in ASSISTANCE.

Req. ID	Description	Type	Rationale	Acceptance criteria	Comments
UAV_001	UAVs must be able to transmit visual images in RTSP 264 to the SAS platform in real-time.	Functional and data requirements	The operator needs real time information from the situation, therefore the UAV video flow should be received in the Ground Control Station in real-time, allowing the pilot to have a better situational awareness.	UAV video flow is received in the Ground Control Station in real-time, allowing the pilot to have a better situational awareness	
UAV_002	At least in the industrial disaster Scenario, UAV must be able to transmit thermal images in real-time.	Functional and data requirements	In dark scenarios situations where the visual cameras do not provide information, another method for monitoring the area is needed. Also,in some cases in some scenarios it isthere is also a need needed to have temperature information.	UAV thermal images are received in the Ground Control Station in real-time allowing the pilot to see in dark and to have measurements of the temperature of the area.	At least in the industrial scenario this is crucial
UAV_003	UAV must be capable to be equipped with a gas/smoke sensor	Functional and data requirements		Gas/smoke measurements are received in the Ground Control Station in an understandable format.	
UAV_004	UAV ground control station allows tracking the UAV during the whole operation	Functional and data requirements	UAV must be under control during the whole operation.	Telemetry information is received from the Ground Control Station during the whole operation without significant losses	
UAV_005	UAV must have the possibility of being controlled by both pilot RC commands and unmanned waypoint navigation capabilities.	Functional and data requirements	It is necessary to have redundancy in the control mode of the UAV. The autonomous mode is crucial for BVLOS operations and an assisted mode is necessary for emergency situations where the onboard system are not working properly.	UAV can be controlled by an RC controller and from the Ground Control Station. Both data links are independent.	
UAV_006	UAV System small enough to be transported by van or pallet, preferably with an MTOW less than 15 kg.	Functional and data requirements	The system needs to be transported to the different areas where they will be stored. This transportation will be easier if it is possible to use a car or a van.	The system will be able to enter in a regular van.	Limit for MTOW is 25 kg due to regulation.
UAV_007	The flight envelope of the aerial vehicle has to be provided in the	Functional and data requirements	The end-user requires this information to plan and decide which missions can the UAV perform, and which ones not.	Information must be accessible to the end-user in an understandable format	

Req. ID	Description	Type	Rationale	Acceptance criteria	Comments
	user interfaces of the UAVs for flying and landing				
UAV_008	UAV used must fulfil with the current regulation in order to obtain the flight permits.	Legal requirements	It will be necessary to obtain the permits for flying in the demonstrations scenarios	UAS characteristics allow obtaining the necessary permits for performing the demonstrations.	
UAV_010	UAV operation time must be at least 20 minutes	Functional and data requirements		UAV is able to fly at least 20 minutes	
UAV_011	Setup time of UAV must be less than 10 minutes.	Functional and data requirements	Setup of the UAV should be as fast as possible for emergency scenarios.	UAV must be ready to fly in a time lower than 10 minutes.	
UAV_012	UAV must provide real-time video streaming and distribution	Functional and data requirements	UAV should provide real-time video to be stored in the SAS and showed in the SA interface to plan and manage the mission	During the pilots, UAVs provide real-time video streaming	
UAV_013	UAV must follow geofencing rules	The scope of the product		During the pilots, UAV must be able to fly following geofencing rules	
UAV_014	UAV must be equipped with command interface to control UAV according to simulation purposes	Functional and data requirements		Command interface works properly to control UAV during the pilot demonstrations	
UAV_015	UAV must be equipped with telemetry data link connected to ASSISTANCE to provide telemetry data	Functional and data requirements		Telemetry data of the UAV must be provided to the SAS	
UAV_017	UAV can be equipped with 3D mapping capabilities depending on the type of planned mission	Functional and data requirements	There could be a need for a 3D model of the terrain, depending on the type of planned mission	3D mapping capabilities must be provided in the scenarios and missions where that functionality is foreseen and required	
UAV_018	The ASSISTANCE catcher drone has to carry a capture device	Functional and data requirements		Capture device integrated into the drone and working properly	
UAV_019	The captor drone must be able to capture multi-copter drones	Functional and data requirements		Captor drone captures drones below with its integrated net or capture device	

Req. ID	Description	Type	Rationale	Acceptance criteria	Comments
UAV_020	The captor drone should be able to load the intruder drone when it is caught, and carry it to a safe place	Functional and data requirements		Captor drone is able to transport the captured intruder to another location	
UAV_021	The Control Station that will manage the swarm of drones must be centralized in order to be able of controlling all the vehicles from a single computer	Functional and data requirements	For coordination purpose of the swarm of drones, they need to be able to be controlled from a single computer.	Control station is able to manage several drones	The Control Station that will manage the swarm of drones must be centralized
UAV_022	The swarm of drones should be composed by at least 4 vehicles.	Functional and data requirements		At least 4 drones can be managed in the swarm	
UAV_023	Swarm drones must be able to integrate or transport the Wi-Fi access points provided by the communication specialists for creating an Ad Hoc Network	Functional and data requirements		Network device integrated and working in the drones that compound the swarm.	
UAV_024	Drone swarm should be reconfigured in case one drone stops its activities	Functional and data requirements		Reconfiguration of the swarm is performed if a drone stops working.	
UAV_025	The catcher drone must be able to calculate an efficient trajectory to get close to the rogue drone.	Functional and data requirements		Calculated trajectory allows the catcher drone to get close to the rogue drone	
UAV_026	The catcher drone must be able to follow the rogue drone in an autonomous way	Functional and data requirements		Catcher drone follows the rogue drone continuously.	

Table 5 – UAV requirements list

3.1.5 Wearable Sensors

These requirements define the basic connectivity requirements and characteristics of the wearable sensors to be carried by the First Responders.

Req. ID	Description	Type	Rationale	Acceptance criteria	Comments
WEA_001	Monoxide detectors (CO) wearable sensors must provide connectivity interfaces (e.g. Bluetooth or Wi-Fi) in order to allow the sensor sharing information with the SAS platform.	Performance requirements		CO detector sensors measurements will be shown through the SA application during the project pilots	
WEA_002	Temperature wearable sensors must provide connectivity interfaces (e.g. Bluetooth or Wi-Fi) in order to allow the sensor sharing information with the SAS platform.	Performance requirements		Commander are able in real-time follow up the fire-fighters physical health. Temperature sensors measurements will be shown through the SA application during the project pilots	
WEA_003	Personal cameras wearable sensors must provide connectivity interfaces (e.g. Bluetooth or Wi-Fi) in order to allow the sensor sharing information with the SAS platform.	Performance requirements		Personal cameras sensors video flows will be shown through the SA application during the project pilots	
WEA_004	GPS wearable sensors must provide connectivity interfaces (e.g. Bluetooth or Wi-Fi) in order to allow the sensor sharing information with the SAS platform.	Performance requirements		GPS sensors locations will be shown through the SA application during the project pilots	
WEA_005	Constants vitals wearable sensors must provide connectivity interfaces (e.g. Bluetooth or Wi-Fi) in order to allow the sensor sharing information with the SAS platform.	Performance requirements		Constants vitals wearable sensors measurements will be shown through the SA application during the project pilots	

Table 6 – Wearable Sensors requirements list

3.1.6 CBRN Hazard Evolution

This list collects the requirements that refer to the CBRN Module used in ASSISTANCE in order to protect the First Responders and enhance their situation awareness regarding CBRN threats.

Req. ID	Description	Type	Rationale	Acceptance criteria	Comments
CBR_001	The CBRN hazard system should listen to a central data bus (the SAS).	Technical requirement	The CBRN hazard system is integrated into the ASSISTANCE system and can communicate via the SAS with all relevant ASSISTANCE modules.	During the demonstrations, the CBRN provides data to the SAS	Revised (added SAS).
CBR_002	Positions of gas measurements can be placed on the map of the Situational Awareness (SA_017) tool and also integrated into the Damaged Assets Location and Routing tool	The scope of the work	The first responders will have a higher SA regarding the gas concentration at the measured positions.	In the demonstrations where it is foreseen, gas measurements can be placed on the SA and ALR tools for planning and routing purposes	

Req. ID	Description	Type	Rationale	Acceptance criteria	Comments
CBR_003	The end-user shall be able to locate new gas measurements on the map of the Situational Awareness (SA_017) tool and also integrated into the Damaged Assets Location and Routing tool (ALR_002)	Usability and humanity requirements	The users need up to date information about gas areas and there geographical location.	In the demonstrations where it is foreseen, gas measurements can be placed on the SA and ALR tools for planning and routing purposes	
CBR_004	The CBRN module dynamically predicts the future position of the hazard footprint based on real-time meteorological information, a realistic landscape, and real-time sensor information.	The scope of the work		During the demonstrations, the CBRN module dynamically predicts the position of hazard footprint if it has the required information	
CBR_005	The user should easily understand the visualisation of the gas measurements on the map.	Usability and humanity requirements		Positively validated by the end-users during the demonstrations	
CBR_006	The CBRN module dynamically calculates the current position of the hazard footprint based on real-time meteorological information, a realistic landscape, and real-time sensor information.	The scope of the work		During the demonstrations, the CBRN module dynamically calculates the position of hazard footprint if it has the required information	
CBR_007	The CBRN module should be suitable for training.	The scope of the work		CBRN has replay and simulation capabilities for training	
CBR_008	The CBRN module can determine a danger zone, including highlighting vulnerable places such as hospitals.	The scope of the work		Danger zones can be places on the CBRN module	
CBR_009	The CBRN module can warn the first responders about approaching the danger zone, in all phases of the emergency.	The scope of the work		During the demonstrations, the CBRN warns FRs when they approach a danger zone	
CBR_010	The CBRN module can localize and position all people and critical assets close to/in the danger zone.	The scope of the work		During the demonstrations, the CBRN module can position people and assets close to the danger zone	
CBR_011	The CBRN module can calculate the uncertainty of the gas cloud position.	The scope of the work		Any uncertainty of the gas cloud position can be calculated during the real demonstrations	
CBR_012	The CBRN module can calculate the optimal sensor position based on current prediction and measurements to gain more certainty about the position of the gas cloud.	The scope of the work		Sensors position can be optimised thanks to the calculations of the CBRN module	
CBR_013	The CBRN module can calculate the fall-out area.	The scope of the work		To be tested during the pilots	

Req. ID	Description	Type	Rationale	Acceptance criteria	Comments
CBR_014	The system shall generate a static visualisation of the situation with the following information: Title mentioning the name of the gas Subtitle mentioning the time of visualization generation Map with current/predicted levels of danger	The scope of the product	This gives the possibility to send the relevant information via other channels than the ASSISTANCE system, e.g., email.	The information is generated following the defined format	

Table 7 – CBRN Hazard Evolution requirements list

3.1.7 Sensors and Meteorological Data Integration

These 2 requirements are related to the integration of meteorological data for the CBRN threats calculations.

Req. ID	Description	Type	Rationale	Acceptance criteria	Comments
MET_001	Meteorological information can be shown on the map.	The scope of the work		To be demonstrated during the pilots	
MET_002	Meteorological information can be used to calculate the movement of the gas plume.	The scope of the work		To be demonstrated during the pilots	

Table 8 – Sensors and Meteorological Data Integration requirements list

3.1.8 Communication

These requirements collect the characteristics of the communication services defined for the ASSISTANCE system.

Req. ID	Description	Type	Rationale	Acceptance criteria	Comments
COM_001	Maximum Global Capacity = 2Mbps	Functional and data requirements			
COM_002	Video Streaming Quality Supported (indicative) = H.264 UDP	Functional and data requirements			
COM_003	Maximum Delay = 850ms	Functional and data requirements			
COM_004	Availability High Availability (4G - LTE)	Functional and data requirements			
COM_005	Physical Interfaces for End Users (units on the field) = Wi-Fi and Ethernet	Functional and data requirements			
COM_006	Physical Interfaces for C2 Users = Ethernet	Functional and data requirements			
COM_007	Communication Field Node - C2 = TCP/IP L3	Functional and data requirements			
COM_008	Remote User to Nomadic Centre communication protocol = Wi-Fi or other radio	Functional and data requirements			
COM_009	UAV to ground communication = Ethernet cable or Wi-Fi	Functional and data requirements			
COM_010	Security protocol to encrypt IP communication = IPSec	Functional and data requirements			

Table 9 – Communication requirements list

3.1.9 Communications Security

These 3 requirements are related to the security protocols to be implemented in the communications of the ASSISTANCE system.

Req. ID	Description	Type	Rationale	Acceptance criteria	Comments
SEC_001	Security Field Node - C2 = IPSEC	The scope of the work			
SEC_002	Security End user (vehicle) - Field Node = None	Relevant facts and assumptions			
SEC_003	Security C2 - 3rd Parties = None	Relevant facts and assumptions			

Table 10 – Security requirements list

3.1.10 Sensor Abstraction Service

This list gathers the requirements related to the Sensor Abstraction Service (SAS) platform of ASSISTANCE, defining its main functionalities.

Req. ID	Description	Type	Rationale	Acceptance criteria	Comments
SAS_001	The platform, Sensor Abstraction Service (SAS), will store information from sensors and display it in a useful way for the rest of the ASSISTANCE components.	The purpose of the product	The SAS must be able to store the data coming from all the sensors deployed, so it can be accessed and used by the SA or other applications.	The data sent by the sensors is stored and can be accessed by the SA during the pilots	
SAS_002	The SAS will provide an API REST service to insert data from the sensors and telemetry from Unmanned Ground Vehicle/Unmanned Aerial Vehicle (UGV/UAV).	Operational requirements	The SAS must integrate the data coming from sensors and UxVs	An API REST is provided so sensors and UxVs tested during the pilots can insert their data in the SAS	
SAS_003	The SAS will provide an API REST service to consult status and historical data.	Operational requirements	The SAS must provide access to applications to consult status and historical data	An API REST is provided so status and historical data can be consulted during the pilots	
SAS_004	The SAS is mission oriented. The mission begins from the moment the incident is declared until it resolves.	The scope of the work	The SAS must operate from the moment the incident is declared to the moment it is resolved	The SAS operation, as demonstrated during the pilots, is mission oriented	
SAS_005	The structure will be agnostic and flexible.	Usability and humanity requirements	The SAS must be flexible enough to incorporate different types of sensors, applications and data	The SAS structure is flexible and agnostic, so it can integrate the different sensors and applications tested during the pilots	

Req. ID	Description	Type	Rationale	Acceptance criteria	Comments
SAS_006	Metric definition must be provided in the cases that are required.	Usability and humanity requirements		Metric definition is provided during the pilot	
SAS_007	The SAS will provide a video record of the different visual sensors.	Usability and humanity requirements	The SAS must integrate and store the video coming from the different visual sensors	A video record of the different sensors is provided during the pilot demonstrations	
SAS_008	Video streaming could be accessed through the infrastructure. The videos can also be accessed later.	Usability and humanity requirements	Video must be accessible in real-time and with replay capabilities	Videos can be accessed through the infrastructure and accessed later during the pilot demonstrations	
SAS_009	Photos should be accessible through the infrastructure.	Usability and humanity requirements		The photos are accessible through the infrastructure during the pilot demonstrations	
SAS_010	The most relevant indicators will be shown on the map. This will allow calculating the routes of access or evacuation	Usability and humanity requirements	The most relevant data and information gathered in the SAS must be shown on the SA map to easily calculate access and evacuation routes when needed	During the pilot demonstrations, the map shows the most relevant indicators and data gathered by the SAS	
SAS_014	The services of the modules that are developed should be available via Docker images.	Operational requirements		The services are available via Docker images	

Table 11 – Sensor Abstraction Service requirements list

3.1.11 Mission Planner and Management

These 7 requirements define the main requirements to be fulfilled by the Mission Planner and Management module of ASSISTANCE.

Req. ID	Description	Type	Rationale	Acceptance criteria	Comments
MIS_001	The ASSISTANCE system will enable the user to manually select the shooting points requested for each object of interest by first selecting the positions of the shooting points and then linking it to the object of interests (for instance a burning gas station)	Functional and data requirements	Choose some points from which the user would like a UAV to make some shooting camera in order to collect some pictures.	Demo	The mission planer TRT will provide relies on a state of the art non-holonomic eikonal solver called Hamilton Fast Marching. Such a solver takes into account turning radius constraints (dubins). It provides robust 1 pass trajectory optimization, and avoid a post-processing step which could imply the violation of no-fly zones. This solver has been designed by the laboratory of applied mathematics of Orsay, CNRS (Centre Nationale pour la Recherche Scientifique) [2] [3]. TRT has acquired recognized expertise on industrial applications related to this solver [4]. The TRT solver will also rely on state-of-the-art graphical acceleration processes. For instance, intervisibility calculation could be accelerated by factors up to 80 thanks to this technology.
MIS_002	ASSISTANCE MIS managing the user profile: End-user, UAV operator	The scope of the product	MIS manages the right and profiles of several types of users	Demo	
MIS_003	MIS enables the user to create a Mission request and assigned a UAV or a land assistance reconnaissance vehicle assignment	The scope of the product	Business process and workflow of the mission request, platform allocation and shooting point creation		MIS manages the workflow from the creation of mission request, creation of the shooting points and Surveillance asset allocation (UAV or land patrol) to the transmission of the mission plan either to the UAV pilot at UAV ground station level or to the land assistance reconnaissance vehicle
MIS_004	MIS shall be able to manage UAVs missions and land assistance vehicles for reconnaissance purpose.	The purpose of the product	Allocation of a platform		Demonstration on one UAV (to be determined by CATEC) and on the Viasat vehicle
MIS_005	Automatic and / or manual mode allocation of a UAV or land vehicle with shooting points	The scope of the product	The MIS is offering two modes: automatic selection based on an algorithm and a manual one	Demo	The algorithm is provided by Thales and the manual one is provided by Viasat
MIS_006	MIS is creating a detailed mission request (including the flight plan for the UAV).	The scope of the product	Creation of a mission order before sending it to the platform operator/pilot	Demo	Extension of Viasat Mission management module to a selection of UAV within a fleet and / or to land vehicles.

Req. ID	Description	Type	Rationale	Acceptance criteria	Comments
MIS_007	Once the mission request is validated by the end-user, it is sent to either the UAV ground station or the land vehicle. MIS shall also handle the acknowledgement validation to be sent by the platform.	The scope of the product	Creation of a mission and transmission to the platform	Demo	Once received the platform, the mission request has to be validated either by the remote pilot or the operator of the vehicle before execution.

Table 12 – Mission Planner and Management requirements list

3.1.12 Damaged Assets Location and Routing

The following requirements collect the main requirements of the Damaged Assets Location and Routing module of the ASSISTANCE system.

Req. ID	Description	Type	Rationale	Acceptance criteria	Comments
ALR_001	The tool will have a user-friendly, intuitive Graphical User Interface.	Usability and humanity requirements		Intuitive navigation that fulfils usability heuristics proposed by Jakob Nielsen [5]	
ALR_002	The tool will allow users to input emergency parameters (type and location), evacuation areas and shelters (location and capacity), damaged infrastructures (location, damage type and risks) and areas with new gas measurements.	Functional and data requirements		FRs and other users can input data required to apply the tool.	
ALR_003	The tool will have a GIS-based system.	Functional and data requirements		Fully functional map allowing interaction to obtain practical information.	
ALR_004	The tool will be able to calculate possible safe evacuation routes and safe access routes for emergency services to critical areas.	Functional and data requirements		The tool calculates safe routes under pilot conditions.	
ALR_005	The tool requires FRs status information (location, available units and type) to calculate dynamically safe routes.	Functional and data requirements		Other systems provide proper information to the tool.	
ALR_006	The tool provides real-time results.	Performance requirements		The computation time due to external interactions is reasonable according to the emergency status.	
ALR_007	The tool will allow users to explore fictitious emergencies to develop previous plans.	Functional and data requirements		The tool can be used in planning steps.	
ALR_008	The tool will calculate approximate evacuation times using emergency particular parameters and historical demographic data.	Functional and data requirements		Emergency parameters and historical demographic data can be estimated.	

Req. ID	Description	Type	Rationale	Acceptance criteria	Comments
ALR_009	The tool will calculate in real-time routes status and access times to the emergency points.	Functional and data requirements		Routes are shown in GIS System.	
ALR_011	The tool should allow changes in the scenario depending on the emergency time evolution.	Functional and data requirements		Model provides reasonable emergency evolution parameters according to the pilots scheduled that modify the scenario.	

Table 13 – Damaged Assets Location and Routing requirements list

3.1.13 Adapted Situational Awareness Tools

This list provides the requirements defined for the Situational Awareness Tool of ASSISTANCE.

Req. ID	Description	Type	Rationale	Acceptance criteria	Comments
SA_001	ASSISTANCE SA application should log all the actions done by users and storing all data received from sensors and personnel.	Functional and data requirements		The system log will be shown during the project pilots in order to check that the pilot actions have been registered properly	
SA_002	ASSISTANCE should have different users' profiles stated with different kind of information assigned.	Functional and data requirements		During the project pilots will be compared the information offered by the system to different kind of FRs organizations	
SA_003	ASSISTANCE SA application HMI should provide discriminate information access depending on the FRs profile connected to the system	Look and feel requirements		During the project pilots will be compared the information offered by the system to different kind of FRs organizations	
SA_004	ASSISTANCE SA application should be executed on mobile devices (e.g. tablets) and adapt its performance to these devices.	Performance requirements		To use mobile devices during the project pilots which run the SA application	
SA_005	ASSISTANCE SA application should show real-time video flows from the connected cameras (including the ones mounted on mobile platforms) depending on the needs and restrictions, for instance bandwidth.	Performance requirements		To show real-time videos through the SA application during the project pilots	
SA_006	ASSISTANCE SA application should integrate IR cameras video flows (including IR cameras mounted on mobile platforms, if any) depending on the needs and restrictions, for instance bandwidth.	Performance requirements		IR cameras video flows will be shown during the project pilots	

Req. ID	Description	Type	Rationale	Acceptance criteria	Comments
SA_007	SA application should integrate the following wearable sensors for being installed on-demand in some FRs uniforms depending on their protection needs. (GPS Sensors, Personal Video Cameras, Carbon monoxide detectors (CO) and Temperature sensors)	Performance requirements		Wearable sensors measurements will be shown during the project pilots	
SA_008	ASSISTANCE SA application should raise warnings when IP sensors are not available.	Performance requirements		During the project pilots some IP sensors will be disconnected in order to check the alarm stated in the SA application	
SA_009	ASSISTANCE SA application should allow messaging capabilities from/to any SA application node	Performance requirements		During the project pilots some messages exchange will be performed between different SA application nodes	
SA_010	ASSISTANCE SA application should give in real-time and with high precision location of own resources (personnel and vehicles) including mobile platforms location (if available).	Performance requirements		Location of persons and vehicles will be shown during the project pilots	
SA_011	ASSISTANCE SA application should properly store all data received by the system from sensors and external sources in order to ensure the availability of all information stored in the database for being shown to the FRs where necessary.	Performance requirements		Stored data will be shown during the project pilots	
SA_012	ASSISTANCE SA application should show near real-time evacuation routes (based on ALR_004) for helping the FRs for moving the victims in a secure and quick way and for FRs evacuation of the area quickly in case of a major incident.	Performance requirements		Evacuation routes will be shown through the SA application during the project pilots	
SA_013	ASSISTANCE should provide layers management of information capabilities on a GIS to foster the possibility to turn off or on information according to specific needs stated by the FRs.	Performance requirements		Layers management of information capabilities will be shown during the project pilots.	
SA_014	SA application should store relevant data gathered during the day and store it properly for 7 days for being used for forensic purposes (If required)	Security requirements		Stored data will be shown during the project pilots	
SA_015	Only authorized SA application users should have access to the SA stored data	Security requirements		Authorized users will access to the stored data during the pilots	
SA_016	SA application should use existing and known standards for data storage and management.	Functional and data requirements		The storage standard user for the SA application will be described in the corresponding deliverable	

Req. ID	Description	Type	Rationale	Acceptance criteria	Comments
SA_017	ASSISTANCE mounted and wearable sensors data (e.g. temperature, toxicity measurements, etc) should be visible on the main SA application HMI and in each ASSISTANCE SA application node (including mobile devices e.g. tablets)	Performance requirements		Mounted and wearable sensors data will be shown through the SA application HMI during the project pilots	
SA_018	SA application HMI should allow map selection, distance measurements, zooming and scrolling	Performance requirements		Map selection, distance measurements, zooming and scrolling features will be tested during the project pilots	
SA_019	No SA application HMI action should require more than 4 clicks	Usability and humanity requirements		Different actions will be performed during the project pilots for testing this requirement	
SA_020	ASSISTANCE SA application should provide augmented video fusion capabilities for overlap real-time video flows from cameras mounted in drones on the emergency area GIS displayed in the SA application HMI.	Performance requirements		Augmented video fusion capabilities will be tested during the project pilots	
SA_021	System must be equipped with an online (real-time) simulation scenario editor	Functional and data requirements		During the demonstrations, the system is able to simulate scenarios in real-time	
SA_022	System must provide an interface to exchange data with UTM systems form UAVs flight planning purposes	Functional and data requirements		UTM systems are able to exchange data with the SA system	
SA_023	ASSISTANCE should interface HEMS location system to visualize HEMS location and support HEMS call decisions	Functional and data requirements		HEMS location system are able to exchange data with the SA system	
SA_024	ASSISTANCE should be equipped with 3D mapping functions to provide terrain model information	Functional and data requirements		End-users validate as positive the 3D mapping functions during the pilot	
SA_025	ASSISTANCE should be equipped with a real-time map ‘tap and fly’ function	Functional and data requirements		The functionality is correctly operating in the pilots and it is validated by the end-users	
SA_026	ASSISTANCE should provide post-simulation/training analysis	Functional and data requirements		To be demonstrated in the pilots	
SA_028	ASSISTANCE access must be secured with user authentication and authorization	Security requirements		Proper security measures are applied to the authentication and authorisation of the ASSISTANCE system	

Table 14 – Adapted Situational Awareness Tools requirements list

3.1.14 Training and Virtual Reality Platforms

This last set of requirements gathers the functionalities and requirements to be fulfilled by the training and virtual reality platforms that will be used in ASSISTANCE by the end-users.

Req. ID	Description	Type	Rationale	Acceptance criteria	Comments
TRA_001	The training includes the use of, besides virtual and/or augmented reality, a variety of methods and tools	User documentation and training	Training process cannot be monotonous, restricted to using only one method or tool, and must be interesting and engaging trainees.	Training should include use, at least three of following methods or tools: applications on mobile phones, case study, practical use of devices, simulations, simulators, decision games, e-learning, experiment, multimedia presentation, discussion,	
TRA_002	Training cannot be spread too much over time.	User documentation and training		Training is organized in accordance with regulations about health and safety at work.	
TRA_003	The training should be divided into a theoretical and practical part	User documentation and training			
TRA_004	During the training, should be used as the most effective method of consolidation of knowledge - teach other persons.	User documentation and training	The best way to learn to teach yourself is to teach others.	Trained persons should be able to teach and train 1-2 people under the supervision of an instructor.	
TRA_005	Feedback after training	User documentation and training		At the end of the training there is an evaluation questionnaire.	
TRA_007	Training with the use of virtual and augmented reality should take into account the FR's perceptive capabilities.	Users of the product			
TRA_008	Training should be organized in small groups for a better follow-up of the practical training.	Users of the product		Training should be organized in groups of 2-6 people.	
TRA_009	Scenarios used during the training may be based on real events.	User documentation and training			
TRA_010	Training curricula must be tailored to the type of FR's.	User documentation and training		Consultation of training curricula with every type of FR's.	

Req. ID	Description	Type	Rationale	Acceptance criteria	Comments
TRA_011	Scheduling of training should take into account the availability, working time of FR's.	User documentation and training	FR's units must have a minimum number of employees ready to action.		
TRA_012	Training module should provide trainee aid mode to provide advice and aid during simulation	User documentation and training			
TRA_013	Training process should provide exam and rating capabilities	User documentation and training			
TRA_014	The training must take into account working with data from both UAVs, smart wearable sensors, robots and drones.	The scope of the work		The training material contains examples of all these tools/technologies.	
TRA_015	The training must prepare FRs for the three pilots. Training content must be clearly connected to the pilots.	The purpose of the product		Evaluate whether training participants think that the training sufficiently prepares them for the pilots.	
TRA_016	The training and training materials must be in English, and must be devoid of country-specific or cultural references.	Cultural and political requirements		Evaluate with WP6 partners whether the training can be used in all countries, prior to making the training available for use.	
VR_001	At the training/pilot location electricity, an HDMI beamer (or large HDMI screen), speakers and an option to darken the room must be available.	Functional and data requirements	This setting is crucial for the VR environment to work.	Location checklists need to be created and checked prior to the training.	
VR_002	At least one technical director needs to be present to prepare the scenario settings of the VR environment.	Operational requirements	The settings must be correctly set to create the right scenarios.	Technical directors present at the training/pilot events.	
VR_003	ADMS instructors must be present when the VR environment is used, or in advance local instructors must be trained in using the VR environment.	Operational requirements	The VR environment should not be used by untrained personnel.	The VR environment is only used with trained instructors present.	

Req. ID	Description	Type	Rationale	Acceptance criteria	Comments
VR_004	Extra VR objects may need to be modelled to visualise the effects of an earthquake.	Functional and data requirements	The visualisations are needed to correctly simulate the earthquake scenario.	The VR objects are available when running the earthquake scenario.	
VR_005	An extra VR object needs to be modelled to visualise a robot	Look and feel requirements	The VR object is needed to correctly visualise a robot within different scenarios.	The VR object is available when running the scenarios.	
VR_006	Data provided by sensors can be simulated outside of the VR environment by use of a tablet	The scope of the product	To be able to train with sensors in the VR environment, the data provided by sensors will be simulated as an alternative to extra VR programming to simulate the sensor data.	Tablet and software are available to simulate the data.	
VR_007	Dedicated AMDS laptops must be used and are available through IFV or ADMS-developer ETC.	Performance requirements	ADMS only runs on these heavy-duty laptops maintained by IFV.	The dedicated laptops are available on-site during the training/pilot.	

Table 15 – Training and Virtual Reality Platforms requirements list

3.2 Validation and Revision Process

3.2.1 Dependencies

During the revision conducted -mainly by the project coordinator and the task leader, but also with the participation of other partners- 3 dependencies were created. Most of them helped to identify some requirements as preconditions of others that were explicitly added to the definitions of the dependent requirements. This is expected to be a helpful contribution to task T2.4 on the design of the architecture by facilitating the identification of dependencies between software components.

Other dependencies aimed at making requirements easier to understand by referring to other requirements that contained the definition of basic explanations of the concepts used in the former.

3.2.2 Conflicts

Only 2 conflicts were detected during the Volere methodology execution, all of them simply identified actual duplicates of requirements that were solved by eliminating one of the duplicates.

3.2.3 Objections

Finally, 30 objections were created for the requirements during the execution of the Volere methodology.

A high proportion of them was oriented to improve the quality of the writing of the objected requirements, by identifying typing or language errors or requesting greater clarity when the requirements were difficult to understand.

Some requirements initiated useful exchanges of point of views between the involved partners, and helped to ensure that all functional, operational, performance and legal aspects of the functionality were considered. In some cases, this implied not only the improvement of the definition of the affected requirements, but also the creation of additional requirements referring to the aspects that were not covered by the former.

In particular, in some of the cases in which partners had written requirements for tools or solutions that were the responsibility of another partner, that responsible partner often created an objection to ask for further detail on what was required and to clarify whether that requirement was technically feasible and inside the scope of the project or not.

Other objections motivated discussions between technical partners that aimed at clarifying interactions or dependencies between software modules, as well as identifying the third-party services or infrastructure to integrate and their characteristics. These discussions will have a useful impact on the definition of the architecture within T2.4.

Finally, a few ones addressed the incorrect identification of the relevance or priority of the requirements considering the needs of the users and stakeholders or the context, thus causing some requirements to increase and some other to reduce their priority.

4 Requirements validation by end-users

After the iterative and collaborative production of the list of requirements shown in the previous chapter, the list was included in a questionnaire to be reviewed and validated by end-users. Both internal and external First Responders were engaged in the validation process, so as to maximise the number of answers and have solid feedback that allows the consortium to extract valid conclusions about the importance and priority of the different services and functionalities defined.

The priority scores obtained through these questionnaires will be taken as reference for the prioritisation of developments of the different tools and systems of ASSISTANCE, which will be further designed in D2.4 System and Network Architecture.

4.1 Questionnaire content and structure

The requirements were structured into the questionnaire according to the same classification followed in Volere for the previous phase. In addition, similar components or services were further grouped into sections, with the only purpose of reducing the final number of sections -or pages of Google Forms- making it easier, simpler and less tedious for the end-users to understand the structure of the questionnaire while filling it in.

Therefore, the questionnaire was organised in the following big sections:

1. Introduction
2. Organisation details
3. ASSISTANCE General Project Requirements
4. Legal and Ethical Requirements
5. Robots and UAVs Requirements
6. Wearable Sensors
7. CBRN Hazard Evolution and Meteorological Data Integration
8. Communication and Security Requirements
9. Sensor Abstraction Service (SAS)
10. Mission Planner and Management
11. Damaged Assets Location and Routing
12. Adapted Situational Awareness (SA) tools
13. Training and Virtual Reality Requirements

4.2 Questionnaire methodology and content

The full questionnaire is presented in Annex B of this document. The questionnaire basically starts introducing the project ASSISTANCE and the main purpose of the questionnaire itself. Then, it highlights that no personal data is collected through the survey and it explains the methodology to be followed by the end-users to fill it in.

After asking for general and anonymous information about the end-user, the questionnaire presents the 11 different sections -covering the 14 categories defined previously in section 2.1-, each one with a table similar to the table below, where end-users value each of the requirements according to its level of importance.

	1 (Not important)	2 (With requirement)	3 (Important)	4 (Serious)	5 (Critical)	Not sure
Requirement 1						

Requirement 2						
Requirement 3						
…						

Table 16 – Requirements table template in the end-users' questionnaire

End-users completed the questionnaires selecting the importance of each of the requirements using a simple scale going from 1 to 5, where 1 is the lowest importance and 5 is the highest one:

1: Unimportant requirement. With or Without this, the solutions/tools are exactly the same.

2: With requirement: Nice to have, but the solutions/tools will be fully useful even without it.

3: Important requirement: Without this, the solutions/tools will be only partially useful.

4: Serious requirement: Without this, the solutions/tools will be usable but not useful for the end-user.

5: Critical requirement: Without this, the solutions/tools will be of no use at all.

The final score of each requirement, therefore, is the average of all the scores received by all the end-users, which offers a clear insight into how important that requirement is for the First Responders community.

Then, these average scores have been translated to the MoSCoW methodology [6], which will help technical partners of ASSISTANCE understand how critical and important each requirement is from the point of view of the end-users. The scale established by the consortium is the following.

- All requirements with a score between 5 and 4 have been prioritised as MUST.
- All requirements with a score between 4 and 3 have been prioritised as SHOULD.
- All requirements with a score between 3 and 2 have been prioritised as COULD.
- All requirements with a score between 2 and 1 have been prioritised as WOULD.

This priority levels -obtained through questionnaires directly from the First Responders- will be the ones taken as reference for next steps of the design and development of the ASSISTANCE components -e.g. design of the Architecture in D2.4- since the feedback provided by end-users is considered as key for the success of the project and the usefulness of the solutions developed.

4.3 Questionnaire results

The consortium has received 24 completed questionnaires, 13 of them from project end-users and academia and 11 from external end-users (mainly EU Fire and Rescue Services and Emergency Services). Therefore, a considerable set of relevant opinions have been gathered through this process, making the requirements -and the tools and services to be developed in posterior work packages- more applicable to the rest of the EU First Responders in order to increase their safety when managing emergency situations.

The results of the questionnaire are presented in the following tables and graphs, structured in 15 categories. 14 categories as initially defined for the respective 14 tools of ASSISTANCE (see section 2.1) and one initial subchapter for the organisation details of the end-users that have participated.

4.3.0 Organisation details

The answers regarding the details of the people that have participated in the questionnaire are shown below.

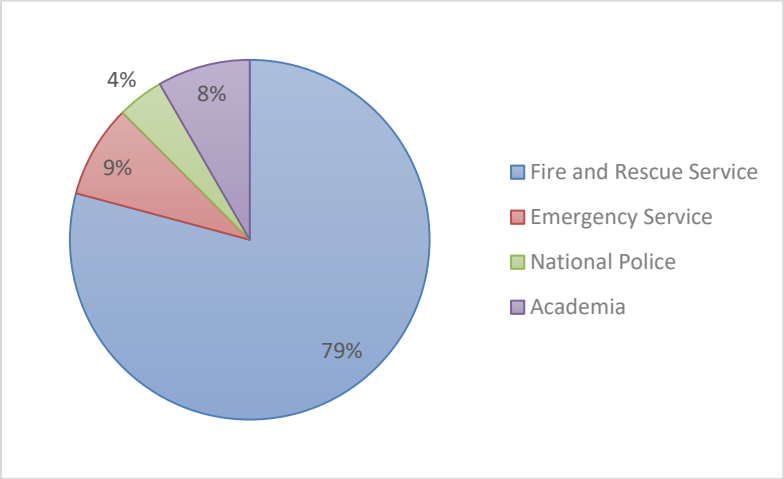


Figure 2 – Type of organisations among the end-users surveyed

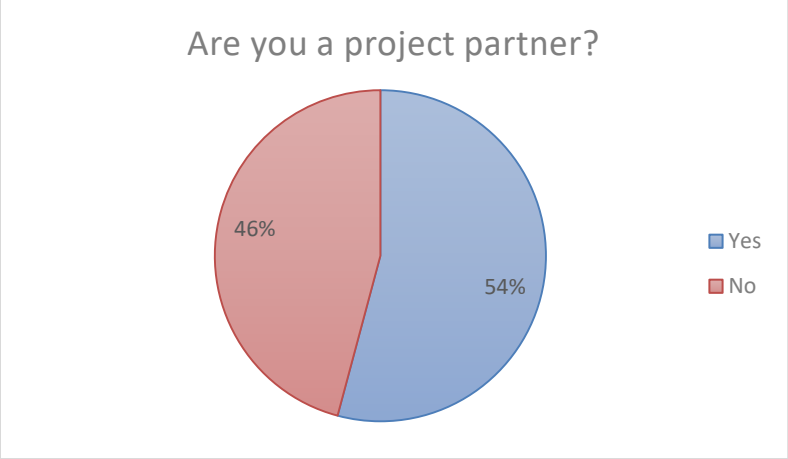


Figure 3 – Share between internal and external end-users surveyed

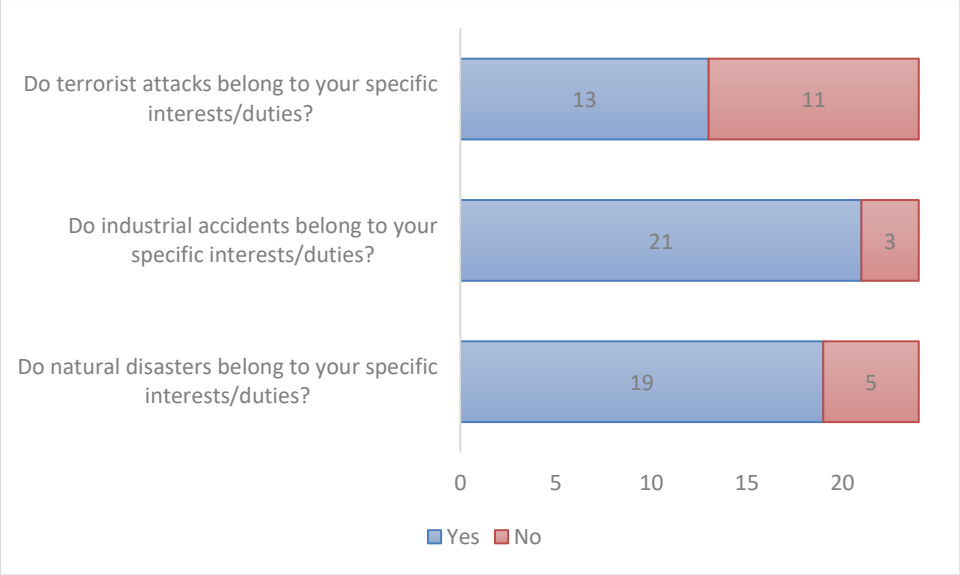


Figure 4 – Fields of competences of the end-users surveyed

4.3.1 ASSISTANCE Project Requirements

All the ASSISTANCE general project requirements are scored between 3 and 5, which means they are considered as critical and serious requirements by the end-users and should be prioritised as Must and Should, according to the MoSCoW methodology.

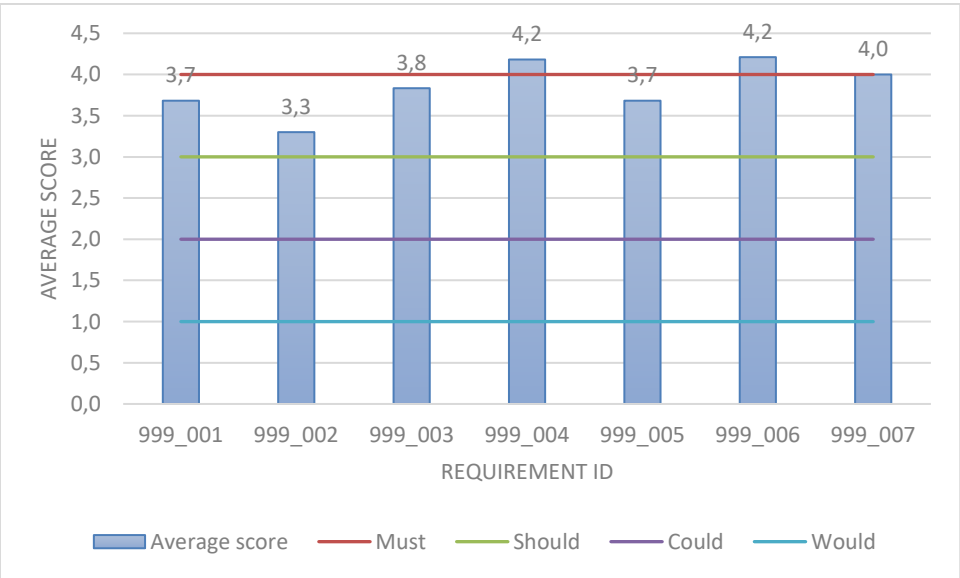


Figure 5 – ASSISTANCE Project Requirements average score

Requirement ID	Average score[2]	Priority	NS/NO[3]	Fire & Rescue[4]	Emergency[5]	National Police[6]	Internal[7]	External[8]
999_001	3,7	S	2	3,6	4,5	2,0	3,6	3,8
999_002	3,3	S	4	3,1	5,0	2,0	3,2	3,5
999_003	3,8	S	0	3,9	3,5	3,0	3,6	4,1
999_004	4,2	M	2	4,3	4,0	3,0	4,1	4,3
999_005	3,7	S	2	3,7	3,5	4,0	3,7	3,7
999_006	4,2	M	5	4,1	4,5	5,0	4,3	4,1
999_007	4,0	M	3	4,0	4,0	5,0	4,1	3,9

Table 17 – ASSISTANCE Project Requirements average score and priority

4.3.2 Legal and Ethical Requirements

Legal and Ethical requirements have been mostly ranked as serious and important requirements by the First Responders.

Figure 6 – Legal and Ethical Requirements average score

Requirement ID	Average score	Priority	NS/NO	Fire & Rescue	Emergency	National Police	Internal	External
LEG_001	3,0	S	4	2,8	3,0	5,0	3,0	3,0
LEG_002	3,3	S	6	2,9	4,5	5,0	3,4	3,2
LEG_003	2,8	C	4	2,4	4,0	5,0	2,8	2,9
LEG_004	2,8	C	4	2,7	2,5	5,0	2,8	2,8
LEG_005	3,2	S	3	3,1	3,0	5,0	3,2	3,2
LEG_006	3,2	S	4	3,0	3,0	5,0	3,1	3,3
LEG_007	3,5	S	4	3,3	3,5	5,0	3,5	3,5
LEG_008	3,5	S	5	3,4	3,0	5,0	3,5	3,6
LEG_009	3,5	S	3	3,3	3,5	5,0	3,6	3,3
LEG_010	2,9	C	4	2,8	3,0	5,0	2,8	3,0
LEG_011	2,9	C	7	2,7	3,0	5,0	2,9	2,9

[2] Average score of the 24 questionnaires collected
[3] Not Sure / No Opinion
[4] Score of the Fire and Rescue Services
[5] Score of the Emergency Services
[6] Score of the National Police
[7] Score of internal end-users
[8] Score of external end-users

Table 18 – Legal and Ethical Requirements average score and priority

4.3.3 Robots Requirements

The Robots requirements have been mostly ranked between 3.0 an 4.5, so considered as Must and Should priorities.

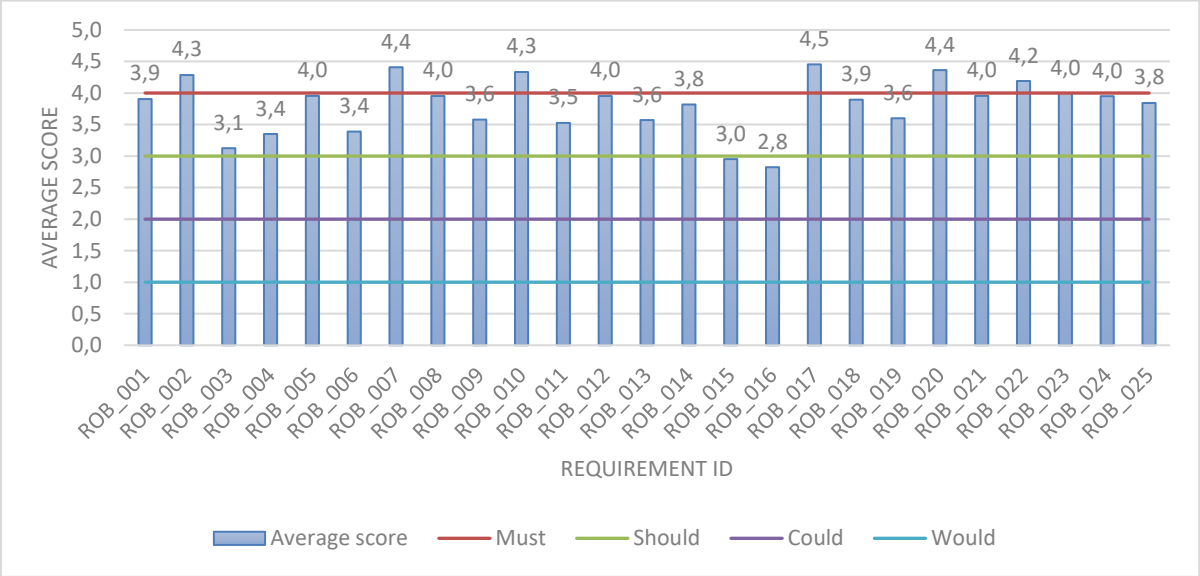


Figure 7 – Robots Requirements average score

Requirement ID	Average score	Priority	NS/NO	Fire & Rescue	Emergency	National Police	Internal	External
ROB_001	3,9	S	3	3,9	3,5	4,0	3,7	4,2
ROB_002	4,3	M	3	4,3	4,0	4,0	4,1	4,6
ROB_003	3,1	S	8	3,2	3,0	2,0	2,9	3,4
ROB_004	3,4	S	4	3,2	3,0	5,0	3,1	3,7
ROB_005	4,0	S	2	3,9	3,5	5,0	3,9	4,0
ROB_006	3,4	S	6	3,3	3,0	5,0	3,2	3,6
ROB_007	4,4	M	2	4,4	3,5	5,0	4,3	4,6
ROB_008	4,0	S	3	3,9	3,0	5,0	3,8	4,2
ROB_009	3,6	S	5	3,3	5,0	5,0	3,4	3,9
ROB_010	4,3	M	3	4,2	5,0	5,0	4,1	4,7
ROB_011	3,5	S	5	3,7	3,0	1,0	3,5	3,6
ROB_012	4,0	S	3	3,9	4,0	5,0	4,2	3,7
ROB_013	3,6	S	3	3,6	4,5	2,0	3,4	3,8
ROB_014	3,8	S	2	3,8	4,0	5,0	3,6	4,1
ROB_015	3,0	C	3	3,1	3,0	2,0	2,8	3,2
ROB_016	2,8	C	7	2,9	3,0	2,0	2,7	3,0
ROB_017	4,5	M	2	4,5	3,5	5,0	4,5	4,3
ROB_018	3,9	S	5	3,8	4,0	5,0	3,9	3,9
ROB_019	3,6	S	4	3,4	4,5	5,0	3,5	3,8
ROB_020	4,4	M	2	4,3	4,5	5,0	4,5	4,2
ROB_021	4,0	S	2	4,0	3,0	5,0	4,0	3,9
ROB_022	4,2	M	3	4,1	4,0	5,0	4,3	4,1
ROB_023	4,0	M	3	3,9	4,0	5,0	3,8	4,3
ROB_024	4,0	S	4	3,9	4,0	5,0	4,1	3,8
ROB_025	3,8	S	5	3,8	4,0	5,0	4,2	3,4

Table 19 – Robots Requirements average score and priority

4.3.4 UAV Requirements

UAV requirements have been ranked quite high by the end-users. All of them have achieved average scores of Critical and Serious requirements.

The high level of Not Sure/No Opinion answers in the last 7 requirements is due to the fact that they were incorporated in the survey after it was released and spread among the end-users, so only some of them -the ones that answered it after the introduction of those requirements- were able to validate and evaluate them. In addition, the 2 last requirements UAV_025 and UAV_026 were introduced once the validation process was over, so they could not be introduced in the validation questionnaire.

However, taking advantage of the Rome Consortium Meeting celebrated 1 week before the submission of this deliverable, those 9 requirements were introduced to the whole consortium and they were validated -both by the technical partners and the project end-users- and considered as very important and relevant to provide all the functionalities needed to cover the scenarios and use cases defined in D2.3.

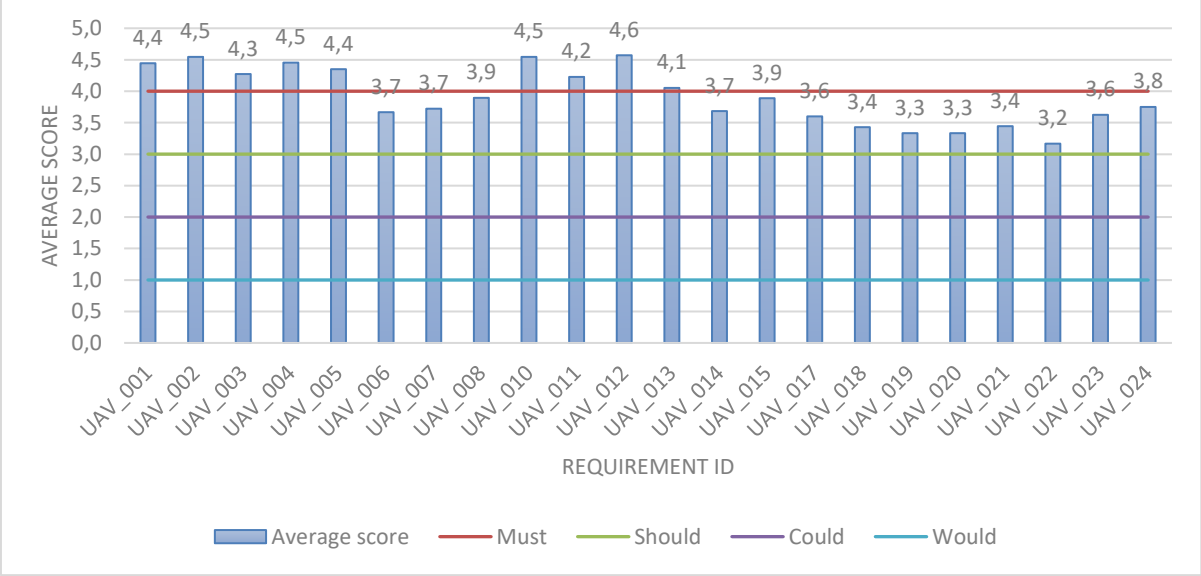


Figure 8 – UAVs Requirements average score

Requirement ID	Average score	Priority	NS/NO	Fire & Rescue	Emergency	National Police	Internal	External
UAV_001	4,4	M	6	4,4	5,0	5,0	4,5	4,4
UAV_002	4,5	M	2	4,6	4,0	5,0	4,5	4,6
UAV_003	4,3	M	2	4,2	4,5	5,0	4,2	4,4
UAV_004	4,5	M	2	4,3	5,0	5,0	4,6	4,3
UAV_005	4,4	M	4	4,3	4,5	5,0	4,3	4,4
UAV_006	3,7	S	3	3,7	3,0	5,0	3,7	3,7
UAV_007	3,7	S	6	3,7	3,5	5,0	3,5	4,0
UAV_008	3,9	S	5	3,7	5,0	5,0	4,1	3,6
UAV_010	4,5	M	2	4,5	4,5	5,0	4,6	4,5
UAV_011	4,2	M	2	4,1	4,5	5,0	4,3	4,2
UAV_012	4,6	M	3	4,5	5,0	5,0	4,6	4,5
UAV_013	4,1	M	5	4,0	4,0	5,0	4,3	3,8
UAV_014	3,7	S	5	3,6	3,5	5,0	3,9	3,4
UAV_015	3,9	S	6	3,7	4,5	5,0	4,0	3,7
UAV_017	3,6	S	4	3,5	3,5	5,0	3,7	3,4
UAV_018	3,4	S	17	3,2	4,0	4,0	3,6	3,0

UAV_019	3,3	S	18	3,3	3,0	4,0	3,3	3,5
UAV_020	3,3	S	18	2,8	4,0	5,0	3,5	3,0
UAV_021	3,4	S	15	3,4	2,0	5,0	3,4	3,5
UAV_022	3,2	S	18	3,0	-	4,0	3,0	3,3
UAV_023	3,6	S	16	3,4	-	5,0	4,0	3,3
UAV_024	3,8	S	16	3,7	3,0	5,0	3,8	3,7

Table 20 – UAVs Requirements average score and priority

4.3.5 Wearable Sensors

Wearable Sensors requirements have very similar scores, since the definitions of these 4 requirements are quite similar themselves. All of them have been considered as Critical requirements by the First Responders.

Regarding requirement WEA_005, it was included at a final phase of the requirements definition process, due to a direct need of one of the project end-users that was not contemplated previously. Because of that, it could not be included in the validation questionnaires. However, taking advantage of the Rome Consortium Meeting celebrated 1 week before the submission of this deliverable, the requirement WEA_005 was introduced to the whole consortium and it was validated -both by the technical partners and the project end-users- and considered as very important and relevant in the ASSISTANCE system.

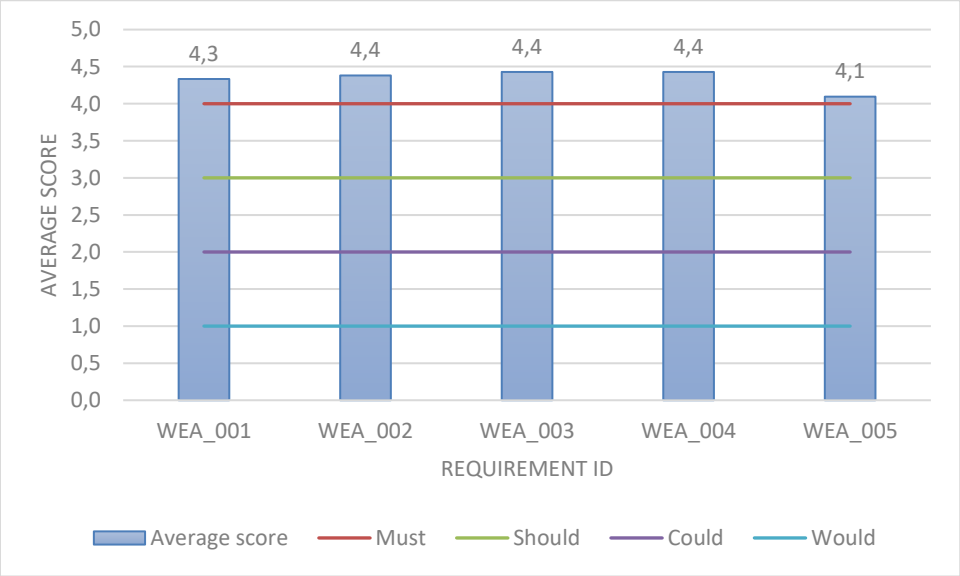


Figure 9 – Wearable Sensors average score

Requirement ID	Average score	Priority	NS/NO	Fire & Rescue	Emergency	National Police	Internal	External
WEA_001	4,3	M	3	4,3	4,0	5,0	4,3	4,4
WEA_002	4,4	M	3	4,2	5,0	5,0	4,3	4,4
WEA_003	4,4	M	3	4,4	4,5	5,0	4,4	4,4
WEA_004	4,4	M	3	4,3	5,0	5,0	4,5	4,3

Table 21 – Wearable Sensors average score and priority

4.3.6 CBRN Hazard Evolution

Half of the CBRN Hazard Evolution requirements have been ranked as Critical (M), while the other half have been ranked as Serious (S), showing a quite high level of importance given by the end-users to this set of requirements.

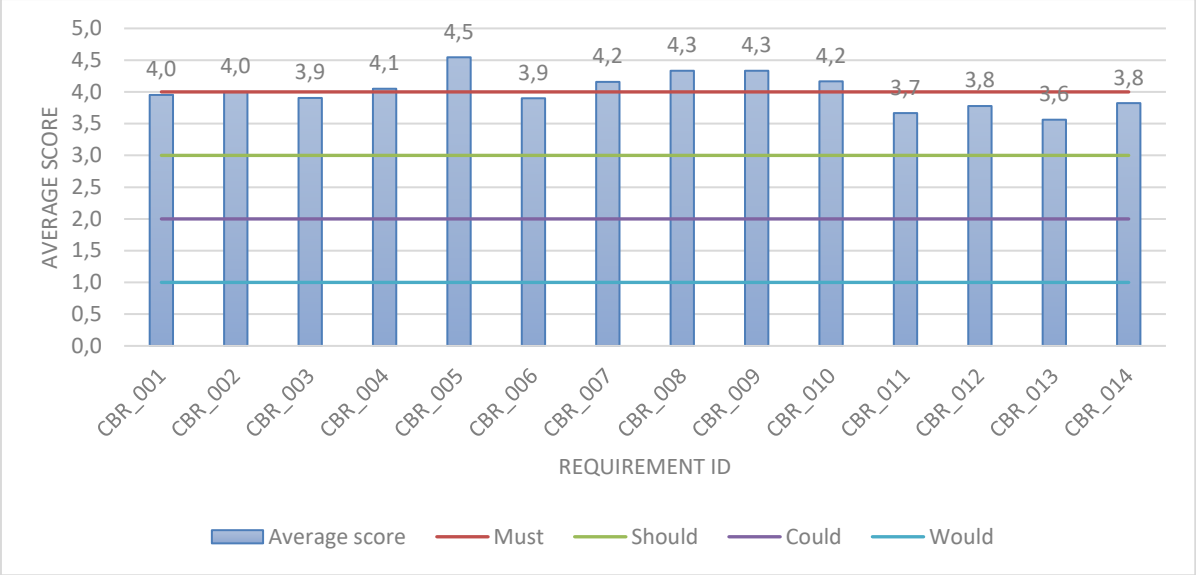


Figure 10 – CBRN Hazard Evolution average score

Requirement ID	Average score	Priority	NS/NO	Fire & Rescue	Emergency	National Police	Internal	External
CBR_001	4,0	S	3	3,9	4,0	5,0	3,9	4,0
CBR_002	4,0	M	2	3,9	4,0	5,0	4,0	4,0
CBR_003	3,9	S	3	3,8	4,0	5,0	3,9	3,9
CBR_004	4,1	M	4	3,9	5,0	5,0	3,7	4,4
CBR_005	4,5	M	2	4,5	4,5	5,0	4,5	4,6
CBR_006	3,9	S	4	3,9	4,0	5,0	3,9	3,9
CBR_007	4,2	M	5	4,3	3,5	3,0	3,9	4,4
CBR_008	4,3	M	6	4,3	4,5	5,0	4,2	4,4
CBR_009	4,3	M	6	4,2	5,0	5,0	4,3	4,3
CBR_010	4,2	M	6	4,0	5,0	5,0	4,0	4,3
CBR_011	3,7	S	6	3,5	4,0	5,0	3,6	3,8
CBR_012	3,8	S	6	3,7	4,0	5,0	3,6	4,0
CBR_013	3,6	S	8	3,5	3,0	5,0	3,4	3,7
CBR_014	3,8	S	7	3,7	4,0	5,0	4,0	3,7

Table 22 – CBRN Hazard Evolution average score and priority

4.3.7 Sensors and Meteorological Data Integration

Regarding Sensors and Meteorological Data, the two only requirements defined for that component have been considered as Critical by the First Responders.

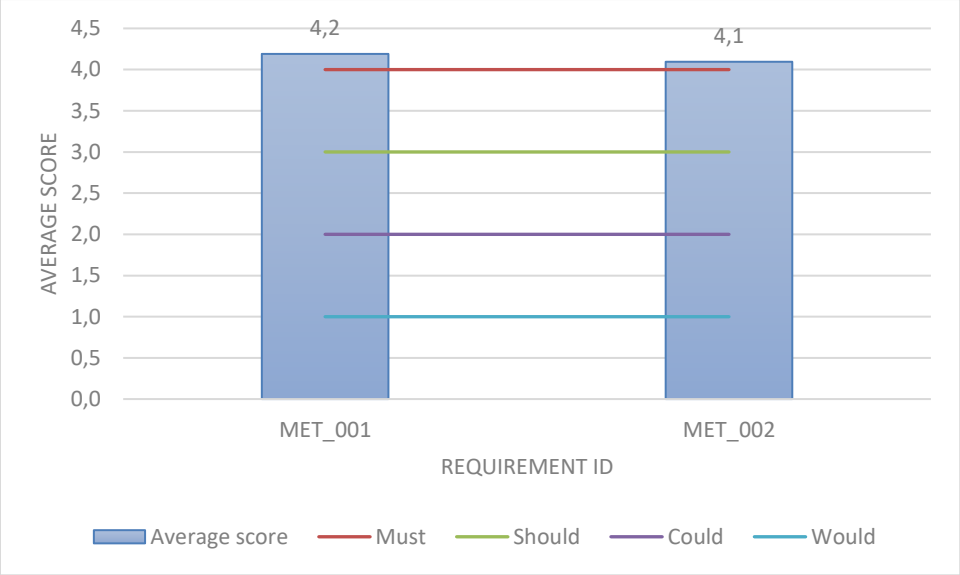


Figure 11 – Sensors and Meteorological Data Integration average score

Requirement ID	Average score	Priority	NS/NO	Fire & Rescue	Emergency	National Police	Internal	External
MET_001	4,2	M	3	4,1	5,0	5,0	4,2	4,2
MET_002	4,1	M	3	3,9	5,0	5,0	4,0	4,2

Table 23 – Sensors and Meteorological Data Integration average score and priority

4.3.8 Communication Requirements

Most of the Communication requirements have an average score of around 4, close to the Must threshold. The high level of Not Sure answers is probably caused by the fact that the requirements for Communication were very technical and not so easy to understand from an end-user point of view.

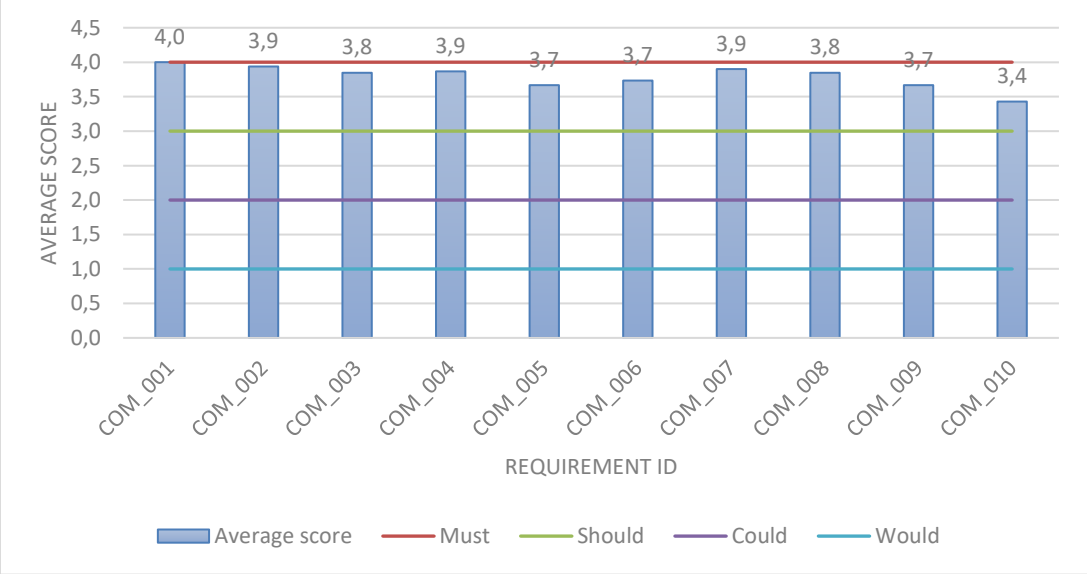


Figure 12 – Communication Requirements average score

Requirement ID	Average score	Priority	NS/NO	Fire & Rescue	Emergency	National Police	Internal	External
COM_001	4,0	M	10	4,0	3,0	5,0	3,9	4,3
COM_002	3,9	S	8	3,9	3,5	5,0	3,9	4,0
COM_003	3,8	S	11	4,0	2,5	5,0	3,7	4,3

COM_004	3,9	S	9	3,8	3,0	5,0	3,9	3,8
COM_005	3,7	S	9	3,6	3,5	5,0	3,7	3,5
COM_006	3,7	S	9	3,8	3,0	5,0	3,8	3,6
COM_007	3,9	S	14	3,9	3,0	5,0	3,6	4,7
COM_008	3,8	S	11	3,8	3,0	5,0	3,7	4,3
COM_009	3,7	S	12	3,6	3,0	5,0	3,8	3,5
COM_010	3,4	S	10	3,3	3,5	5,0	3,2	4,0

Table 24 – Communication Requirements average score and priority

4.3.9 Security Requirements

The three Security requirements defined have been considered as Serious requirements by the end-users (score between 3 and 4). As in the previous set of requirements, the high level of Not Sure answerws may be related to the fact that the requirements were defined in a very technical manner, and were not so easily understood for the First Responders perspective.

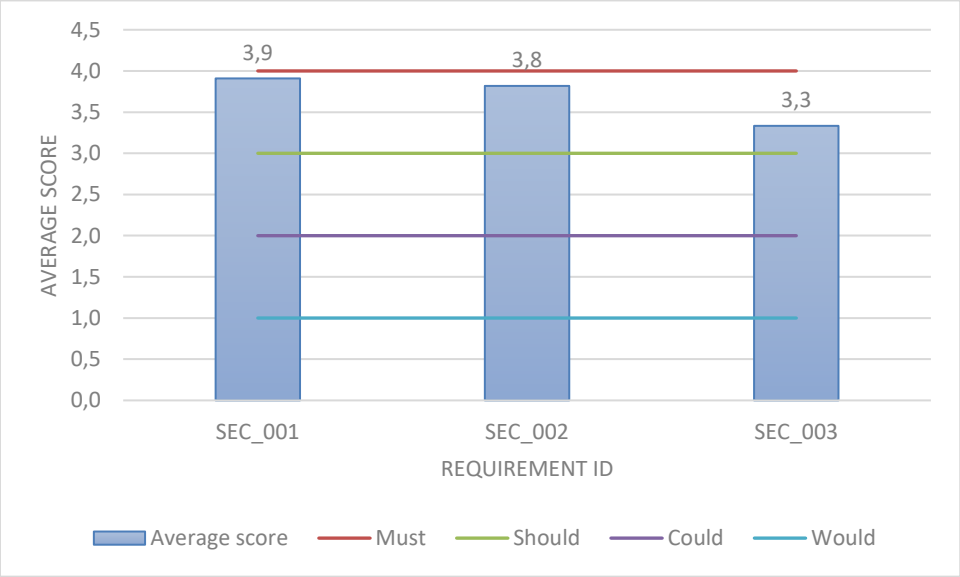


Figure 13 – Security Requirements average score

Requirement ID	Average score	Priority	NS/NO	Fire & Rescue	Emergency	National Police	Internal	External
SEC_001	3,9	S	13	3,9	3,5	5,0	3,6	4,7
SEC_002	3,8	S	13	3,8	3,5	5,0	3,6	4,3
SEC_003	3,3	S	12	3,1	3,5	5,0	3,3	3,3

Table 25 – Security Requirements average score and priority

4.3.10 Sensor Abstraction Service

All the Sensor Abstraction Service requirements have been ranked around the Must threshold, with scores between 3.7 and 4.2.

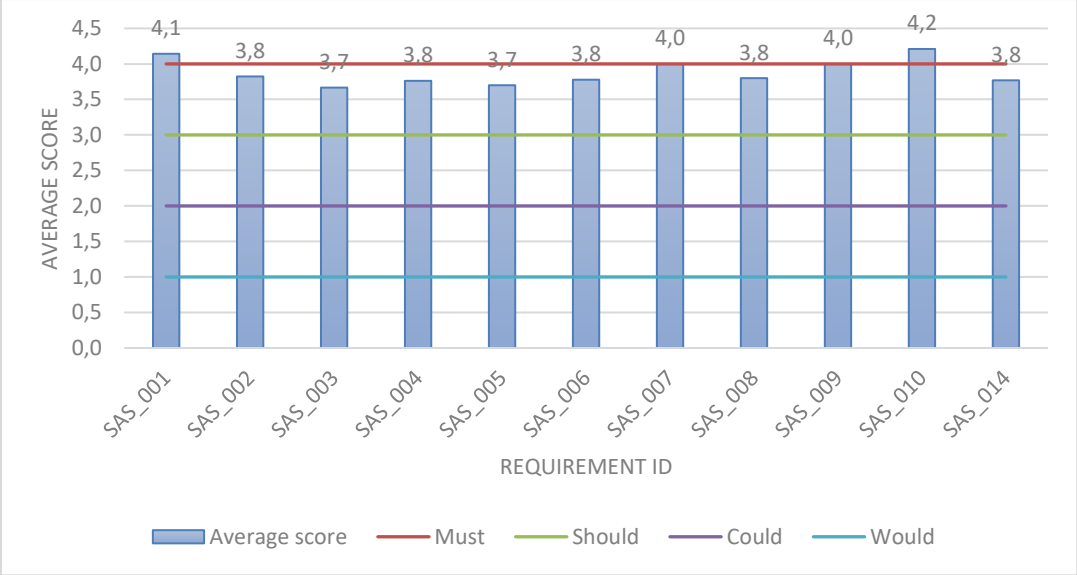


Figure 14 – Sensor Abstraction Service average score

Requirement ID	Average score	Priority	NS/NO	Fire & Rescue	Emergency	National Police	Internal	External
SAS_001	4,1	M	3	4,1	3,5	5,0	4,2	4,1
SAS_002	3,8	S	7	3,9	3,0	5,0	3,5	4,3
SAS_003	3,7	S	6	3,6	3,0	5,0	3,6	3,8
SAS_004	3,8	S	3	3,7	3,0	5,0	3,9	3,6
SAS_005	3,7	S	4	3,8	3,0	5,0	3,7	3,8
SAS_006	3,8	S	6	3,8	3,0	5,0	3,7	3,9
SAS_007	4,0	M	4	3,9	4,0	5,0	4,1	3,9
SAS_008	3,8	S	4	3,7	4,0	5,0	3,8	3,9
SAS_009	4,0	M	3	3,9	4,0	5,0	3,9	4,1
SAS_010	4,2	M	5	4,2	4,0	5,0	4,1	4,3
SAS_014	3,8	S	11	3,6	4,0	5,0	3,8	3,8

Table 26 – Sensor Abstraction Service average score and priority

4.3.11 Mission Planner and Management

Most Mission Planner requirements are ranked as Serious, although MIS_007 has reached the Critical level.

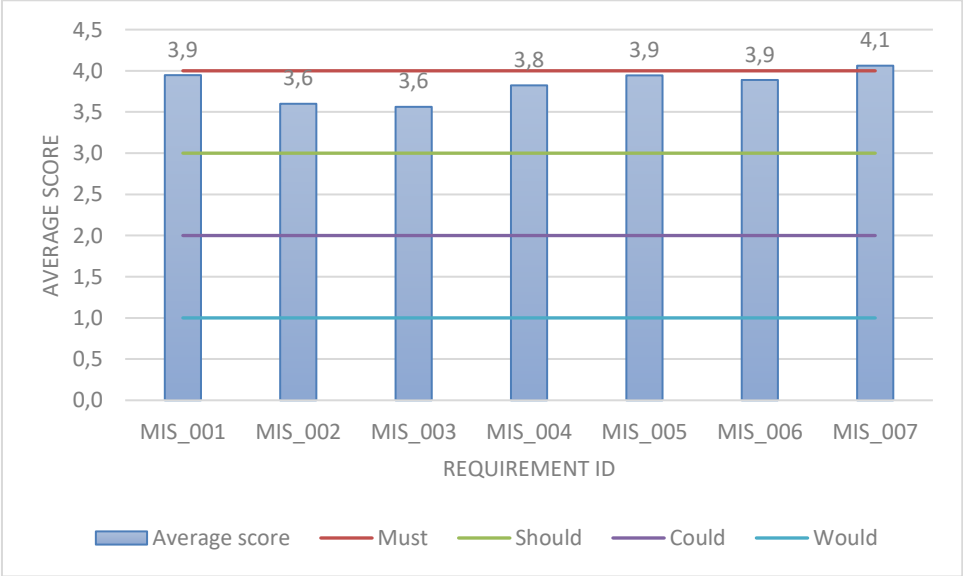


Figure 15 – Mission Planner and Management average score

Requirement ID	Average score	Priority	NS/NO	Fire & Rescue	Emergency	National Police	Internal	External
MIS_001	3,9	S	5	3,8	4,5	5,0	3,9	4,0
MIS_002	3,6	S	9	3,5	3,5	5,0	3,4	3,8
MIS_003	3,6	S	8	3,5	3,5	5,0	3,3	4,0
MIS_004	3,8	S	7	3,8	3,5	5,0	3,6	4,1
MIS_005	3,9	S	6	3,9	3,5	5,0	3,9	4,0
MIS_006	3,9	S	6	3,9	3,5	5,0	3,6	4,3
MIS_007	4,1	M	8	4,0	4,0	5,0	4,0	4,1

Table 27 – Mission Planner and Management average score and priority

4.3.12 Damaged Assets Location and Routing

Half of the requirements defined for the Damaged Assets Location and Routing component have been classified as Critical, while the other half are considered as Serious requirements.

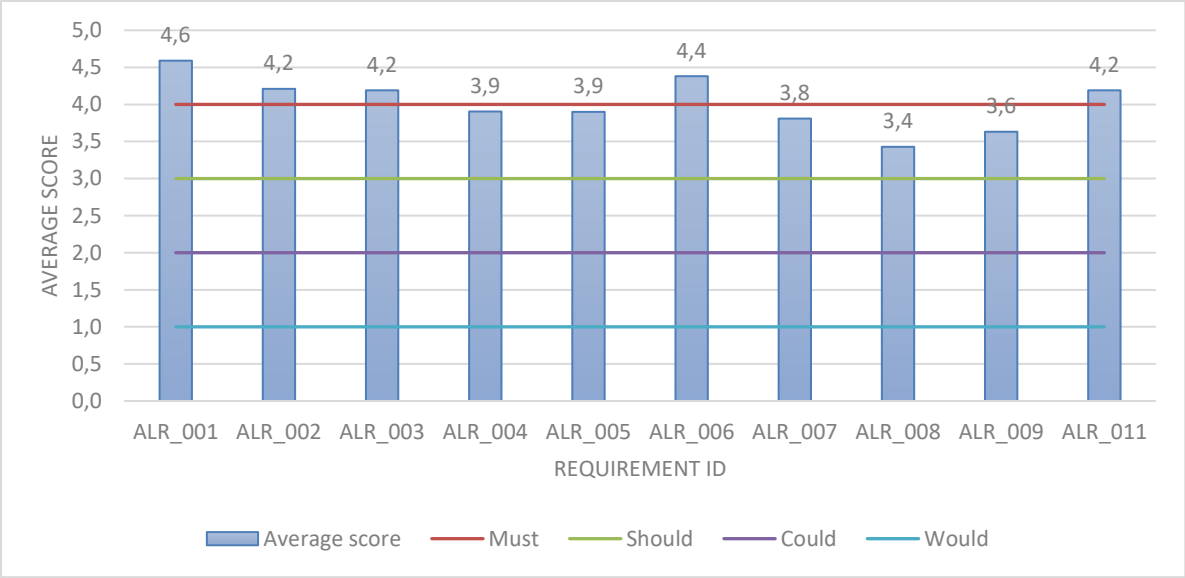


Figure 16 – Damaged Assets Location and Routing average score

Requirement ID	Average score	Priority	NS/NO	Fire & Rescue	Emergency	National Police	Internal	External
ALR_001	4,6	M	2	4,5	4,5	5,0	4,7	4,4
ALR_002	4,2	M	5	4,1	5,0	5,0	4,2	4,3
ALR_003	4,2	M	3	4,2	4,5	5,0	3,9	4,6
ALR_004	3,9	S	3	3,8	4,5	5,0	3,7	4,2
ALR_005	3,9	S	4	3,8	4,5	5,0	3,7	4,3
ALR_006	4,4	M	3	4,3	4,5	5,0	4,3	4,4
ALR_007	3,8	S	3	3,7	3,5	5,0	3,8	3,9
ALR_008	3,4	S	3	3,2	3,5	5,0	3,4	3,4
ALR_009	3,6	S	5	3,6	3,5	5,0	3,5	3,9
ALR_011	4,2	M	3	4,1	4,0	5,0	4,3	4,1

Table 28 – Damaged Assets Location and Routing average score and priority

4.3.13 Adapted Situational Awareness Tools Requirements

The extense list of requirements for the Adapted Situational Awareness Tools present a variety of scores. Most of them are inside the Should threshold (between 3 and 4), while only 3 have reached the Must score (above 4).

Figure 17 – Adapted Situational Awareness Tools Requirements average score

Requirement ID	Average score	Priority	NS/NO	Fire & Rescue	Emergency	National Police	Internal	External
SA_001	3,9	S	4	3,6	5,0	5,0	4,0	3,6
SA_002	3,8	S	3	3,6	4,0	5,0	3,8	3,8
SA_003	3,1	S	7	3,1	3,0	3,0	2,7	3,7
SA_004	3,9	S	3	3,8	3,5	5,0	4,3	3,3
SA_005	3,9	S	5	3,9	4,0	5,0	4,0	3,9
SA_006	4,2	M	4	4,2	4,0	5,0	4,3	4,1
SA_007	4,2	M	4	4,0	4,5	5,0	4,2	4,1
SA_008	3,7	S	5	3,8	3,0	4,0	3,5	4,0
SA_009	3,8	S	6	3,9	3,0	4,0	3,8	3,8
SA_010	4,2	M	5	4,1	4,5	5,0	4,3	4,0
SA_011	4,0	S	3	3,8	4,0	5,0	4,1	3,8
SA_012	3,6	S	6	3,3	4,0	5,0	3,5	3,7
SA_013	3,7	S	6	3,6	4,0	4,0	3,5	3,9
SA_014	3,7	S	4	3,6	3,5	5,0	3,8	3,6
SA_015	3,9	S	4	3,7	4,5	5,0	4,0	3,8
SA_016	3,8	S	7	3,7	4,0	4,0	3,8	3,7
SA_017	3,7	S	6	3,8	3,0	4,0	3,5	4,1
SA_018	3,8	S	3	3,8	3,5	5,0	3,6	4,0
SA_019	3,7	S	5	3,6	3,5	4,0	3,8	3,6
SA_020	3,6	S	6	3,5	3,5	5,0	3,5	3,7
SA_021	3,7	S	4	3,7	3,0	5,0	3,7	3,6
SA_022	3,5	S	6	3,4	3,5	5,0	3,5	3,6
SA_023	3,5	S	8	3,4	4,0	4,0	3,3	3,8
SA_024	3,3	S	4	3,1	4,0	5,0	3,3	3,3
SA_025	3,6	S	7	3,6	3,0	5,0	3,7	3,5
SA_026	3,8	S	3	3,6	3,5	5,0	4,1	3,3
SA_028	3,7	S	5	3,6	4,0	5,0	3,5	4,1

Table 29 – Adapted Situational Awareness Tools Requirements average score and priority

4.3.14 Training and Virtual Reality Platforms Requirements

Most of the Training and Virtual Reality Platforms requirements present scores close to the Must threshold, going from 3.5 to 4.4. The considerable low level of Not Sure/No Opinion answers collected may be related to the fact that the requirements of training and virtual platforms were of high interest for the end-users and that they were very clearly defined.

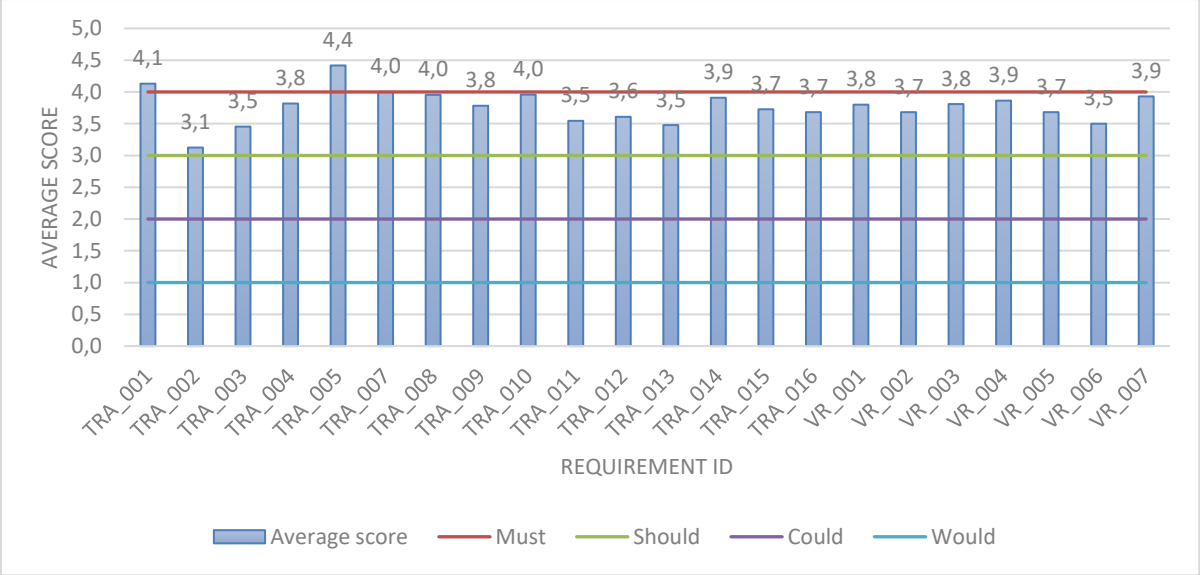


Figure 18 – Training and Virtual Reality Platforms Requirements average score

Requirement ID	Average score	Priority	NS/NO	Fire & Rescue	Emergency	National Police	Internal	External
TRA_001	4,1	M	1	4,1	3,5	4,0	4,1	4,2
TRA_002	3,1	S	0	3,2	3,5	2,0	2,9	3,4
TRA_003	3,5	S	2	3,5	4,0	4,0	3,2	3,9
TRA_004	3,8	S	2	3,8	3,5	4,0	3,7	4,0
TRA_005	4,4	M	0	4,4	3,5	5,0	4,5	4,3
TRA_007	4,0	M	0	3,9	3,5	5,0	4,2	3,7
TRA_008	4,0	S	2	4,1	3,5	2,0	3,8	4,2
TRA_009	3,8	S	1	3,9	4,0	3,0	3,5	4,1
TRA_010	4,0	S	0	4,0	4,5	3,0	4,0	3,9
TRA_011	3,5	S	2	3,4	4,5	5,0	3,4	3,8
TRA_012	3,6	S	1	3,6	3,5	4,0	3,8	3,4
TRA_013	3,5	S	1	3,5	3,5	4,0	3,3	3,7
TRA_014	3,9	S	2	3,9	3,5	4,0	3,9	3,9
TRA_015	3,7	S	2	3,8	4,0	4,0	3,6	3,9
TRA_016	3,7	S	2	3,6	5,0	3,0	3,8	3,6
VR_001	3,8	S	1	3,8	4,0	3,0	3,8	3,8
VR_002	3,7	S	0	3,8	3,5	4,0	3,6	3,8
VR_003	3,8	S	2	3,9	4,0	4,0	3,8	3,9
VR_004	3,9	S	2	3,9	3,0	4,0	4,0	3,7
VR_005	3,7	S	0	3,7	3,0	4,0	4,0	3,3
VR_006	3,5	S	0	3,5	3,0	4,0	3,5	3,5
VR_007	3,9	S	2	3,8	4,0	4,0	4,1	3,6

Table 30 – Training and Virtual Reality Platforms Requirements average score and priority

4.4 Analysis of the questionnaire results

4.4.1 General results

In total, 22 end-users and 2 academia entities (13 internal and 11 external) have filled in the questionnaires. As shown in Table 31, the average priority scores for the requirements are mostly within the Must (50 requirements) and Should (120 requirements) categories, which shows that the requirements defined are, in general, of high importance and relevance for the end-users.

Priority	Number of requirements
Must	50
Should	120
Could	6
Would	0
TOTAL	176

Table 31 – Requirements general results

4.4.2 Response ratio

The average ratio of responses is 79.2%, defined as the ratio of answers that contain a valid number (from 1 to 5), so discounting the lack of answers and 'Not sure' answers. This ratio is considered acceptable, given the high number of end-users that filled in the questionnaire. However, this response ratio is decreased mainly because of three factors:

- Some requirements were introduced at an advanced phase of the validation process, due to the sudden need of technical partners or project end-users to introduce requirements that were not defined and/or contemplated before. Therefore, those requirements were introduced in the questionnaire after it was already released and only some of the end-users were able to validate them. This has been addressed via the validation of those requirements in the Consortium Plenary meeting celebrated before the submission of this deliverable. This is explained in more detail in the corresponding subchapters 4.3.4 and 4.3.5.
- Two end-users did not complete the whole questionnaire, leaving 30% and 84% of the requirements without answer, which also considerably lowered the average response ratio.
- Some requirements were defined in a very technical way -e.g. security and communication requirements- so they might have been difficult for the end-users to properly understand them, decreasing the number of answers collected.

Category of the requirement	Response ratio
ASSISTANCE Project Requirements	89%
Legal and Ethical Requirements	82%
Robots Requirements	85%
UAV Requirements	67%
Wearable Sensors	88%
CBRN Hazard Evolution	80%
Sensors and Meteorological Data Integration	88%
Communication Requirements	57%
Security Requirements	47%
Sensor Abstraction Service	79%
Mission Planner and Management	71%
Damaged Assets Location and Routing	86%
Adapted Situational Awareness Tools Requirements	79%
Training and Virtual Reality Platforms Requirements	92%
TOTAL	**79%**

Table 32 – Ratio of response of the questionnaire

4.4.3 Comparison between internal and external end-users

The tables shown in section 4.3 show that no big differences arise from comparing the average scores of internal end-users with the ones given by external end-users:

- The sum of all the average scores provided by internal end-users is 664, while it is 682 for the external end-users, only a 3% higher.
- From the whole list of 176 requirements valued, the 42% were ranked higher by internal end-users, while 58% were ranked higher by external end-users.
- Some technical requirements, such as ROB_025, COM_007, COM_010, SEC_001, SEC_002 or SAS_002, show the highest differences between internal and external end-users. This may be caused because the technic details described were not so easily understood by all end-users, implying bigger differences in the answers.

This lack of relevant differences in the answers provided by internal and external end-users might imply that the requirements and posterior tools developed in ASSISTANCE might be more easily scaled among First Responders all over Europe, since they seem to have quite similar concerns and priorities. Moreover, it might show that most of the requirements were understood similarly by external end-users, even when not having the respective background and details on the foreseen ASSISTANCE system and tools.

4.4.4 Comparison between different profiles of First Responders

The comparison between the 3 different types of First Responders -Fire and Rescue Services, Law Enforcement Agencies, and Emergency Services- was not conducted in a thorough manner, since the low number of answers collected from Police (1) and Emergency Services (2) make it more difficult to extract valid and solid conclusions.

However, the results show that the National Police gave the highest average score to the requirements (810), followed by the Emergency Services (660) and the Fire and Rescue Services (659), with quite similar results.

5 Impacts on the ASSISTANCE project

5.1 Impacts on the Reference Scenarios and Use Cases

In parallel with the elaboration of this deliverable, the deliverable D2.3 of ASSISTANCE Reference Scenarios and Pilot Experiments specifications has been prepared.

These two tasks are complementary and have clear dependencies, since the user requirements defined in D2.2 need to be proved and tested in the scenarios and use cases defined in D2.3. In fact, the work done by ASSISTANCE partners in deliverable D2.3 includes the correlation traceability between the objectives defined for each use case and the user requirements defined in D2.2 for the different technologies and solutions.

5.2 Impacts on the ASSISTANCE Architecture

Together with the use cases described in D2.3, the requirements described in the present D2.2 provide a clear and complete vision of the functionality to be covered by the ASSISTANCE project, what in turn will help technical partners identifying the blocks of functionality and generating the design of the architecture of the software. In particular, it will help to define the set of user applications to be developed and the set of services to be offered by the ASSISTANCE backend. Both shall be further elaborated and described in deliverable D2.4 ASSISTANCE System and Network Architecture Design. Furthermore, the validation conducted by the end-users will allow to prioritise and focus the design and development of the different components, tools and functionalities of ASSISTANCE, so they completely satisfy the First Responders' requirements.

5.3 Impacts on technical Work Packages

The requirements described in this deliverable -together with the use cases defined in D2.3- provide a list of functionalities and needs that must be taken into account for the detailed design and posterior development of ASSISTANCE tools, both in terms of end-user applications and in terms of services offered by the ASSISTANCE system.

Technical work packages where the ASSISTANCE solutions will be designed and developed (WP3, WP4, WP5 and WP6) need to do so in accordance with the specifications collected in this deliverable, in order to ensure that they properly and effectively satisfy all end-users' requirements. Moreover, those work packages will, of course, give more detailed descriptions and designs of the final tools to be developed and integrated in ASSISTANCE.

5.4 Impacts on testing

The requirements specified for each ASSISTANCE component -together with the KPIs defined in D2.3- shall be the basis for the validation of its quality during the testing activities that shall take place as part of WP7 and concretely in task T7.4 Data Analysis, Economical and Usability Evaluation, providing the success criteria for many of the tests.

6 Conclusion

In parallel will the development of task T2.3 and its related D2.3 ASSISTANCE Reference Scenarios and Pilot Experiments specifications, task T2.2 has made an important effort in producing a large set of requirements that specify the characteristics and functionalities of the ASSISTANCE system and different components.

In total, 178 requirements have been defined in an iterative and collaborative way by the project partners, covering all the different components that form the ASSISTANCE system. These requirements cover multiple aspects of the ASSISTANCE tools and components, from the purpose of the project to the most detailed functional specification, including context assumptions, performance requisites and, of course, the legal requirements inspired by the national and European regulations.

A suitable methodology, inspired by Volere, has been used for the collaboration between involved partners and the peer-review for assuring the good quality and relevance of the results. This iterative and collaborative definition of requirements has allowed the consortium to reach a robust and complete definition of the components' functionalities and needs. In the iterative process, 3 dependencies, 2 conflicts and 30 objections were detected and resolved by the consortium.

Besides, a questionnaire has been elaborated in order to collect the evaluation and opinion of external and internal end-users. Therefore, the requirements have been ranked according to the level of importance and priority that different First Responders give to them. These priority levels will be used for next steps of the design and development of the different components of ASSISTANCE.

In total, 22 end-users and 2 academia entities (13 internal and 11 external) have filled in the questionnaires. The average priority scores for the requirements are mostly within the Must (50 requirements) and Should (120 requirements) categories, which shows that the requirements defined are, in general, of high importance and relevance for the end-users.

A more detailed analysis of the answers, shown in the tables of section 4.3, has allowed us to conclude that no relevant differences are observed between the answers given by the internal end-users and the external end-users. This might imply that the requirements and posterior tools developed in ASSISTANCE might be more easily scaled among First Responders all over Europe, since they seem to have quite similar concerns and priorities.

The comparison between the 3 different types of First Responders, however, was not conducted in a thorough manner, since the low number of answers collected from Police (1) and Emergency Services (2) make it more difficult to extract valid and solid conclusions.

In summary, the requirements generated have provided a solid base for subsequent activities to be taken in T2.4 and WP3, WP4, WP5 and WP6. The design of the architecture, the detailed specification of applications and services and the definition of validation tests shall take profit of the work described in the present deliverable.

References

[1] “Volere - Requirements Resources,” [Online]. Available: https://www.volere.org/templates/volere-requirements-specification-template/.

[2] J.-M. Mirebeau, “Fast marching methods for curvature penalized shortest path,” 2016.

[3] J. P. Jean-Marie Mirebeau, “Hamilton fast marching, a numerical solver for anisotropic and non-holonomic eikonal PDEs,” 2017.

[4] J. D. Jean-Marie Mirebeau, “Automatic differentiation of non-holonomic fast marching for computing most threatening trajectories under sensor surveillance,” 2017.

[5] J. Nielsen, “Ten Usability Heuristics”.

[6] Business Analyst Learnings, “MoSCoW : Requirements Prioritization Technique,” [Online]. Available: https://businessanalystlearnings.com/ba-techniques/2013/3/5/moscow-technique-requirements-prioritization.

Annex A - Usage of Volere tool

This section explains the usage of the Volere collaboration tool, which was used for the requirements generation within ASSISTANCE.

Volere is a Web application developed by ETRA that is inspired by Volere methodology and aims at facilitating the collaboration between the members of a team in the process of gathering a great number of requirements for the specification of a complex and modular software system.

To work with Volere, a user must be registered and logged in the application with his/her username and password. The tool supports two kinds of user profile: managers, with privileges for managing the project, and users, with rights to participate in the requirements gathering process for the project.

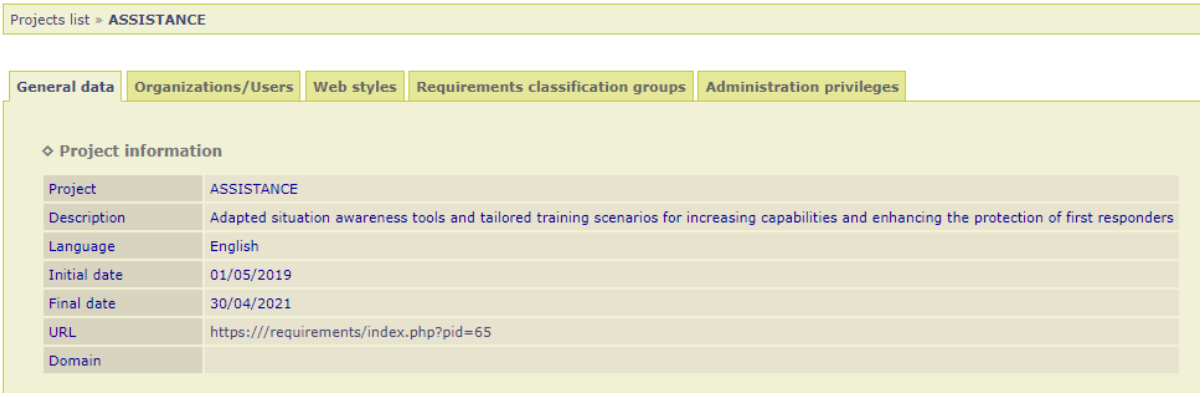


Figure 19 – Volere form for editing the definition of a project in Volere

The first step for the process is the creation of the project, which can only be done by a user with manager profile. The manager has the following privileges:

- Defining projects and their associated data
- Customise the visual aspect of the tools to match the corporate identity of the organisation (in our case, the ASSISTANCE project)
- Creating the categories for the requirements of the project
- Authorising registered users to participate in the requirements gathering process. Volere allows grouping the registered users into organisations and using the organisation as a criterion for filtering the requirements at the time of presenting them.

Figure 20 – Volere form for managing the requirements classification groups of a project

Requirement Definition

After logging into Volere (with username and password), a user authorised to participate in the requirements gathering process can see the main page, listing the requirements created until now by all participants.

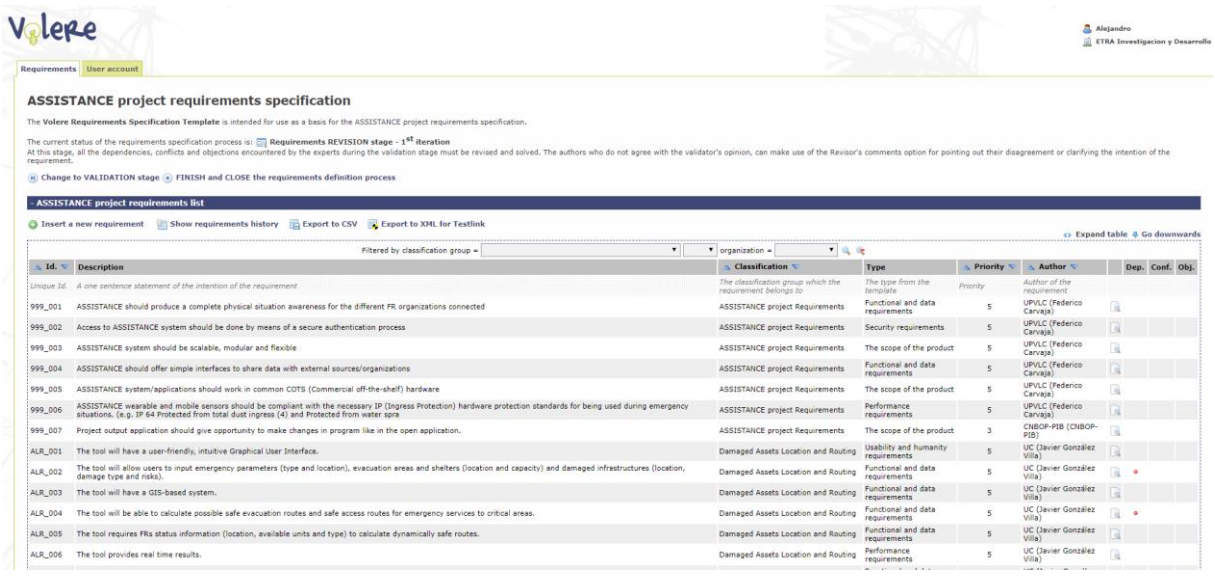


Figure 21 – Requirements overview page

For facilitating the work, the user can apply a **filter** to the list, what allows displaying only the requirements that belong to a particular category and/or were written by users belonging to a particular organisation.

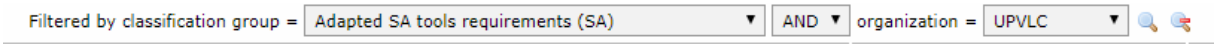


Figure 22 – Requirements filter controls

An authorised user can create new requirements at any time by means of the button "Insert new requirement". This action causes the requirement creation form to be displayed:

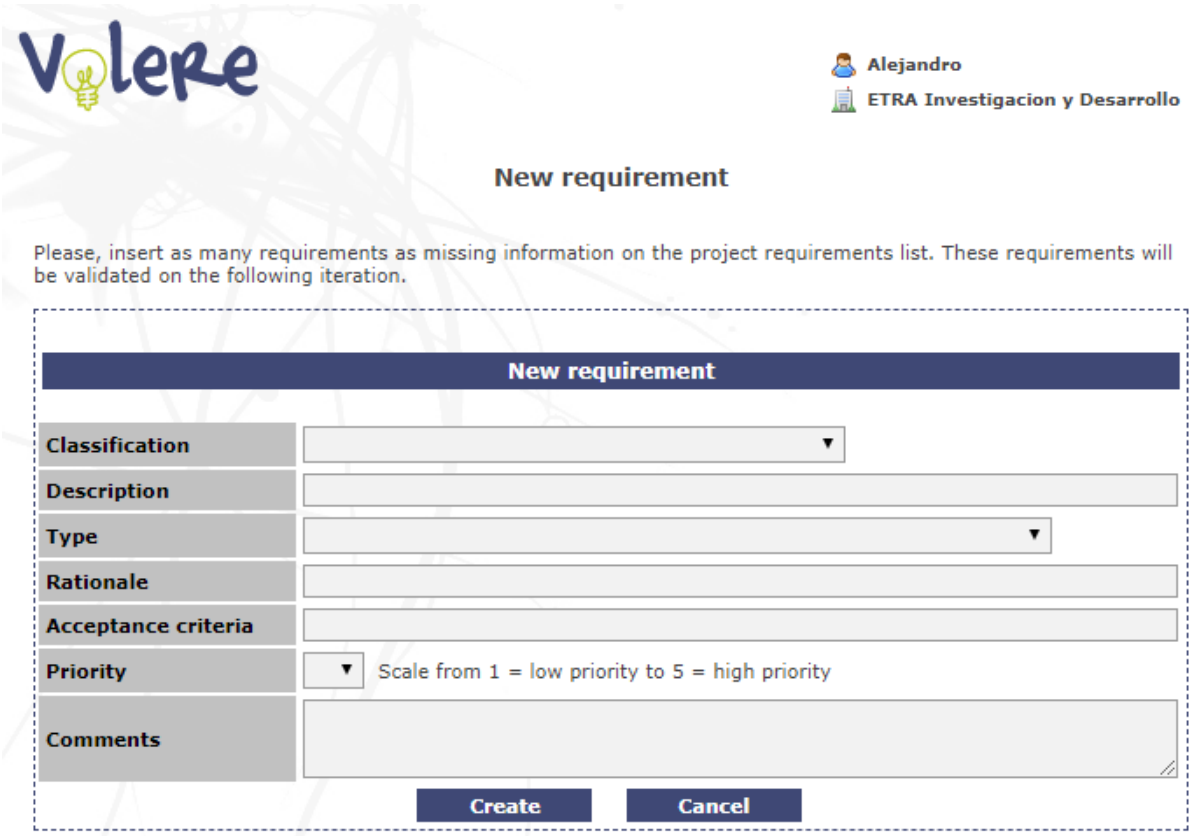


Figure 23 – New Requirement creation form

This form allows entering all the data of the requirement, except the identifier that is automatically generated.

The creation of new requirements can be done at any time. However, the requirements created during a validation stage cannot be validated (no objections, conflicts or dependencies can be created for them) until the validation stage of the following iteration.

Requirement Validation

As mentioned in the previous section, only the author of a requirement can edit it, and the collaborative work by other users consist of taking the role of **validator** of the requirement and generating **objections**, **conflicts** or **dependencies**.

This can only be done during the validation stage. Volere shall not allow it during initial requirements definition stage or revision stages.

Volere tool (except for the initial requirements definition stage) lists the dependencies, conflicts and objections in a table below the requirements table. The table is subdivided into three parts: one for conflicts, another for objections and another for objections. Each sub-table has its own button ( ) for creating a new element.

The forms for providing the data of an objection, a conflict or a dependency are very similar:

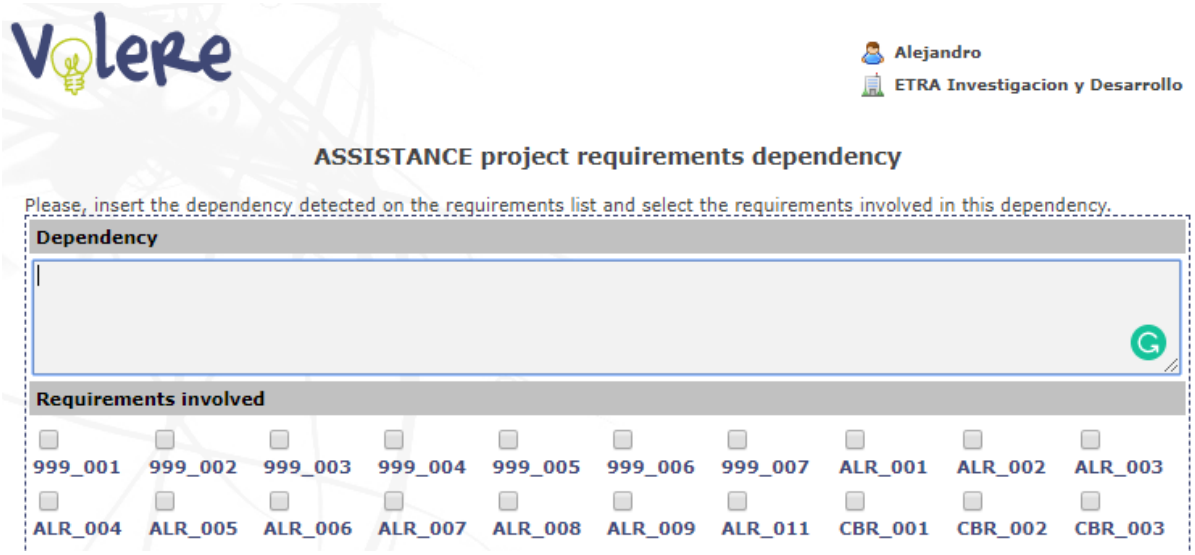
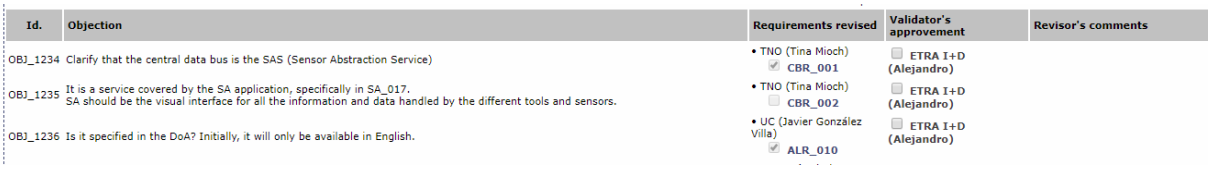


Figure 24 – Objection form

The description of the objection, conflict or dependency must be written in the text field. The affected requirement or requirements (at least two in the case of conflicts or dependencies) must be selected using the checkboxes below. A tooltip displaying the description of the requirement can be displayed by moving the mouse on it.

The same as for requirements only the user that created an objection, conflict or dependency can later edit it or remove it, and only during the same validation stage within which it was created. This can be done by means of the buttons located at the rightmost column of the table.

Once an objection, conflict or dependency has been created, it receives an automatically generated identifier, appears in the corresponding table, and is visible for all users. The rows of the table allow seeing, at a glance, its identifier, its description, the affected requirements (id and author, being possible to display the details by clicking on the identifier).



Id.	Objection	Requirements revised	Validator's approvement	Revisor's comments
OBJ_1234	Clarify that the central data bus is the SAS (Sensor Abstraction Service)	• TNO (Tina Mioch) CBR_001	ETRA I+D (Alejandro)	
OBJ_1235	It is a service covered by the SA application, specifically in SA_017. SA should be the visual interface for all the information and data handled by the different tools and sensors.	• TNO (Tina Mioch) CBR_002	ETRA I+D (Alejandro)	
OBJ_1236	Is it specified in the DoA? Initially, it will only be available in English.	• UC (Javier González Villa) ALR_010	ETRA I+D (Alejandro)	

Figure 25 – Objection list with their corresponding information

In addition to this, for each requirement with at least one unresolved issue (objection, conflict or dependency) a small coloured circle is displayed in the corresponding column of the requirements list. The colour is red for issues of the current iteration or yellow for issues left pending since the previous iteration. Clicking on the circle displays a form listing the issues.

Requirement Revision

The purpose of the revision stage is the resolution of the objections, conflicts or dependencies created in previous validation stage(s). As explained in section 2.1, the resolution implies some interaction

between the author of the requirement and the validator, which is out of the scope of Volere tool, and in the case of ASSISTANCE was generally done by means of emails exchange and, in some specific cases, by phone or conference calls.

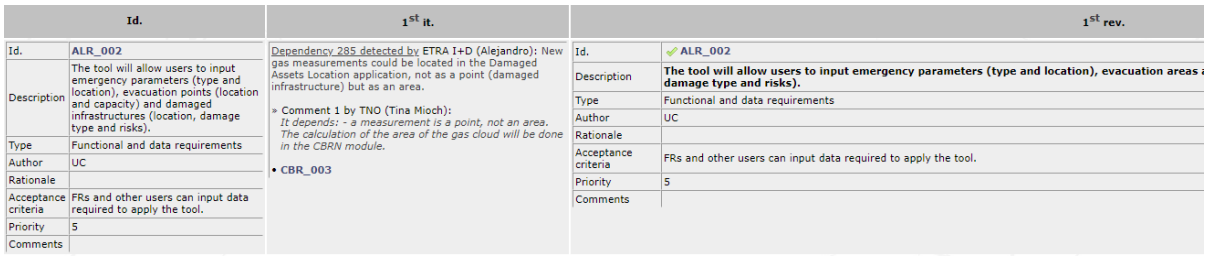
Volere facilitates the identification of the author and validator, and provides a simple, unidirectional communication way making it possible for the author of the requirement to add a comment to the objection, conflict or dependency.

During the revision stage, the table of dependencies, conflicts and objections display **checkboxes** for the management of the two steps of the resolution: one per requirement that the author can use to check that it has been conveniently amended, and another for the validator confirming that he/she approves the amendment and accepts the resolution.

Once a decision has been taken on how to solve an objection, conflict or dependency, the author of the requirement can proceed with the editing of the affected requirement or requirements, in some cases deleting some or creating new ones. When he/she considers that all required changes have been done, he/she clicks the corresponding checkbox. The author can add a comment describing the solution applied.

Later on, the validator that created the objection, conflict or dependency is expected to review the amendment and, in case of agreement, check the corresponding box to confirm his/her approval.

After the first iteration, Volere provides an alternative way of listing the requirements that displays the history of changes for each one, for each of the iterations.



Id.		1st it.	1st rev.	
Id.	ALR_002	Dependency 285 detected by ETRA I+D (Alejandro): New gas measurements could be located in the Damaged Assets Location application, not as a point (damaged infrastructure) but as an area.	Id.	ALR_002
Description	The tool will allow users to input emergency parameters (type and location), evacuation points (location and capacity) and damaged infrastructures (location, damage type and risks).	» Comment 1 by TNO (Tina Mioch): *It depends: - a measurement is a point, not an area. The calculation of the area of the gas cloud will be done in the CBRN module.*	Description	**The tool will allow users to input emergency parameters (type and location), evacuation areas a damage type and risks).**
Type	Functional and data requirements	• CBR_003	Type	Functional and data requirements
Author	UC		Author	UC
Rationale			Rationale	
Acceptance criteria	FRs and other users can input data required to apply the tool.		Acceptance criteria	FRs and other users can input data required to apply the tool.
Priority	5		Priority	5
Comments			Comments	

Figure 26 – Requirements history page in Volere

Annex B – End-users questionnaire

ASSISTANCE Requirements

This questionnaire is part of the User Requirements Gathering, Analysis and Tracking task of the project ASSISTANCE (Adapted Situation Awareness Tools And Tailored Training Scenarios For Increasing Capabilities And Enhancing The Protection Of First Responders), funded by the European Commission under the topic SU-DRS02-2018-2019-2020: Technologies for first responders.
The questionnaire aims at validating and prioritising - by a group of potential end-users - a set of user and technical requirements that have been defined for the project. These requirements will set the guidelines for the design and development of the corresponding ASSISTANCE tools.

Protection of Personal Data and Ethical Procedures

The researchers involved in the project will pre-process the data anonymously and confidentially:
1. All the information collected will be de-identified and treated as confidential by the researchers. Your demographic information will be used only to contextualise the statistical analysis of the aggregate results and not be published or used in any form, rather than the above mentioned statistical analysis;
2. All the data will be securely stored and used only for the purpose of the present research, in accordance with ethical requirements;
3. You can withdraw from the questionnaire at any time, without any obligation to explain the reasons for doing so, until you submit the survey. After you submit the survey, we cannot remove your responses because we will not know which responses came from you.

The overall results generated from this exercise may be published in journal articles, conference presentations, via any other mode of scientific exchange, and dissemination that will be seen as appropriate by the researchers. However, participants' anonymity will always be protected, and all data will be de-identified.
You will no receive any personal benefit for your participation in this survey. Your participation may help us to learn more about First Responders requirements, and we hope this knowledge will benefit others in the future. No risk is foreseen.

Who to contact
For further information about ASSISTANCE project, please visit our website at https://assistance-project.eu/. If you have any questions or concerns at this point or in the future, please feel free to contact:

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Project coordinator contact data
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mesteve@dcom.upv.es
+34 96 387 91 94

ASSISTANCE in a nutshell

The main purpose of ASSISTANCE project is twofold:
- On the one hand to help and protect different kind of first responders' (FR) organizations that work together taking into account the type of disaster/crisis they are mitigating in each moment.
- On the other hand, to enhance their capabilities for facing complex situations providing them advanced training based on Virtual Reality (VR), Mixed Reality (MR) and Augmented Reality (AR), tailored to their real needs depending on the type of incident.

ASSISTANCE project will use novel technologies such as; UAV, Robots, drones' swarms and advanced training based on VR, MR and AR for increasing the FR's situation awareness (SA) taking into account their need in terms of data (e.g. real-time video, persons and objects location, evacuation routes status, ad-hoc network coverage and so on).

Different types of adapted SA modules will be developed inside a common SA framework capable of offering the sensor outcome needed by each FR organization (e.g. real-time video and resources location for firemen, evacuation routes status for emergency health services and so on). Regarding training, an advanced training network based on VR, MR, AR and other novel technologies and methodologies (e.g. tailored curricula, immersive interfaces, adapted training methodology definition, etc.) will be established in order to share different VR platforms and scenarios for enhancing the current training capabilities and skills of different FRs organization.

All the ASSISTANCE results will be tested under controlled conditions in three different demonstration pilots. Solutions will be developed in compliance with EU societal values, fundamental rights and applicable legislation, including in the area of privacy and personal data protection. Societal aspects (e.g. perception of security, possible effects of technological solutions on societal resilience, gender diversity) have to be taken into account in a comprehensive and thorough manner.

Questionnaire methodology

Filling in the questionnaire should not take more than 15 minutes. Please, complete the form selecting the importance of each of the requirements proposed, according to the following scale:

1: Unimportant requirement. With or Without this, the solutions/tools are exactly the same.
2: With requirement: Nice to have, but the solutions/tools will be fully useful even without it.
3: Important requirement: Without this, the solutions/tools will be only partially useful.
4: Serious requirement: Without this, the solutions/tools will be usable but not useful for the end-user.
5: Critical requirement: Without this, the solutions/tools will be of no use at all.

User requirements have been structured in 11 blocks, according to the different tools and solutions that will be developed in ASSISTANCE.

European Commission

Project co-funded by the European Union within the Horizon 2020 Programme

Organisation details (2/13)

1. **Organisation type**
Mark only one oval.

- ◯ Fire and Rescue Service
- ◯ Emergency Service
- ◯ National Police
- ◯ Municipal Police
- ◯ Public body
- ◯ Academia
- ◯ Private security
- ◯ Other: _____

2. **Are you a project partner of ASSISTANCE?**
Mark only one oval.

- ◯ Yes
- ◯ No
- ◯ Other: _____

3. **Do natural disasters belong to your specific interests/duties?**
Mark only one oval.

- ◯ Yes
- ◯ No

4. **Do industrial accidents belong to your specific interests/duties?**
Mark only one oval.

- ◯ Yes
- ◯ No

5. **Do terrorist attacks belong to your specific interests/duties?**
Mark only one oval.

- ◯ Yes
- ◯ No

6. **Please, briefly describe the tasks you perform related to those topics**

_____

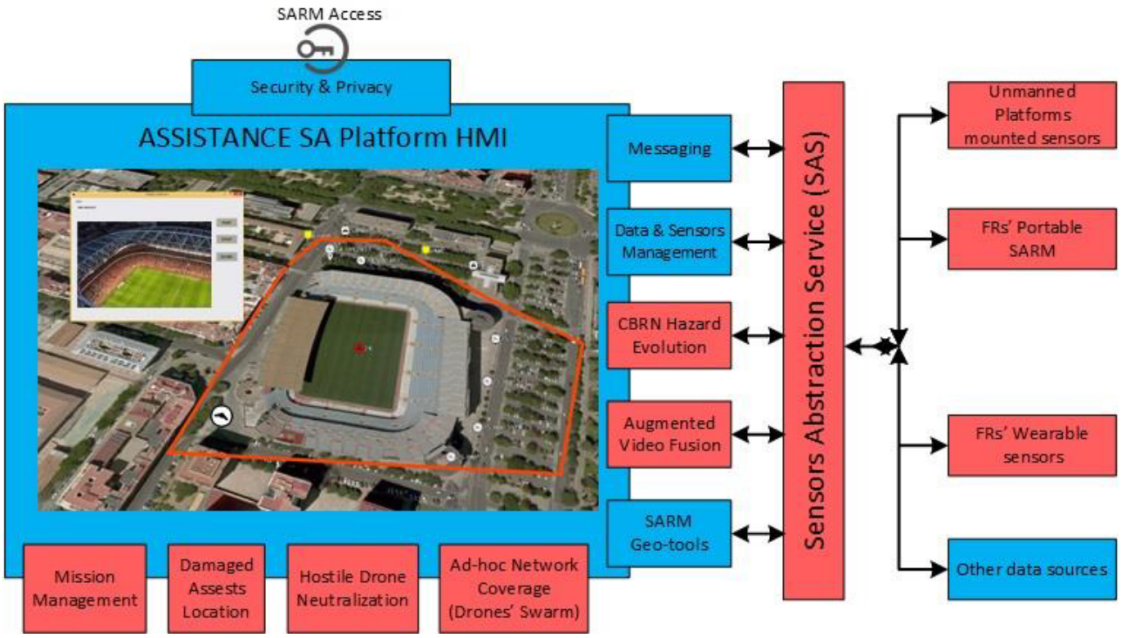
_____

_____

_____

_____

ASSISTANCE General Project Requirements (3/13)


SARM Access
Security & Privacy
ASSISTANCE SA Platform HMI
Messaging
Data & Sensors Management
CBRN Hazard Evolution
Augmented Video Fusion
SARM Geo-tools
Sensors Abstraction Service (SAS)
Unmanned Platforms mounted sensors
FRs' Portable SARM
FRs' Wearable sensors
Other data sources
Mission Management
Damaged Assests Location
Hostile Drone Neutralization
Ad-hoc Network Coverage (Drones' Swarm)

7. **ASSISTANCE General Project Requirements**

Mark only one oval per row.

	1 (Not important)	2 (With requirement)	3 (Important)	4 (Serious)	5 (Critical)	Not sure
ASSISTANCE should produce a complete physical situation awareness for the different FR organizations connected						
Access to ASSISTANCE system should be done by means of a secure authentication process						
ASSISTANCE system should be scalable, modular and flexible						
ASSISTANCE should offer simple interfaces to share data with external sources/organizations						
ASSISTANCE system/applications should work in common COTS (Commercial off-the-shelf) hardware						
ASSISTANCE wearable and mobile sensors should be compliant with the necessary IP (Ingress Protection) hardware protection standards for being used during emergency situations. (e.g. IP 64 Protected from total dust ingress (4) and Protected from water spra						
Project output application should give opportunity to make changes in program like in the open application.						

Legal and Ethical Requirements (4/13)

8. **Legal and Ethical Requirements**

Mark only one oval per row.

	1 (Not important)	2 (With requirement)	3 (Important)	4 (Serious)	5 (Critical)	Not sure
Procedures and criteria to identify and/or recruit research participants should be compliant with ethics requirements						
The participation of humans in research actions should be managed by informed consent procedures						
The research with humans should receive opinions/approvals by the local/national ethics committees of partners involved						
The host institution should confirm that it has appointed a Data Protection Officer (DPO) and her/his contact will be made available to all data subjects						
In case of processing of special categories of personal data, detailed justification should be provided						
The beneficiaries of processed data should explain the reason why the data they intend to process are relevant and limited to the purposes of research project						
A description of measures that will be implemented to safeguard the rights of the data subjects should be provided						
In case the research involves profiling, the beneficiary should provide an explanation as to how the data subjects will be informed						
In case of further processing of previously collected personal data, the beneficiary should confirm to have lawful and technical basis for the data processing						

	1 (Not important)	2 (With requirement)	3 (Important)	4 (Serious)	5 (Critical)	Not sure
An evaluation of the ethics risks of all data processing activities should be conducted; if necessary a data protection impact assessment will be provided						
There should occur not only meeting with Data Protection Officer but also Data Protection Policy should be invented and sharing it to project participant.						

Robots and UAVs Requirements (5/13)

The consortium has selected a set of sensors highly demanded by the FRs in order to be integrated in the aerial platforms and robots included in ASSISTANCE project.
These sensors will provide real time information also according to the FRs' expectations, that will increase the FRs' Situational Awareness during their mitigation activities in different scenarios.

9. **Robots Requirements**

Mark only one oval per row.

	1 (Not important)	2 (With requirement)	3 (Important)	4 (Serious)	5 (Critical)	Not sure
Robot should be capable to operate in temperature range from -40C to 60C.						
Robot should be protected from enviroment (dust and water) according to IP67.						
Robot shall have minimum maxmium speed of 4 m/s.						
Robot shall have minimum work time of 4h.						
Robot should have capability of changing batteries without tools.						
Robot should be equipped with manipulator maximum load 5 kg.						
Robot should have mobility to traverse terrain, like debris, stairs, etc.						
Minimal operation range 400m.						
Robot control should be protected by authentication system.						
Robot should be eqipped with monitoring system for: battery level, radio link quality, robot orientation						
Robot should be operated by one person.						
Robot setup time should be lower than 10 minutes.						
Control system should be operated in multiple languates.						
Robot has to be localised on map with accuracy lower than 1m						
Robot should have maximum weight of 25kg.						
Maximum Size 60x60x80cm (width x lenght x height).						
Control system should be user friendly.						
Control system should have low latency.						
Robot data link has to be secured.						
Robot has to have capability to carry multiple sensors.						
Sensors can be mounted quicly without any tools.						
Robot can transfer sensor results to operator using its datalink.						
Robot has to be equipped with multiple cameras						
Robot can be teleoperated/telemanipulated by remote operator or work in automatic mode.						

	1 (Not important)	2 (With requirement)	3 (Important)	4 (Serious)	5 (Critical)	Not sure
Sensor can connect to robot using specified open standard.						

10. **Unmanned Aerial Vehicles (UAVs)**

Mark only one oval per row.

	1 (Not important)	2 (With requirement)	3 (Important)	4 (Serious)	5 (Critical)	Not sure
UAVs must be able to transmit visual images in RTSP 264 to the SAS platform in real time.						
At least in the industrial disaster Scenario, UAV must be able to transmit thermal images in real time.						
UAV must be capable to be equipped with a gas/smoke sensor						
UAV ground control station allows tracking the UAV during the whole operation						
UAV must have the posibility of being controlled by both pilot RC commands and unmanned waypoint navigation capabilities.						
UAV System small enough to be transported by van or pallet, preferibly with a MTOW less than 15 kg.						
The flight envelope of the aerial vehicle has to be provided for flying and landing						
UAV used must fulfill with the current regulation in order to obtain the flight permits.						
UAV operation time must be at least 20 minutes						
Setup time of UAV must be less than 10 minutes.						
UAV must provide real time video streaming and distribution						
UAV must follow geofencing rules						
UAV must be equipped with command interface to control UAV according to simulation purposes						

	1 (Not important)	2 (With requirement)	3 (Important)	4 (Serious)	5 (Critical)	Not sure
UAV must be equipped with telemetry data link connected to ASSISTANCE to provide telemetry data						
UAV can be equipped with 3D mapping capabilities depending on the type of planned mission						
The ASSISTANCE catcher drone has to carry a capture device						
The captor drone must be able to capture multicopter drones of Maximum Take-Off Weight less than 1.5kg.						
The captor drone should be able to load the intruder drone when it is catched, and carry it to a safe place						
The Control Station that will manage the swarm of drones must be centralized in order to be able of controlling all the vehicles from a single computer						
The swarm of drones should be composed by at least 4 vehicles.						
Swarm drones must be able to integrate or transport the WiFi acces points provided by the communication specialists for creating an Ad Hoc Network						
Drone swarm should be reconfigured in case one drone stop its activities						

Wearable Sensors (6/13)

The following sensors have been selected for being mounted on the FRs' personal equipment: GPS sensors, Personal video cameras, Carbon monoxide (CO) detectors, Temperature sensors.

11. **Wearable Sensors**

Mark only one oval per row.

	1 (Not important)	2 (With requirement)	3 (Important)	4 (Serious)	5 (Critical)	Not sure
Monoxide detectors (CO) wearable sensors must provide connectivity interfaces (e.g. Bluetooth or WiFi) in order to allow the sensor sharing information with the SAS platform.						
Temperature wearable sensors must provide connectivity interfaces (e.g. Bluetooth or WiFi) in order to allow the sensor sharing information with the SAS platform.						
Personal cameras wearable sensors must provide connectivity interfaces (e.g. Bluetooth or WiFi) in order to allow the sensor sharing information with the SAS platform.						
GPS wearable sensors must provide connectivity interfaces (e.g. Bluetooth or WiFi) in order to allow the sensor sharing information with the SAS platform.						

CBRN Hazard Evolution and Meteorological Data Integration (7/13)

This module will consist of a webserver engine for consequence calculations, which output includes potential hazard footprints that can be projected on the GIS background. Potential toxic footprint predictions, generated by gas cloud dispersion models, can be continuously updated by measurements from external chemical sensors mounted. This output can be continuously adapted and adjusted based on real time information from sensor-data, meteorological data, or status reports from drones, robots or UAV's.

12. **CBRN Hazard Evolution**

Mark only one oval per row.

	1 (Not important)	2 (With requirement)	3 (Important)	4 (Serious)	5 (Critical)	Not sure
The CBRN hazard system should listen and be integrated with the Sensor Abstraction Service (SAS)						
Positions of gas measurements can be placed on the map of the Situational Awareness (SA_017) tool and also integrated in the Damaged Assets Location and Routing tool						
The end user shall be able to locate new gas measurements on the map of the Situational Awareness (SA_017) tool and also integrated in the Damaged Assets Location and Routing tool (ALR_002)						
The system can predict the development of the hazard footprint based on meteo information and position of gas source.						
The user should easily understand the visualisation of the gas measurements on the map.						
The CBRN module output can be continuously adapted and adjusted based on real time information from sensor-data, meteorological data, or status reports from drones, robots or UAVâ€™s.						
The CBRN module should be suitable for training						
The CBRN module can determine a danger zone, including highlighting vulnerable places such as hospitals						

	1 (Not important)	2 (With requirement)	3 (Important)	4 (Serious)	5 (Critical)	Not sure
The CBRN module can warn the first responders about approaching the danger zone, in all phases of the emergency						
The CBRN module can localize and position all people and critical assets close to/in the danger zone						
The CBRN module can calculate the uncertainty of the gas cloud position						
The CBRN module can calculate the optimal sensor position based on current prediction and measurements to gain more certainty about the position of the gas cloud						
The CBRN module can calculate the fall-out area						
The system shall generate a static visualisation of the situation with the following information: Title mentioning the name of the gas Subtitle mentioning the time of visualization generation Map with current/predicted levels of danger						

13. **Sensors and Meteorological Data Integration**
Mark only one oval per row.

	1 (Not important)	2 (With requirement)	3 (Important)	4 (Serious)	5 (Critical)	Not sure
Meteo information can be shown on the map.						
Meteo information can be used to calculate the movement of the gas plume.						

Communication and Security Requirements (8/13)

14. **Communication Requirements**

Mark only one oval per row.

	1 (Not important)	2 (With requirement)	3 (Important)	4 (Serious)	5 (Critical)	Not sure
COMMUNICATION Maximum Global Capacity = 2Mbps						
COMMUNICATION Video Streaming Quality Supported (indicative) = H.264 UDP						
COMMUNICATION Maximum Delay = 850ms						
COMMUNICATION Availability High Availability (4G - LTE)						
COMMUNICATION Physical Interfaces for End Users (units on the field) = WiFi and Ethernet						
COMMUNICATION Physical Interfaces for C2 Users = Ethernet						
COMMUNICATION Communication Field Node - C2 = TCP/IP L3						
Remote User to Nomadic Center communication protocol = Wifi or other radio						
UAV to ground communication = Ethernet cable or wifi						
Security protocol to encrypt IP communication = IPSec						

15. **Security Requirements**

Mark only one oval per row.

	1 (Not important)	2 (With requirement)	3 (Important)	4 (Serious)	5 (Critical)	Not sure
SECURITY Security Field Node - C2 = IPSEC						
SECURITY Security End user (vehicle) - Field Node = None						
SECURITY Security C2 - 3rd Parties = None						

Sensor Abstraction Service (SAS) (9/13)

The SAS will be a middleware that will provide interoperability and allow to synchronize data between ASSISTANCE Situational Awareness (SA) platform and the different heterogeneous sensing elements of ASSISTANCE, it will work asynchronously, by subscription and efficiently.
The information maintained in the SAS will be consulted or subscribed by queries to receive

notifications of any changes that are produced from the initial results. Furthermore, SAS will be built following the security-by-design paradigm, in the sense that strong security mechanisms will be implemented to ensure the integrity and availability of the data at any time.
SAS will also be able to be used as forensic tool, as it will allow to store all the changes that occur during and event in order to make an offline analysis of all data flows. In terms of sensor data analysis, it also allows to define data series related to sensors, usually to maintain a temporary window in which to observe the data in a user friendly manner (e.g. with a graphic representation).

16. **Sensor Abstraction Service (SAS)**

Mark only one oval per row.

	1 (Not important)	2 (With requirement)	3 (Important)	4 (Serious)	5 (Critical)	Not sure
The platform, Sensor Abstraction Service (SAS), will store information from sensors and display it in a useful way.						
The SAS will provide an API REST service to insert data from the sensors and telemetry from Unmanned Ground Vehicle/Unmanned Aerial Vehicle (UGV/UAV).						
The SAS will provide an API REST service to consult status and historical data.						
The SAS is mission oriented. The mission begins from the moment the incident is declared until it resolves.						
The structure will be agnostic and flexible.						
Metric definition must be provided in the cases that are required.						
The SAS will provide a video record of the different visual sensors.						
Video streaming could be accessed through the infrastructure. The videos can also be accessed later.						
In the same way, the photos should be accessible through the infrastructure.						
The most relevant indicators will be shown on the map. This will allow to calculate the routes of access or evacuation						
The services of the modules that are developed should be available via Docker images.						

Mission Planner and Management (10/13)

The mission management module (MM) will help defining and communicating mission planning activities to the assets operators deployed on the incident location. The MM system allows to improve the collaboration between the end user (FRs) and the asset and payload operators. This system will

allow FRs to request technical missions promptly through a platform which will convert the requested mission into technical requirements that will be executed by the asset and payload operators.

17. **Mission Planner and Management**

Mark only one oval per row.

	1 (Not important)	2 (With requirement)	3 (Important)	4 (Serious)	5 (Critical)	Not sure
The ASSISTANCE system will enable the user to manually select the shooting points requested for each object of interest by first selecting the positions of the shooting points and then linking it to the object of interests (for instance a burning gas station)						
ASSISTANCE MIS managing the user profile: End user, UAV operator						
MIS enables the user to create a Mission request and assigned a UAV or a land assistance reconnaissance vehicle assignment						
MIS shall be able to manage UAVs missions and a land assistance vehicles for reconnaissance purpose.						
Automatic and / or manual mode allocation of a UAV or land vehicle with shooting points						
MIS is creating a detailed mission request (including the flight plan for the UAV).						
Once the mission request is validated by the end user, it is sent to either the UAV ground station or the land vehicle. MIS shall also handle the acknowlgement validation to be sent by the platform.						

Damaged Assets Location and Routing (11/13)

The real-time images provided by the cameras mounted on drones/UAVs in case of an emergency can be used to increase the FRs SA. Taking advantage of the UAV video streaming, the purpose of this module will be twofold:
(i) firstly to easily locate and take into account damaged assets and/or infrastructure given an area, and on the other hand

(ii) to provide rerouting mechanisms based on damaged assets or infrastructure in order to better plan intervention or evacuation routes.

18. **Damaged Assets Location and Routing**

Mark only one oval per row.

	1 (Not important)	2 (With requirement)	3 (Important)	4 (Serious)	5 (Critical)	Not sure
The tool will have a user-friendly, intuitive Graphical User Interface.						
The tool will allow users to input emergency parameters (type and location), evacuation areas and shelters (location and capacity), damaged infrastructures (location, damage type and risks) and areas with new gas measurements.						
The tool will have a GIS-based system.						
The tool will be able to calculate possible safe evacuation routes and safe access routes for emergency services to critical areas.						
The tool requires FRs status information (location, available units and type) to calculate dynamically safe routes.						
The tool provides real time results.						
The tool will allow users to explore fictitious emergencies to develop previous plans.						
The tool will calculate approximate evacuation times using emergency particular parameters and historical demographic data.						
The tool will calculate in real time routes status and access times to the emergency points.						
The tool should allow changes in the scenario depending on the emergency time evolution.						

Adapted Situational Awareness (SA) tools (12/13)

19. **Adapted Situational Awareness (SA) tools**

Mark only one oval per row.

	1 (Not important)	2 (With requirement)	3 (Important)	4 (Serious)	5 (Critical)	Not sure
ASSISTANCE SA application should log all the actions done by users and storing all data received from sensors and personnel.						
ASSISTANCE should have different users' profiles stated with different kind of information assigned.						
ASSISTANCE SA application HMI should provide discriminate information access depending on the FRs profile connected to the system						
ASSISTANCE SA application should be executed in mobile devices (e.g. tablets) and adapt its performance to these devices.						
ASSISTANCE SA application should show real time video flows from the connected cameras (including the ones mounted on mobile platforms) depending on the needs and restrictions, for instance bandwidth.						
ASSISTANCE SA application should integrate IR cameras video flows (including IR cameras mounted on mobile platforms, if any) depending on the needs and restrictions, for instance bandwidth.						
SA application should integrate the following wearable sensors for being installed on demand in some FRs uniforms depending on their protection needs. (GPS Sensors, Personal Video Cameras, Carbon monoxide detectors (CO) and Temperature sensors)						

	1 (Not important)	2 (With requirement)	3 (Important)	4 (Serious)	5 (Critical)	Not sure
ASSISTANCE SA application should raise warnings when IP sensors are not available.						
ASSISTANCE SA application should allow messaging capabilities from/to any SA application node						
ASSISTANCE SA application should give in real time and with high precision location of own resources (personnel and vehicles) including mobile platforms location (if available).						
ASSISTANCE SA application should properly store all data received by the system from sensors and external sources in order to ensure the availability of all information stored in the database for being shown to the FRs where necessary.						
ASSISTANCE SA application should show near real-time evacuation routes (based on ALR_004) for helping the FRs for moving the victims in a secure and quick way and for FRs evacuation of the area quickly in case of mayor incident.						
ASSISTANCE should provide layers management of information capabilities on a GIS to foster the possibility to turn off or on information according to specific needs stated by the FRs.						
SA application should store relevant data gathered during the day and store it properly for 7 days for being used for forensic purpose (If required)						

	1 (Not important)	2 (With requirement)	3 (Important)	4 (Serious)	5 (Critical)	Not sure
Only authorized SA application users should have access to the SA stored data						
SA application should use existing and known standards for data storage and management.						
ASSISTANCE mounted and wearable sensors data (e.g. temperature, toxicity measurements, etc) should be visible on the main SA application HMI and in each ASSISTANCE SA application node (including mobile devices e.g. tablets)						
SA application HMI should allow map selection, distance measurements, zooming and scrolling						
No SA application HMI action should require more than 4 clicks						
ASSISTANCE SA application should provide augmented video fusion capabilities for overlap real time video flows from cameras mounted in drones on the emergency area GIS displayed in the SA application HMI.						
System must be equipped with online (real time) simulation scenario editor						
System must provide interface to exchange data with UTM systems form UAVs flight planning purposes						
ASSISTANCE should interface HEMS location system to visualize HEMS location and support HEMS call decisions						
ASSISTANCE should be equipped with 3D mapping functions to provide terrain model information to raise situation awareness						

	1 (Not important)	2 (With requirement)	3 (Important)	4 (Serious)	5 (Critical)	Not sure
ASSISTANCE should be equipped with real time map 'tap and fly' function						
ASISTANCE should provide post simulation/training analysis						
ASSISTANCE access must be secured with user authentication and authorization						

Training and Virtual Reality Requirements (13/13)

ASSISTANCE will stablish the core of a European training network for FRs based on the concept of sharing different on line training facilities and the use of new technologies such as virtual, mixed and augmented reality.
The main objective of this training network is to increase the FRs skills and capabilities through the use of the above mentioned new technologies with the added value of sharing already existing training platforms, methodologies, training facilities and new virtual scenarios among different FRs organizations from different countries.

20. **Training Requirements**

Mark only one oval per row.

	1 (Not important)	2 (With requirement)	3 (Important)	4 (Serious)	5 (Critical)	Not sure
The training includes the use of, besides virtual and/or augmented reality, a variety of methods and tools						
Training can not be spread too much over time.						
The training should be divided into a theoretical and practical part						
During the training, should be used the most effective method of consolidation of knowledge - teach other persons.						
Feedback after training						
Training with the use of virtual and augmented reality should take into account the FR's perceptive capabilities.						
Training should be organized in small groups for a better follow-up of the practical training.						
Scenarios used during the training may be based on real events.						
Training curricula must be tailored to the type of FR's.						
Scheduling of training should take into account the availability, working time of FR's.						
Training module should provide trainee aid mode to provide advice and aid during simulation						
Training process should provide exam and rating capabilities						
The training must take into account working with data from both UAVs, smart wearable sensors, robots and drones.						

	1 (Not important)	2 (With requirement)	3 (Important)	4 (Serious)	5 (Critical)	Not sure
The training must prepare FRs for the three pilots. Training content must be clearly connected to the pilots.						
The training and training materials must be in English, and must be devoid of country-specific or cultural references.						

21. **Virtual Reality (VR) Platforms**
Mark only one oval per row.

	1 (Not important)	2 (With requirement)	3 (Important)	4 (Serious)	5 (Critical)	Not sure
At the training/pilot location electricity, an HDMI beamer (or large HDMI screen), speakers and an option to darken the room must be available.						
At least one technical director needs to be present to prepare the scenario settings of the VR environment.						
ADMS instructors must be present when the VR environment is used, or in advance local instructors must be trained in using the VR environment.						
Extra VR objects may need to be modelled to visualise the effects of an earthquake.						
An extra VR object needs to be modelled to visualise a robot						
Data provided by sensors can be simulated outside of the VR environment by use of a tablet						
Dedicated AMDS laptops must be used and are available through IFV or ADMS-developer ETC.						

22. **If there is any other requirement that is not included in the list and you consider important, please describe it:**

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