A Holistic Fire Management Ecosystem for Prevention, Detection and Restoration of Environmental Disasters

TREEADS D2.5 Detection and Response Understanding and Technical Requirement Report V1

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LIST OF ABBREVIATIONS AND ACRONYMS

Table 1 Abbreviations and acronyms

Abbreviation	Meaning
DR	Detection and Response
FR	Functional requirements
LIDAR	Light Detection and Ranging
NFR	Non-functional requirements
PP	Prevention and Preparedness
RA	Restoration and Adaptation
RGB	Red-green-blue
UaV	Unmanned Aerial Vehicle
VR	Virtual Reality
WP	Work Package
WUI	Wildlan-urban Interface

EXECUTIVE SUMMARY

The document, stemming from online workshops and pilot questionnaires, outlines the functional and non-functional requirements for the Detection and Response phase of wildfires in the TREEADS project. The focus is on eight piloting countries: Norway, Italy, Romania, Spain, Austria, Germany, Greece, and Taiwan. The document is dynamic and subject to updates as more information becomes available.

The document incorporates insights from questionnaires distributed to each pilot. The structure includes General Pilot Description, As-Is Situation, and To-Be Situation sections. The first provides an overview of each pilot, wildfire lifecycles, and involved actors. The second defines the current operational processes, guidelines, policies, and existing equipment. The third focuses on the desired situation post-implementation, outlining new functionalities and infrastructure expectations.

The functional approach emphasizes "what" the system should do, providing clarity in objectives, facilitating communication, and being results-oriented. It is vital in software development and for creating detailed requirements documents. The non-functional approach focuses on "how" the system should operate and the quality criteria it must meet. It addresses performance, safety, usability, scalability, and maintenance, ensuring the system's adaptability and compliance with legal requirements.

Functional requirements are categorized into Input (IN), Data (DAT), Processing (PROC), Configuration (CONF), and Output (OUT). The identifiers follow the nomenclature FR-CATN-M.

Non-functional requirements are categorized into Availability (AV), Accessibility (ACC), Integrity (INT), Security (SEC), Interoperability (IOP), Compatibility (COMP), Capacity (CAP), and Performance (PERF). Subcategories include Devices (IOP-DEV), Systems (IOP-SYS), Physical Resources (IOP-PR), Connectivity (IOP-CON). The identifiers follow the nomenclature NFR-CATN-M.

INTRODUCTION

BACKGROUND

This document has been prepared taking as a starting point the inputs from the specific online workshops dedicated to each pilot (eight in total) and from a questionnaire filled by pilot partners designed by WP2, fundamentally aimed at separating the current state from the desirable once has implemented and deployed each pilot and their integration with TREEADS.

Notice this is a live document, and it is going to be updated as more information and data become available.

That this document was completed according to the knowledge at the delivery moment.

PURPOSE AND SCOPE

This document specifies functional and non-functional Requirements in the Detection and Response phase of wildfires.

This document specifies functional and non-functional Requirements in the Detection and Response phase of wildfires.

The current deliverable will focus on eight piloting countries (Norway, Italy, Romania, Spain, Austria, Germany, Greece & Taiwan). We studied the relevant literature in the countries, prepare a workshop for each pilot and we surveyed the relevant pilot partners to learn about their insights, using WP2 designed questionnaire.

After each pilot completed their workshop, where feedback and ideas were collected and discussed, and once questionnaire was filled the questionnaire, we provide, within this document, an analysis outlining the desired functional and non-functional requirements, based each pilot proposals.

These requirements will guide the technical partners in their efforts to develop the TREEADS holistic fire management platform for prevention, detection and response, and restoration of environmental disasters.

Please Notice this is a live document, and it is going to be updated as more information and data become available.

FIRST APPROACH OF DETECTION AND RESPONSE - PILOT CASES

QUESTIONNAIRE PILOT RESPONSES DESCRIPTION

The questionnaires were distributed to each pilot to help us to complete this document and was structured as follows with this intention.

The questionnaire template and the result of the eight questionnaires were included in the D2.2 "Live doc, Europe-Wide geographical and socio-economic details, Empowerment and Engagement.", from page 82 to 368.

The questionnaire was sent and answered individually to each of the participants from the different pilots, each of them focusing on the sections that fell within their competence.

METHODOLOGY

The methodology followed is explained in depth from page 49 to 52 of the document "D2.2 Live doc, Europe-Wide geographical and socio-economic details, Empowerment and Engagement.".

Summarizing:

The deployment of the TREEADS ecosystem in wildfire management is expected to bring significant changes in organizational structure, human factors, professional culture, and relationships between stakeholders. However, organizational-level implementation poses risks due to a gap between user requirements and technological solutions. To address this, a methodology has been developed to assist organizations internally and externally in preparing for system changes, presented in a live document and potentially part of a handbook accompanying the TREEADS Ecosystem. The methodology involves defining the 'As-Is' and 'To-Be' situations, determining optimal TREEADS solutions, and implementing feedback loops.

Use Case Definition:

- 'As-Is' describes the current state, including operational processes, existing infrastructure, KPIs, constraints, and risks.
- 'To-Be' envisions the future state with TREEADS, incorporating updated information, new components, and revised KPIs.

Optimal TREEADS Solution:

- Criteria are articulated and used in decision-making, combining with barriers and limitations.
- Criteria and constraints are refined after examining TREEADS ecosystem offerings.
- Iterative steps may redefine initial use case characteristics.

Communication:

- Various communication tools like questionnaires, surveys, workshops, and information repositories are employed.
- Questionnaires play a crucial role, serving as a primary medium for organized data exchange.
- Workshops facilitate direct information exchange and active participation.

- A dedicated repository, mainly in Teams, stores information like questionnaires, workshops, and TREEADS offerings.

Questionnaires:

- Questionnaires are vital for communication and data collection.
- Users should invest time and effort in their design, involving stakeholders and technical personnel.
- The template includes an overview, 'As-Is' and 'To-Be' situations, and a section for Permits & Ethics requirements.
- Permits & Ethics requirements are crucial for technology selection.
- Iterative clarifications through workshops may be needed.
- Responses are synthesized to elicit criteria, constraints, and specifications for technology selection.

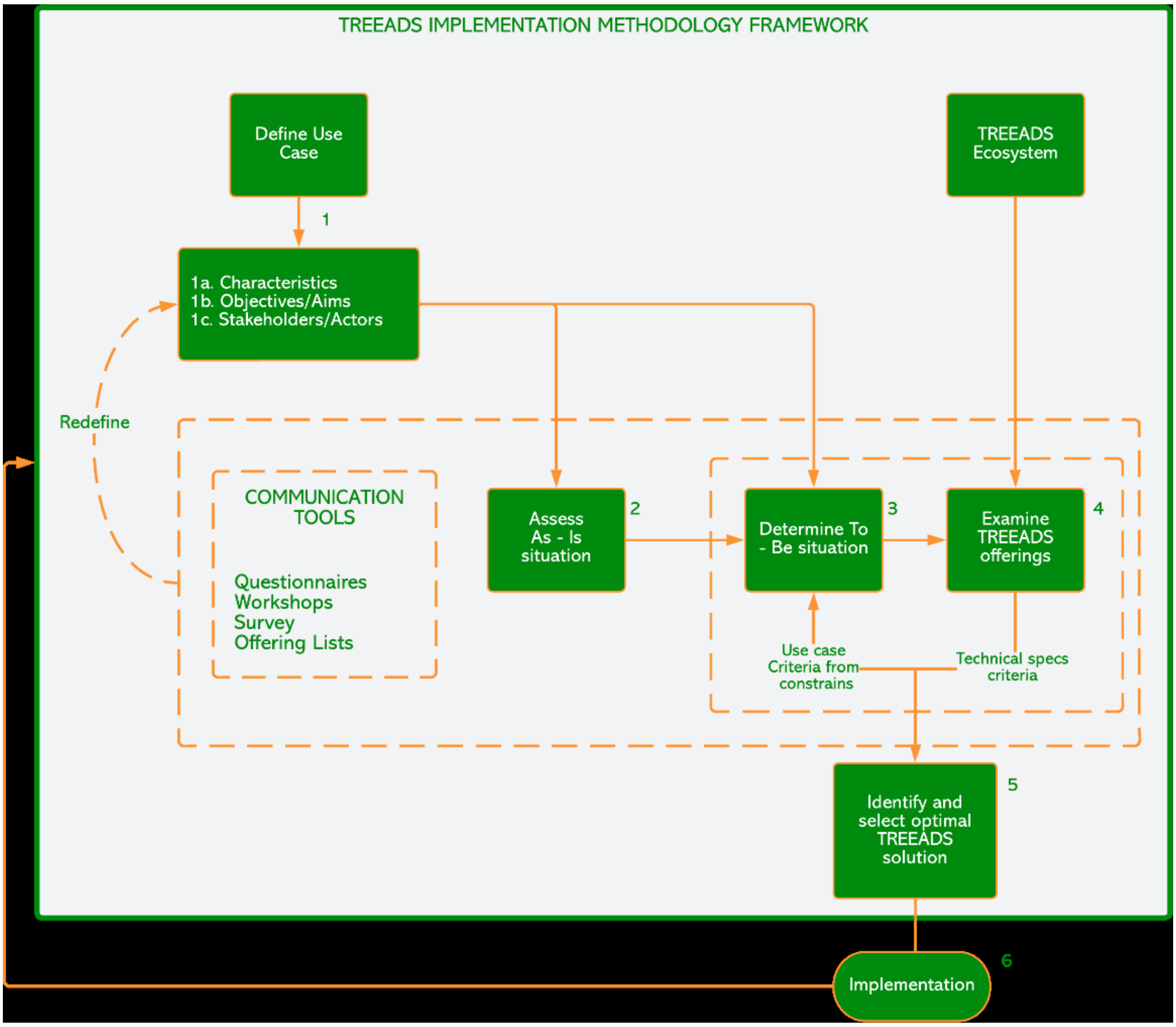

Figure 1: TREEADs implementation methodology framework

WHO ANSWERED THE QUESTIONNAIRE

The partners that act as liaison with the stakeholders entered into the previous incidents (we have no register of how many stakeholders answer on this phase), the current situation and the desired situation in the future, while the technological partners (all the participants in each pilot answer the questionnaire) focused on exposing the technologies that they contributed to the project in this first deliverable, with the intention of trying to improve the current situation, getting closer to the desired situation in the future through the use of its technologies from a holistic platform.

With these questionnaires, the Leader of each pilot composed a document or general "Questionnaire" that grouped all the responses of said partners participating in the pilot.

HOW MANY QUESTIONNAIRES AND RESPONSER PER QUESTIONNAIRE

Eight questionnaires were used to create this document, one by each pilot:

- Norway (6 partners)
- Italy (7 partners)
- Austria (8 partners)
- Spain (10 partners)
- Germany (8 partners)
- Greece (9 partners)
- Taiwan (1 partners)
- Romania (6 partners)

We do not know the exact number of responses from stakeholders for each of the questionnaires because the questionnaires were managed directly by the leaders of each pilot independently, including surveys during workshops. These did not record the number of responses, since it was not considered important for the objective and was not explicitly requested.

GENERAL PILOT DESCRIPTION

In the first section, each pilot makes an introduction with an overview of the Pilot, which includes wildfire lifecycle and involved actors in the TREEADS scope, an overview of a characteristic wildfire lifecycle for each specific region and major stakeholders that need to be involved in project.

This first part of the questionnaire also includes the description of some wildfire incidents or events as an operational example of wildfires treatment in the area and also a brief outline of how operations were carried out at the time of the incident, including information related to conditions meteorological -monitored or not-.

This first section helps us to get to know the actors involved in each pilot and, indirectly thanks to the examples of incidents, also how it was done at the operational level in real cases, and what results there were.

AS-IS SITUATON VS TO-BE SITUATION

AS IS SITUATION

The second section is aimed at defining the current situation without TREEADS.

In this section each pilot made a high level description of current operational processes relevant to TREEADS as national guidelines and policies, current wildfire measures related with each phase (2.1.3 describes current wildfire for detection and response related operational processes), current information monitored at each phase in active fires (including current automated wildfire detection systems), the existing equipment and/or ICT and technology infrastructure, and some key performance indicators (if proceed according to the pilot) used to assess the quality of the processes and operations.

This second section helps us to understand the current detection techniques -if they use any night-time detection system, how do they take terrain information, etc., current automatization level, equipment, and the response of all stakeholders in accordance with current guides and policies considering also current table-top exercises.

TO BE SITUATION

The third and last section focuses on the desired situation once pilot has been developed and TREEADS has been also completed, focused on how their solution will improve aspects from wildfire phases.

This section basically includes the same sections as the second one but is oriented to the moment in which the pilot has been completely developed (new functionalities proposed by each pilot) and his infrastructure has been fully deployed (new equipment/hardware/ICT/Aerial means/etc deployed by the pilot partners) along with the final expectations once TREEADS has been integrated.

This last section helps us to define more clearly what each pilot wants to develop, check the equipment to be deployed, the functions to be implemented and, what is expected from the TREEADS platform at a global level, that is, how is it expected that TREEADS complements the pilot.

Mention just that we take into special account the importance of considering/check the existence of equipment that allows night-time detection, one of the objectives of this project, for which we have taken special care in looking for devices that do not need visible light to detect fire.

In the same way we also consider the importance of improve of Distance/terrain understanding, making special focus on automatic mapping elements (such as LiDARs) and the use of terrain updated information from different sources, as will be seen in the following tables.

SUMMARIZING THE PURPOSE OF EACH PILOT FOCUS ON THE DETECTION AND RESPONSE PHASE

The following table shows a summarizing the purpose of each pilot focus on the detection and response phase.

Table 2 Summarizing the purpose of each pilot focus on the detection and response phase

Pilot	Purpose summary	Detection and Response approach
Norway Pilot	The Norwegian pilot focuses on characterizing wildfires and protecting infrastructure in wildland-urban interface (WUI) areas. Activities include flame propagation models, development of fire-resistant materials, guidelines for safety zones, and standardization of IoT sensor data during rescue and logistic processes. Detection and response involve field measurements for wildfire characterization and standardizing IoT data. Integrated technologies include fire-resistant materials, PFP protection, ISO standard 10303 for logistics, fire extinguishing foam, and fire testing methodology.	Characterise wildland fire in Norwegian forest and coastal heather land by field measurements of flame propagation speed, temperature, and heat flux. Streamline rescue and logistics processes by standardising data from the IoT (sensors etc.) used in the pilot, using relevant ISO standards.
Italy Pilot	The Italian pilot aims to evaluate data related to wildfire scenarios using simulations and models for Cable Car platform design. Objectives include infrastructure fire emergency management, validation of eco-sustainable construction materials, fire detection and response simulations, and preventive risk analysis. While no direct fire detection functionality is planned, simulations and external sources like Copernicus are considered. Technologies include forest fire spread simulation, wind field models, atmospheric pollutant dispersion models, and VR training.	There is no direct fire detection functionality development intention in this pilot (everything will be simulated) beyond integrating the Campania app alert functionality, although the inclusion of detection devices (such as the ACCELI UaV with cameras and sensors) associated with the preliminary design of the cable car that could provide the infrastructure with detection capacity is proposed, as well as the use of external sources such as information from Copernicus or phone call alarms. The requirement extraction for Detection will orient from this point of view.
Romania Pilot	The Romanian pilot focuses on AR-VR technology for a training platform to reduce firefighter response times. It considers the use of detection tools for fire and human presence, including ACCELI UaV with cameras	There is no direct fire detection functionality development

	and sensors. Operational scenarios involve territory opening analysis, mapping water sources, continuous monitoring, and information transfer to the Operational Command Centre. Technologies include AR helmet, VR training, and potential technologies for fire detection and decision support.	intention in this pilot. Everything will be simulated. Potential technologies: · Context aware decision support, validation of fire detection and decision support system
Spain Pilot	The Spanish pilot incorporates a monitoring platform based on sensors, cameras, LiDAR, and artificial vision tools. It aims to integrate detection services with computer vision tools and external sources like Copernicus. The focus is on supporting responders using platform-managed information and infrastructure. Technologies include drones with LiDAR and IR/EO cameras, 5G helmets, portable communication systems, thermal cameras, and software for forest mapping, hotspot detection, AI mission planning, and drone swarm coordination.	The inclusion of detection services based on computer vision tools feeds by cameras and sensors onboarded on different platforms, as well as the use of external sources such as information from Copernicus or phone calls are going to be considered. The functionalities to support responders in the field using all the information and infrastructures managed by the platform are identified. In addition, needs to be monitored by the platform are identified in order to feed the developed models and provide the most complete support possible
Austria Pilot	The Austrian pilot aims to enhance preventive and tactical responses to wildfires in WUI regions. It focuses on real-time information, situational awareness, and efficient fire extinction. Technologies include fire and smoke propagation models, hot spot detection, risk assessment, and UAVs for surveillance. The platform supports rapid intervention teams, evacuation planning, and decision-making based on fire spread simulations, wind field models, and air pollution models.	The majority of fire incidents in Austria are of small-scale (5-10 ha) which require a fast reaction from first responders to take control of the situation and extinguish the fire within a couple of hours. For such operations platforms/sensors (e.g., cameras for monitoring) are needed that can be installed rapidly, delivering near real time (10min-1 hour) information for assessment and decision-making for rapid intervention teams.

		Direct communication via the 5G platform allows for a smooth interaction between firefighters and executive staff. This shall increase the security of the firefighters. In the meantime, the "fire domain" simulations allow for a forecast of the fire development and support decisions on e.g., evacuations of communities or the expected closures of the highways.
Germany Pilot	The German pilot aims to develop prevention and simulation models, optimize firefighting equipment, and implement new training techniques. It focuses on measuring safety parameters, characterizing smoke, predicting wildfire using Computational Fluid Dynamics, and developing tactics and training concepts. Detection and response involve laboratory and real-scale fire tests, testing new firefighting techniques, and assessing environmental impact. Technologies include sensors for soil humidity, temperature, infrared, smoke toxicity measurement, and airflow sensors.	During the laboratory and real-scale fire tests, soil moisture, temperature, humidity, air pressure and the main flow direction and velocity are determined. The focus during active fire is: · To Develop and test new firefighting techniques · To test of OS-Foam in Real-Scale-Fire-Cases · To Assess the environmental impact of foam/fire retardants
Greece Pilot	The Greek pilot focuses on the DR phase, emphasizing real-time monitoring, communication networks, firefighting techniques, and evacuation. Activities include environmental monitoring, sensor installation, drone flights, fire protection plan update, field firefighting exercises, and handbook development. Operational scenarios involve fire detection, rapid response decisions, dynamic modelling, equipment utilization, communications, UAV deployment, and crowd evacuation simulations. Integrated technologies include fire danger index, fixed-wing drone, 4G/5G network, fire and smoke propagation forecasting, and decision support tools	· The main operational scenarios in the DR phase are: · Detection of fire · Rapid 1st response decision · Wildfire Dynamic Modeling · Utilization Fire Service Equipment · Operational Communications, providing a ground point data stream to the modelling systems as well as dynamic

		information at operational level, and instant messaging to help evacuation · Deployment of a fleet of UAVs to obtain information and provide real-time monitoring and coverage of the fire, facilitating rapid firefighter response.
Taiwan Pilot	The Taiwanese pilot focuses on developing and testing fire-resistant materials and implementing an IoT network platform for fire detection and weather monitoring. Activities include fire and smoke propagation modelling, sensor and camera testing, and data collection for prediction algorithms. While not explicitly addressing the DR phase, the pilot emphasizes collecting data for potential wildfire hazard prediction.	This pilot does not include any activities and solutions specifically related to the DR phase of fire

APPROACH: EXPLANATION OF THE STRENGTHS AND THE APPLICATION OF THE FUNCTIONAL AND NON-FUNCTIONAL APPROACH

Taking standards “ISO/IEC 25010 Quality Software Product“ and “ISO/IEC/IEEE 29148:2018 Systems and software engineering – Life cycle processes – Requirements engineering.” as a reference, the strengths and applications of this approach are explained.

The functional approach focuses on "what" the system should do, while the non-functional approach focuses on "how" it should do it and the quality criteria it must meet. Both approaches are essential to fully understand the requirements of a technology solution and to ensure its long-term success.

Functional Approach Strengths:

1. **Clarity in Objectives:** The functional approach focuses on the functions and characteristics that the system must perform. It facilitates a clear understanding of what the technological solution is expected to achieve.

2. **Facilitate Communication:** By describing the specific functions that the system must perform, communication between stakeholders and developers is facilitated.

3. **Results Oriented:** Allows a clear definition of the expected results. It facilitates the measurement of the success of the system by calculating its ability to perform specified functions.

4. **Iterative development:** It allows for an iterative development approach, where features can be developed and improved in successive stages.

Applications:

It is especially useful in software development as functions and features are key elements. Also, it is used to create detailed requirements documents that serve as a reference throughout the development cycle. Besides it facilitates the creation of specific test cases to verify whether the required functions are implemented correctly.

Non-Functional Approach Strengths:

1. **Performance and Efficiency:** It focuses on aspects such as performance, efficiency, and the system's ability to handle large volumes of data.
2. **Safety and Reliability:** Addresses system security, availability and reliability, ensuring its integrity and protection against threats.
3. **Usability and User Experience:** Consider aspects related to ease of use, user interface, and user experience.
4. **Scalability and Maintenance:** Evaluates the system's ability to adapt to growth and facilitate its maintenance over time.

Applications:

Allows you to allocate resources based on non-functional requirements, such as storage capacity, power, etc. It also helps establish quality standards and ensure that the system meets certain performance criteria. It facilitates the evaluation of different technologies to determine which best fits specific non-functional requirements. Finally, ensure that the system meets legal and regulatory requirements, such as privacy and security regulations.

FUNCTIONAL REQUIREMENT

For the description of the functional requirements, the following table was used, grouped by categories based on the most common functional requirements layers.

Table 3 Functional requirements categories

FUNCTIONAL REQUIREMENT CATEGORY	CATEGORY ABREVIATION (CAT)
INPUT	IN
DATA	DAT
PROCESSING	PROC
CONFIG	CONF
OUTPUT	OUT

The definition of the identifiers (**ID**) of these requirements uses the following nomenclature:

FR-CATN-M

FR = Functional requirements

CAT = Category abbreviation

N = index

M = subindex

NON-FUNCTIONAL REQUIREMENTS

For the description of the non-functional requirements, the following table was used, grouped by categories based on the most common non-functional requirements.

Table 4 Non-functional requirements categories

NON-FUNCTIONAL REQUIREMENT CATEGORY	SUBCATEGORY (With…)	CATEGORY ABREVIATION (CAT)
AVAILABILITY		AV
ACCESIBILITY		ACC
INTEGRITY		INT
SECURITY		SEC
INTEROPERABILITY		IOP
	DEVICES	IOP-DEV
	SYSTEMS	IOP-SYS
	PHYSICAL RESOURCES	IOP-PR
	CONNECTIVITY	IOP-CON
COMPATIBILITY		COMP
CAPACITY		CAP
PERFORMANCE		PERF

The definition of the identifiers (**ID**) of these requirements uses the following nomenclature:

NFR-CATN-M

NFR = Non-functional requirements

CAT = Category abbreviation

N = index

M = subindex

Pilot's requirements

1. Norway

DESCRIPTION

The intention of this pilot according to actual knowledge is the forest and Coastal Heather land characterization by using different sensors and Cameras (FRN) some of them onboarded on areal platforms (Drone Hopper, ACCELI) together with information from different sources across standardized repositories (JOTNE) with the intent of expand and dynamize terrain and ecosystem knowledge, centralizing access to make it easily accessible.

This pilot plans to use this information to, across digital twins' technology, to study different wildfire scenarios impact in the different characterized ecosystem thereby optimize response strategies.

DETECTION approach

Though there seems no direct fire detection functionality development intention in this pilot on first instance -focus on terrain characterization and digital twins-, the inclusion of detection devices as smoke detectors or detection services onboarded on different platforms, as well as the use of external sources such phone calls are going to be considered as desirable requirements, as they seem compatible with the experience of this pilot and TREEADS purpose.

Alarm receivers' notifications configuration ability is also commented on questionaries, so this requirement table includes this functionality.

RESPONSE approach

The extraction of requirements for the Response phase in this pilot has been developed trying to take advantage of the full information retrieved in the pilot experience, including results obtained in the characterization process together with the different data repositories (maps, paths), adding desirable GPS localization of firefighters, first responders and resources, offering a central access point to responders.

This requirement table also make emphasis on isolate some possible data of interest, thinking in a possible digital twins' customization for wildfires, without explicit specification of digital twins itself.

AS-IS VERSUS TO-BE SITUATION

AS-IS

There is no systematic characterization of the fire dynamics of Norwegian wildfires today. Characterizing wildfires and their impact the surrounding buildings and infrastructure is done by literature study of relevant case incidents and field measurements. This includes the main types of wildfires in Norway: forest, grass and heather fires.

The current fire test methods for building materials and products are not necessarily relevant for Norwegian wildfires.

There are no existing Norwegian guidelines regarding necessary safety zones around critical infrastructure and WUI areas, and these need to be developed. This can be done through literature study, field measurements and input from stakeholders.

There are no existing Norwegian guidelines regarding building technical requirements for wooden houses and cottages situated in high-risk zones regarding wildfires. These can be developed through literature study, field- and lab tests and input from stakeholders.

TO-BE

Based on existing test methods and knowledge gathered from the classification of the Norwegian wildfire conditions, relevant and realistic test methods can be developed as to evaluate the performance of relevant building materials.

With these test methods it will be possible to develop more cost-effective methods of protecting key infrastructure and buildings in high-risk areas.

There is a need to streamline recue and logistics processes to make the process of preparing, responding and fighting Norwegian wildfires more effective.

FUNCTIONAL REQUIREMENTS

The following table shows the functional requirements of Norwegian pilot.

Table 5 Functional Requirements Norway

NUM	ID	Description	Detection	Response
1	**FR-IN1**	The system must be able to retrieve, store and manage the information generated by all the sensors used for detection	X	
1.1	**FR-IN1-1**	The system must be able to retrieve, store and manage information from cameras/optical sensors	X	
1.2	**FR-IN1-2**	The system must be able to retrieve, store and manage information from infrared cameras/optical sensors	X	
1.5	**FR-IN1-5**	The system must be able to retrieve, store and manage information from wind speed sensors		X
1.6	**FR-IN1-6**	The system must be able to retrieve, store and manage information from wind direction sensors		X
1.7	**FR-IN1-7**	The system must be able to retrieve, store and manage information from humidity sensors		X

NUM	ID	Description	Detection	Response
1.8	**FR-IN1-8**	The system must be able to retrieve, store and manage information from smoke detectors	X	
1.12	**FR-IN1-12**	The system must be able to retrieve, store and manage information from ambient temperature sensors		X
1.13	**FR-IN1-13**	The system must be able to retrieve, store and manage information from ambient soil temperature sensors		X
2	**FR-IN2**	The system must be able to retrieve, store and manage information from other systems		X
2.1	**FR-IN2-1**	The system must be able to obtain, storing and manage information relative to Rainfall for the area		X
2.2	**FR-IN2-2**	The system must be able to obtain, storing and manage information relative to first responders' location		X
3	**FR-IN3**	The system must be able to allow the input, storage and management of information		X
3.1	**FR-IN3-1**	Relative to characterized soil samples.		X
3.2	**FR-IN3-2**	Relative to fire response teams		X
3.3	**FR-IN3-3**	Relative to fire extinction resources		X
3.5	**FR-IN3-5**	Relative to terrain information		X
4	**FR-DAT1**	The system should be able to manage information concerning fire response teams	X	X
4.1	**FR-DAT1-1**	Firefighters	X	X
4.2	**FR-DAT1-2**	Volunteers	X	X
4.3	**FR-DAT1-3**	Civil protection	X	X
4.4	**FR-DAT1-4**	Regional emergency services	X	X
4.5	**FR-DAT1-5**	Police	X	X
4.6	**FR-DAT1-6**	Forest rangers	X	X
4.7	**FR-DAT1-7**	Coast guard	X	X

NUM	ID	Description	Detection	Response
5	**FR-DAT2**	Fire response team's information should include dynamic information		X
5.1	**FR-DAT2-1**	Schedules	X	X
5.2	**FR-DAT2-2**	GPS Location		X
5.3	**FR-DAT2-3**	Specialization level		X
5.4	**FR-DAT2-4**	Availability		X
5.5	**FR-DAT2-5**	Number of troops		X
6	**FR-DAT3**	The system should be able to manage information concerning firefighting resources		X
6.1	**FR-DAT3-1**	Firetrucks		X
6.2	**FR-DAT3-2**	Helicopters		X
6.3	**FR-DAT3-3**	Water pumps		X
6.4	**FR-DAT3-4**	Specific fire extinguishers		X
6.5	**FR-DAT3-5**	Third party provided resources		X
7	**FR-DAT4**	Firefighting resources information should include dynamic information		X
7.1	**FR-DAT4-1**	Related to their condition		X
7.2	**FR-DAT4-2**	GPS Localization		X
7.3	**FR-DAT4-3**	Type of resource		X
7.4	**FR-DAT4-4**	Quantitative measurements		X
7.5	**FR-DAT4-5**	Capabilities		X
7.6	**FR-DAT4-6**	Availability		X
8	**FR-DAT5**	The system should manage terrain information	X	X
8.1	**FR-DAT5-1**	Terrain information should include data on characterized ecosystems.	X	X
8.2	**FR-DAT5-2**	Terrain information should include data on characterized biomes.	X	X

NUM	ID	Description	Detection	Response
8.3	**FR-DAT5-3**	Terrain information should include data on the terrain's orography.	X	X
9	**FR-DAT6**	The system should be able to store fire-detection notifications and response phase monitoring information in a database of historical incidents	X	X
10	**FR-PROC1**	The system must have the ability to operate with different data managed by it, store and manage results	X	X
10.1	**FR-PROC1-1**	To obtain fire speed propagation	X	X
10.2	**FR-PROC1-2**	To obtain heat fluxes	X	X
10.3	**FR-PROC1-3**	To track/trace location of the responders		X
10.4	**FR-PROC1-4**	To obtain the location of the response teams		X
11	**FR-PROC2**	The system must be able to manage fire detections	X	
11.1	**FR-PROC2-1**	With sensors as a start point	X	
11.2	**FR-PROC2-2**	Launched by smoke detectors	X	
11.3	**FR-PROC2-3**	With an emergency phone call as a starting point	X	
12	**FR-PROC3**	The system should be able to exploit information from an historical database to provide elaborated information during the wildfire.?		X?
13	**FR-CONF1**	It should be possible to configure parameterizable events in the system that generate alarms to monitor the level of fire risk.	X	X
16	**FR-CONF4**	The system must allow parameters configuration	X	X
16.1	**FR-CONF4-1**	Notification alarm receivers	X	X
17	**FR-OUT1**	The system should have a central support access point/dashboard capable of receiving requests related to the information managed by the system		X
18	**FR-OUT2**	The system must be able to manage display information during the response phase		X
18.1	**FR-OUT2-1**	the location of the response teams		X
18.4	**FR-OUT2-4**	On demand maps' catalogue		X

NUM	ID	Description	Detection	Response
20	**FR-OUT4**	The system must be able to send notifications alarms	X	X

NON-FUNCTIONAL REQUIREMENTS

The following table shows the non-functional requirements of Norwegian pilot.

Table 6 Non-functional Requirements Norway

NUM	ID	Description
1	**NFR-AV1**	System must be available to field actors during detection and response phase
3	**NFR-ACC2**	The system should have a stable interface to allow the connection with the human resources involved in extinguishing the fire.
4	**NFR-AC3**	The system should be equipped with a prioritized communication channel in case of wildfire detection or other related events.
4.1	**NFR-AC3-1**	between the local government and the fire department
5	**NFR-INT**	Responders' personal devices must correctly receive and report fire alarms
7	**NFR-IOP-DEV1**	The system should have sensors and devices installed to capture all the parameters to be considered in wildfire detection and response phases
8	**NFR-IOP-CON1**	The system should have connectivity with sensors and devices involved in the detection of parameters related to the detection and response phases of a wildfire
9	**NFR-IOP-CON2**	Communication between system connected participants (users, devices, platforms, connected resources, TREEADS services as decision support system) should be established using telematic means that always ensures communication.
9.1	**NFR-IOP-CON2-1**	4G/5G Mobile connectivity
9.4	**NFR-IOP-CON2-4**	Internet
10	**NFR-IOP-PR1**	The system should have access to aerial means capable of transporting sensors and/or cameras
10.1	**NFR-IOP-PR1-1**	unmanned aerial means as drones
10.2	**NFR-IOP-PR1-2**	helicopters
15	**NFR-COMP1**	The information should be retrieved using Open-Source Framework

NUM	ID	Description
15.1	**NFR-COMP1-1**	The information should be retrieved using Arrowhead Framework (the IoT Open-Source Framework)
16	**NFR-COMP2**	The information managed by the system should be stored in a repository based/standardized database on open standards
16.1	**NFR-COMP2-1**	The information should be stored in a repository based on open standards (ISO 10303) in STEP data format.

2. Italy

DESCRIPTION

The intention of this pilot according to actual knowledge is the data evaluation related with different wildfires propagation scenarios using simulations (STRESS) and fire propagation models (USAL) with the intention to support a preliminary design for a Cable car layout.

DETECTION approach

There is no direct fire detection functionality development intention in this pilot (everything seems will be simulated) beyond integrating Campania app alert functionality, although the inclusion of detection devices (such as ACCELI UaV with cameras and sensors) associated with the preliminary design of the cable car that could provide the infrastructure with detection capacity is proposed, as well as the use of external sources such as information from Copernicus or phone calls alarms. We will orient requirement extraction for Detection from this point of view.

RESPONSE approach

The extraction of functional requirements for the Response phase in this pilot has been developed with three ideas in mind:

First, to take advantage of the results obtained in their simulation tests to be consumed in the response phase by any TREEADS agent, with no major impact on development.

Second to consider the intent that preliminary design ensures a secure area in case of wildfire for on-field responders in terms of communication infrastructure.

And third, to take advantages of already developed tools (Campana APP, IterGIS regione campagnia Decision support) on this response phase, with TREEADS integration idea if it was desirable.

AS-IS VERSUS TO-BE SITUATION

AS-IS

The existing pain points are related to the intervals describing the length in time of the fires:

A) average time elapsed from reporting the event to the Operations Room and the start of the intervention
B) average time elapsed from the start of the intervention to final shutdown.
C) An additional pain pointis related to the high number of(relatively) small extensions fires

TO BE

The Italian Pilot was originally addresses at the validation of an innovative Infrastructures Fire Emergency Management Strategy applied to the design of a Cable-Car System in the Sorrento Peninsula, the connected result will be the Optimized Cable car layout and the definition of the related active and/or passive mitigation measures and resulting emergency procedures

- Validation of an innovative Infrastructures Fire Emergency Management Strategy applied to the design of a Cable-Car System in the Sorrento Peninsula
- Validation of eco-sustainable construction materials with increased fire performances developed in T4.7
- Fire detection and Response simulation in real environment
- Preventive risk analysis in protected forest areas and possible economic restoration solutions after forest fires

The Italian Pilot will integrate the following TREEADS technologies:

- Forest fire spread simulation (USAL)
- Wind field model (USAL)
- Atmospheric pollutants dispersion model (USAL)
- Nature-based and fire-resilient solution for prevention and restoration (RINA-C)
- Resilient, event-driven, context-aware fire detection and decision support for response processes (FI)
- VR TRAINING (SIMAVI) probably

FUNCTIONAL REQUIREMENTS

The following table shows the functional requirements of Italian pilot.

Table 7 Functional Requirements Italy

NUM	ID	Description	Detection	Response
2	**FR-IN2**	The system must be able to retrieve, store and manage information from other systems	X	X
2.5	**FR-IN2-5**	The system must be able to obtain, store and manage information from external GIS Source		X
2.6	**FR-IN2-6**	The system must be able to obtain, store and manage information from external WEB Source		X
2.7	**FR-IN2-7**	The system must be able to obtain, store and manage information from Copernicus Services	X?	X
2.9	**FR-IN2-9**	SMA Campania app emergency notifications	X	
9	**FR-DAT6**	The system should be able to store fire-detection notifications and/or response phase monitoring information in a database of historical incidents	X	

NUM	ID	Description	Detection	Response
10	**FR-PROC1**	The system must have the ability to operate with different data managed by it, store and manage results		X
10.17	**FR-PROC1-17**	As a decision support system		X
11	**FR-PROC2**	The system must be able to manage fire detections	X	
11.3	**FR-PROC2-3**	With an emergency phone call as a starting point	X	
11.4	**FR-PROC2-4**	With a dedicated app emergency notification tool as a start point	X	
17	**FR-OUT1**	The system should have a central support access point/dashboard capable of receiving requests related to the information managed by the system		X

NON-FUNCTIONAL REQUIREMENTS

The following table shows the non-functional requirements of Italian pilot.

Table 8 Non-functional Requirements Italy

NUM	ID	Description
1	**NFR-AV1**	System must be available to field actors during detection and response phase
2	**NFR-ACC1**	System must be accessible to field actors using a personal device
2.1	**NFR-ACC1-1**	From an App (android? OS??)
9	**NFR-IOP-CON2**	Communication between system connected participants (users, devices, platforms, connected resources, TREEADS services as decision support system) should be established using telematic means that always ensures communication.
9.1	**NFR-IOP-CON2-1**	4G/5G Mobile connectivity
12	**NFR-IOP-SYS1**	The system should be integrated with external data sources
12.1	**NFR-IOP-SYS1-1**	With a regional database
12.2	**NFR-IOP-SYS1-2**	With a centralized database
13	**NFR-IOP-SYS2**	The system should be integrated with external Systems

NUM	ID	Description
13.1	**NFR-IOP-SYS2-1**	WebGis based Decision Support System https://itergis.regione.campania.it/
14	**NFR-IOP-SYS3**	System must be integrated with Copernicus services

3. Romania

DESCRIPTION

The intention of this pilot according to actual knowledge is to develop a training system driven by AR-VR technology (SIMAVI) to reduce firefighters' response times in case of fire hazards, although they also raise the need to use detection tools for both fire and human presence, at the level of sensors and cameras on land (?) and on board (ACCELI), which also directly implies, again, the use of VR tools.

DETECTION approach

There is no direct fire detection functionality development intention in this pilot (everything seems will be simulated), although the inclusion of detection devices (such as ACCELI UaV with cameras and sensors) associated with fire detection, as well as the use of external sources such as information from Copernicus are going to be considered just in case.

RESPONSE approach

The extraction of requirements for the response phase in this pilot has been developed with a main idea: the simulations/trainings must use some critical data, related to the monitoring/known data that the simulation requires to work -which in turn would be the data monitored by a AR/VR support system in a real situation- together with the associated responses that could be of interest to support responders, also considering the non-functional technical requirements to make it viable.

AS-IS VERSUS TO-BE SITUATION

AS-IS

Mainly the response to fires is ensured after receiving the information about the fire through the unique number for emergency calls - 112, available throughout the country, which can be called from all public telephone networks, a number that ensures the reception of emergency calls from citizens and their transmission to the specialized intervention agencies, in order to ensure an immediate, uniform and uniform response to the resolution of emergencies.

Limited intervention possibilities due to the precarity of the access roads, hard-to-reach terrain, long distance from the water source, dry vegetation, stumps, felled trees, plant and wood debris left over from logging, the presence of bears. Adding to the complexity of the intervention was the fact that the affected area was known to have been a battlefield during WW II, which incurred increased danger to firefighters being exposed to unknown old war ammunition.

TO-BE

Detection and response:

The system put in place during the prevention phase should be able to provide the relevant training and tactical information to first responders to prepare and tackle the intervention in an efficient manner. The fire detection and decision support will provide firefighters with relevant information for an efficient response during the intervention.

FUNCTIONAL REQUIREMENTS

The following table shows the functional requirements of Romanian pilot.

Table 9 Functional Requirements Romania

NUM	ID	Description	Detection	Response
1	**FR-IN1**	The system must be able to retrieve, store and manage the information generated by all the sensors used for detection	X	
1.1	**FR-IN1-1**	The system must be able to retrieve, store and manage information from cameras/optical sensors	X	
1.2	**FR-IN1-2**	The system must be able to retrieve, store and manage information from infrared cameras/optical sensors	X	
1.9	**FR-IN1-9**	The system must be able to retrieve, store and manage information from LiDAR	X	X
2	**FR-IN2**	The system must be able to retrieve, store and manage information from other systems	X	X
2.4	**FR-IN2-4**	The system must be able to obtain, store and manage information from external database	X	
2.7	**FR-IN2-7**	The system must be able to obtain, store and manage information from Copernicus Services	X	X
5	**FR-DAT2**	Fire response team's information should include dynamic information		X
5.2	**FR-DAT2-2**	GPS Location		X
6	**FR-DAT3**	The system should be able to manage information concerning firefighting resources		X
6.1	**FR-DAT3-1**	Firetrucks		X
6.6	**FR-DAT3-6**	ATV's		X
6.7	**FR-DAT3-7**	Drones		X

NUM	ID	Description	Detection	Response
7	**FR-DAT4**	Firefighting resources information should include dynamic information		X
7.1	**FR-DAT4-1**	Related to their condition		X
7.2	**FR-DAT4-2**	GPS Localization		X
7.3	**FR-DAT4-3**	Type of resource		X
7.4	**FR-DAT4-4**	Quantitative measurements		X
7.6	**FR-DAT4-6**	Availability		X
10	**FR-PROC1**	The system must have the ability to operate with different data managed by it, store and manage results		X
10.5	**FR-PROC1-5**	To detect human presence/human footprints		X
17	**FR-OUT1**	The system should have a central support access point/dashboard capable of receiving requests related to the information managed by the system		X
18	**FR-OUT2**	The system must be able to manage display information during the response phase		X
18.1	**FR-OUT2-1**	the location of the response teams		X
18.2	**FR-OUT2-2**	The location of each member of the fire response teams		X

NON-FUNCTIONAL REQUIREMENTS

The following table shows the non-functional requirements of Romanian pilot.

Table 10 Non-functional Requirements Romania

NUM	ID	Description
1	**NFR-AV1**	System must be available to field actors during detection and response phase
2	**NFR-ACC1**	System must be accessible to field actors using a personal device
3	**NFR-ACC2**	The system should have a stable interface to allow the connection with the human resources involved in extinguishing the fire.
7	**NFR-IOP-DEV1**	The system should have sensors and devices installed to capture all the parameters to be considered in wildfire detection and response phases

NUM	ID	Description
8	**NFR-IOP-CON1**	The system should have connectivity with sensors and devices involved in the detection of parameters related to the detection and response phases of a wildfire
9	**NFR-IOP-CON2**	Communication between system connected participants (users, devices, platforms, connected resources, TREEADS services as decision support system) should be established using telematic means that always ensures communication.
9.1	**NFR-IOP-CON2-1**	4G/5G Mobile connectivity
9.4	**NFR-IOP-CON2-4**	Internet
10	**NFR-IOP-PR1**	The system should have access to aerial means capable of transporting sensors and/or cameras
10.1	**NFR-IOP-PR1-1**	unmanned aerial means as drones
10.2	**NFR-IOP-PR1-2**	helicopters
11	**NFR-IOP-PR2**	All aerial assets used by the system should be geo-referenced and plotted at all times.
12	**NFR-IOP-SYS1**	The system should be integrated with external data sources
12.1	**NFR-IOP-SYS1-1**	With a regional database
14	**NFR-IOP-SYS3**	System must be integrated with Copernicus services
19	**NFR-PER2**	Real-time performance is mandatory in some cases
20	**NFR-CAP2**	The system should be able to process high volume data

4. Spain

DESCRIPTION

The intention of this pilot according to actual knowledge is to have three develop layers:

First to develop a large monitoring system based on sensors, cameras and LiDAR, some of them on aerial platforms such as HAPS (CGE-ALTRAN) or Drones (Dron Hopper, ACCELI, UdG), which feeds, together with static data sources (FAFCYLE), artificial vision tools (USAL, CARTIF, NOA, CGE-ALTRAN) enriched with a variety of models (USAL, NOA, CARTIFF) that allow the inference of useful information for any of the phases of a wildfire.

Then they also propose the combined integration of different GIS (UdG, CARTIF) that facilitate the treatment of geographic information.

To finalize, this pilot also considers the directed deployment of HAPs as aerials mobile networks that improve on field responders' connectivity in areas with low coverage (CGE-ALTRAN), in the response phase, as well as the use of 5G EDGEs (CGE-ALTRAN) to improve response times in both DR phases.

DETECTION approach

The inclusion of detection services based on computer vision tools feeds by cameras and sensors onboarded on different platforms, as well as the use of external sources such as information from Copernicus or phone calls are going to be considered.

RESPONSE approach

The extraction of requirements for the response phase in this pilot has been developed with a main idea: what functionalities and conditions do we need in case we want to give support to on field responders using all the information and infrastructures managed by the system, and what the system will need to monitor to feed developed models to, combined with static data, give a support as complete as possible.

AS-IS VERSUS TO-BE SITUATION

AS-IS

Pain points:

- The number of firefighters parks and thus the number of firefighters of non-forest fires, which can affect to forest areas and the problems to defend urban zones.
- The high percent of elderly people in rural areas and therefore the abandonment of the traditional use of the land.
- The floating population of some rural areas in summer which quadruple their population and increases the chances of fire incidents.
- The abandonment of some forest areas because of the lack of budget to follow through forest restoration and management plans.

- The trend of drought in the area over the last years.
- The lack of maintenance of forest prevention infrastructures.
- The lack of urban-forest fire prevention plans at local level
- The lack of management of private forest lands, especially those owned by many owners with low surface.
- General decline in tree health due to climate change and proliferation offorest pests and diseases.
- The inexistence of mixed forest due to one-specie-same-age reforestation plans.

The prevention and control of forest fires must be planned from four different points:

1. Social prevention: Educational and outreach work.
2. Technical prevention: Defence plans against forest fires.
3. Direct prevention and actions: Improvement and adaptation of the means
4. surveillance, prevention and extinction. Carrying out forestry work
5. preventive.
6. Coordination in the extinction of forest fires.
7. Adequacy of the current legislation on fires.

TO-BE

The objective is to improve as-is situation:

- Providing an accurate and reliable state of the forest areas and in particular the forest urban interfaces.
- To provide an automatic detection and response in case of fires.
- Providing efficient simulation models of the fire but also of the different elements (e.g., pollutants, smoke, etc.)
- To provide an efficient technological solution during operation of fires.

Soil and vegetation will be monitored before, during and after fire. In addition, this monitoring will be applied remotely (i.e., four-layer coverage) and within the forest areas (i.e., IoT network of sensors).

Population vulnerability, floating population and other indices could be also assessed.

Some ecosystem services based on indices and different parameters provided by satellites and remote sensing techniques could be also assessed.

FUNCTIONAL REQUIREMENTS

The following table shows the functional requirements of Spanish pilot.

Table 11 Functional Requirements Spain

NUM	ID	Description	Detection	Response
1	**FR-IN1**	The system must be able to retrieve, store and manage the information generated by all the sensors used for detection	X	

NUM	ID	Description	Detection	Response
1.1	**FR-IN1-1**	The system must be able to retrieve, store and manage information from cameras/optical sensors	X	
1.2	**FR-IN1-2**	The system must be able to retrieve, store and manage information from infrared cameras/optical sensors	X	
1.3	**FR-IN1-3**	The system must be able to retrieve, store and manage information from multispectral cameras	X	
1.8	**FR-IN1-8**	The system must be able to retrieve, store and manage information from smoke detectors	X	
1.10	**FR-IN1-10**	The system must be able to retrieve, store and manage information from incidents detectors	X	
3	**FR-IN3**	The system must be able to allow the input, storage and management of information	X	
3.6	**FR-IN3-6**	Relative to forecast parameters	X	
3.7	**FR-IN3-7**	Relative to custom parameters	X	
4	**FR-DAT1**	The system should be able to manage information concerning fire response teams	X	X
4.1	**FR-DAT1-1**	Firefighters	X	X
4.2	**FR-DAT1-2**	Volunteers	X	X
4.8	**FR-DAT1-8**	Helicopter crew	X	X
4.9	**FR-DAT1-9**	Environmental agents	X	X
4.10	**FR-DAT1-10**	Fire technicians	X	X
4.11	**FR-DAT1-11**	Communication officers	X	X
5	**FR-DAT2**	Fire response team's information should include dynamic information		X
5.2	**FR-DAT2-2**	GPS Location		X
5.3	**FR-DAT2-3**	Specialization level		X
5.4	**FR-DAT2-4**	Availability		X
5.5	**FR-DAT2-5**	Number of troops		X

NUM	ID	Description	Detection	Response
6	**FR-DAT3**	The system should be able to manage information concerning firefighting resources		X
6.7	**FR-DAT3-7**	Drones	X	X
6.8	**FR-DAT3-8**	HAPs (high altitude platforms)	X	X
6.9	**FR-DAT3-9**	Firefighter's parks/departments		X
6.10	**FR-DAT3-10**	Bulldozers		X
7	**FR-DAT4**	Firefighting resources information should include dynamic information		X
7.1	**FR-DAT4-1**	Related to their condition		X
7.2	**FR-DAT4-2**	GPS Localization		X
7.3	**FR-DAT4-3**	Type of resource		X
7.4	**FR-DAT4-4**	Quantitative measurements		X
7.5	**FR-DAT4-5**	Capabilities		X
7.6	**FR-DAT4-6**	Availability		X
8	**FR-DAT5**	The system should manage terrain information	X	X
8.3	**FR-DAT5-3**	Terrain information should include data on the terrain's orography.	X	X
8.4	**FR-DAT5-4**	Terrain information should include characterized data on the terrain's population (elderly people, etc.)		X
8.5	**FR-DAT5-5**	Terrain information should include data on the terrain's floating population		X
8.6	**FR-DAT5-6**	Terrain information should include data on the terrain's forest-urban areas maintenance status	X	X
8.7	**FR-DAT5-7**	Terrain should include data on the terrain's dryness	X	
8.8	**FR-DAT5-8**	Terrain information should include data on the terrain's forestry infrastructures maintenance status	X	X
8.9	**FR-DAT5-9**	Terrain information should include data on the wildfire area access paths (roads, paths)		X

NUM	ID	Description	Detection	Response
10	**FR-PROC1**	The system must have the ability to operate with different data managed by it, store and manage results		X
10.3	**FR-PROC1-3**	To track/trace location of the responders		X
10.6	**FR-PROC1-6**	To obtain soil and vegetation terrain information		X
10.18	**FR-PROC1-18**	To monitor wildfires in real time		X
10.22	**FR-PROC1-22**	To obtain georeferenced fire detections	X	
11	**FR-PROC2**	The system must be able to manage fire detections	X	
11.1	**FR-PROC2-1**	With sensors as a start point	X	
11.2	**FR-PROC2-2**	Launched by smoke detectors	X	
11.3	**FR-PROC2-3**	With an emergency phone call as a starting point	X	
14	**FR-CONF2**	The systems should allow the creation, combination and parameter's configuration using all indexes managed	X	
14.1	**FR-CONF2-1**	To provide times of danger based on general forecast and custom on premise parameters	X	
14.2	**FR-CONF2-2**	to set up custom metrics and KPI's	X	
14.5	**FR-CONF2-5**	To generate data sources to feed prediction models	X	
15	**FR-CONF3**	The system must allow to set delimited territory areas in terms of risk and vulnerability	X	X
15.1	**FR-CONF3-1**	This Areas should include information about possible intervention requirements		X
15.2	**FR-CONF3-2**	This Areas must include stored information about means and resources		X
15.3	**FR-CONF3-3**	This Areas could include information about deployment of means and resources		X
16	**FR-CONF4**	The system must allow parameters configuration	X	X
16.1	**FR-CONF4-1**	Notification alarm receivers	X	X

NUM	ID	Description	Detection	Response
17	**FR-OUT1**	The system should have a central support access point/dashboard capable of receiving requests related to the information managed by the system		X
18	**FR-OUT2**	The system must be able to manage display information during the response phase		X
18.1	**FR-OUT2-1**	the location of the response teams		X
18.2	**FR-OUT2-2**	The location of each member of the fire response teams		X
18.3	**FR-OUT2-3**	Vulnerability per area information	X	
18.4	**FR-OUT2-4**	On demand maps' catalogue		X
19	**FR-OUT3**	The system must provide access to custom developed services		X
19.1	**FR-OUT3-1**	Multispectral images on demand		X
19.2	**FR-OUT3-2**	Multispectral image processing services		X
19.3	**FR-OUT3-3**	5G connectivity using HAPs		X
20	**FR-OUT4**	The system must be able to send notifications alarms	X	X

NON-FUNCTIONAL REQUIREMENTS

The following table shows the non-functional requirements of Spanish pilot.

Table 12 Non-functional Requirements Spain

NUM	ID	Description
1	**NFR-AV1**	System must be available to field actors during detection and response phase
2	**NFR-ACC1**	System must be accessible to field actors using a personal device
3	**NFR-ACC2**	The system should have a stable interface to allow the connection with the human resources involved in extinguishing the fire.
5	**NFR-INT**	Responders' personal devices must correctly receive and report fire alarms
7	**NFR-IOP-DEV1**	The system should have sensors and devices installed to capture all the parameters to be considered in wildfire detection and response phases

NUM	ID	Description
8	**NFR-IOP-CON1**	The system should have connectivity with sensors and devices involved in the detection of parameters related to the detection and response phases of a wildfire
9	**NFR-IOP-CON2**	Communication between system connected participants (users, devices, platforms, connected resources, TREEADS services as decision support system) should be established using telematic means that always ensures communication.
9.1	**NFR-IOP-CON2-1**	4G/5G Mobile connectivity
9.2	**NFR-IOP-CON2-2**	WLAN based connectivity using radiofrequency networks to provide communication between security forces
9.3	**NFR-IOP-CON2-3**	Using HAPs for EDGE processing
9.4	**NFR-IOP-CON2-4**	Internet
10	**NFR-IOP-PR1**	The system should have access to aerial means capable of transporting sensors and/or cameras
10.3	**NFR-IOP-PR1-3**	HAPs
11	**NFR-IOP-PR2**	All aerial assets used by the system should be geo-referenced and plotted at all times.
13	**NFR-IOP-SYS2**	The system should be integrated with external Systems
13.2	**NFR-IOP-SYS2-2**	QGIS based systems
14	**NFR-IOP-SYS3**	System must be integrated with Copernicus services

5. Austria

DESCRIPTION

The Austrian pilot aims to enhance preventive and tactical responses to wildfires in WUI regions. It focuses on real-time information, situational awareness, and efficient fire extinction. Technologies include fire and smoke propagation models, hot spot detection, risk assessment, and UAVs for surveillance. The platform supports rapid intervention teams, evacuation planning, and decision-making based on fire spread simulations, wind field models, and air pollution models.

AS-IS VERSUS TO-BE SITUATION

AS-IS

Team leader trainings/response trainings for forest fires are necessary; this does not yet work ideally.

Air reconnaissance has not yet a satisfactory effect. The forces of the Federal Ministry of the Interior (BMI) and the armed forces are not sufficient. There have already been many research projects for reconnaissance platforms, but the authorities are not willing to pursue this and do not consider it necessary.

Geographical conditions in the Alpine region are problematic; special operational tactics in Alpine terrain would be necessary. In Europe, there is a focus on Mediterranean countries, but little on high mountainous areas.

Further equipment is currently being purchased. The support from the federal government must be extended to other provinces (so far mainly Styria, Lower Austria, Tyrol). There is a forest fire fund, which supports the procurement of equipment. This year is for the first time a chance to purchase new equipment for fighting forest fires within this fund.

Human Resources: “Fit for firefighting” as a slogan. Firefighting in alpine terrain is a huge burden. For the future, one should consider: How can the emergency forces be optimally trained? The problem has been exacerbated by the pandemic (insufficient fitness of junior emergency forces). Women are often fitter than men. More focus on training programmes is needed. "Fit for firefighting" programme should be expanded (business run, fitness centre, swimming pool, etc.). The problem is not only limited to the fire brigade, but also to the rescue service, mountain rescue, etc.).

A fire index with measurements of vegetation, similar to Portugal would be useful. In Germany, there is the grassfire index.

ELKOS: Uniform operations management and communication system of the Ministry of the Interior. It is a situation management programme for supra-local situations to be used between police and fire brigade. Currently it is at a standstill, but it would be very important to activate it. There is no uniform standard throughout Austria.

There is a lack of helicopters capable of carrying at least 3000 L.

SITAC (International symbols for situation management; short for TACTICAL SITUATION, see Appendix A.3) should also be used in Austria, currently the Austrian standard symbols (ÖNORM S 2308) are used, but within international cooperations our signs and symbols are not understood.

There is a lack of overall national crisis and disaster management, eg. pilots that fly helicopters and drones in forest fire have usually completely different daily work and do not identify with this task. There is also the need for a nationwide emergency communication approach. The easiest way is to use normal radio (BOS)

TO-BE

Important for this pilot region in TREEADS is international networking and exchange, more sensors, improved communication, and an improved situation map. International assistance is needed for larger dimensions: Interoperability, standards, SOPs are important. SITACs should be used for forest fire operations.

They would need a TREEADS platform similar to Whatsapp that is easy to use also without WLAN. The goal of the TREEADS platform must be a proven, simple user interface with reliable information – best if integrated in an already working and well accepted environment.

There have been past projects in which useful software has been developed, but it also has to work without network connection.

The majority of fire incidents in Austria are of small-scale (5-10 ha) which require a fast reaction from first responders to take control of the situation and extinguish the fire within a couple of hours. For such operations systems/sensors (e.g. cameras for monitoring) are needed that can be installed rapidly, delivering near real time (10min-1 hour) information for assessment and decision-making for rapid intervention teams (detection and response phase)

FUNCTIONAL REQUIREMENTS

The following table shows the functional requirements of Austrian pilot.

Table 13 Functional Requirements Austria

NUM	ID	Description	Detection	Response
1	**FR-IN1**	The system must be able to retrieve, store and manage the information generated by all the sensors used for detection	X	
1.1	**FR-IN1-1**	The system must be able to retrieve, store and manage information from cameras/optical sensors	X	
1.2	**FR-IN1-2**	The system must be able to retrieve, store and manage information from infrared cameras/optical sensors	X	

NUM	ID	Description	Detection	Response
4	**FR-DAT1**	The system should be able to manage information concerning fire response teams	X	X
4.1	**FR-DAT1-1**	Firefighters	X	**X**
5	**FR-DAT2**	Fire response team's information should include dynamic information		**X**
5.2	**FR-DAT2-2**	GPS Location		**X**
5.3	**FR-DAT2-3**	Specialization level		**X**
5.4	**FR-DAT2-4**	Availability		**X**
5.5	**FR-DAT2-5**	Number of troops		**X**
6	**FR-DAT3**	The system should be able to manage information concerning firefighting resources		**X**
6.2	**FR-DAT3-2**	Helicopters		X
6.5	**FR-DAT3-5**	Third party provided resources		X
6.7	**FR-DAT3-7**	Drones	X	X
6.9	**FR-DAT3-9**	Firefighter's parks/departments		X
7	**FR-DAT4**	Firefighting resources information should include dynamic information		X
7.2	**FR-DAT4-2**	GPS Localization		X
7.3	**FR-DAT4-3**	Type of resource		X
7.4	**FR-DAT4-4**	Quantitative measurements		X
7.6	**FR-DAT4-6**	Availability		X
8	**FR-DAT5**	The system should manage terrain information	X	X
8.3	**FR-DAT5-3**	Terrain information should include data on the terrain's orography.	X	X
8.10	**FR-DAT5-10**	Terrain information should include data on terrain's water source's location		X
10	**FR-PROC1**	The system must have the ability to operate with different data managed by it, store and manage results	X	

NUM	ID	Description	Detection	Response
10.22	**FR-PROC1-22**	To obtain georeferenced fire detections	X	
11	**FR-PROC2**	The system must be able to manage fire detections	X	
11.1	**FR-PROC2-1**	With sensors as a start point	X	
11.3	**FR-PROC2-3**	With an emergency phone call as a starting point	X	
11.4	**FR-PROC2-4**	With a dedicated app emergency notification tool as a start point	X	
11.5	**FR-PROC2-5**	With a public web as a start point	X	
17	**FR-OUT1**	The system should have a central support access point/dashboard capable of receiving requests related to the information managed by the system		X

NON FUNCTIONALS REQUIREMENTS

The following table shows the non-functional requirements of Austrian pilot.

Table 14 Non-functional Requirements Austria

NUM	ID	Description
1	**NFR-AV1**	System must be available to field actors during detection and response phase
1.1	**NFR-AV1-1**	Also, without WLAN connectivity available
2	**NFR-ACC1**	System must be accessible to field actors using a personal device
2.1	**NFR-ACC1-1**	From an App (android? OS??)
7	**NFR-IOP-DEV1**	The system should have sensors and devices installed to capture all the parameters to be considered in wildfire detection and response phases
8	**NFR-IOP-CON1**	The system should have connectivity with sensors and devices involved in the detection of parameters related to the detection and response phases of a wildfire
9	**NFR-IOP-CON2**	Communication between system connected participants (users, devices, platforms, connected resources, TREEADS services as decision support system) should be established using telematic means that always ensures communication.
9.1	**NFR-IOP-CON2-1**	4G/5G Mobile connectivity

NUM	ID	Description
9.2	**NFR-IOP-CON2-2**	WLAN based connectivity using radiofrequency networks to provide communication between security forces
9.4	**NFR-IOP-CON2-4**	Internet
10	**NFR-IOP-PR1**	The system should have access to aerial means capable of transporting sensors and/or cameras
10.1	**NFR-IOP-PR1-1**	unmanned aerial means as drones
10.2	**NFR-IOP-PR1-2**	helicopters
11	**NFR-IOP-PR2**	All aerial assets used by the system should be geo-referenced and plotted at all times.

6. Germany

DESCRIPTION

The develop intention of this pilot according to actual knowledge is to be focus on three objectives:

- Generation of complex data by conducting experiments in a controlled environment (BAM, OvGU) using real soil samples as start point, that help to better understand fire smoke propagation in forest soil fires, combining numerical simulations (as FDS) and different algorithmic models
- Generate complex data by conducting experiments a controlled environment (BAM, OvGU) using real soil samples as start point to advance in new extinguishment agents (One Seven-OS) and to improve firefighting tactics using for example drones (ACCELI) for extinguishments tasks as foam spray devices, combining numerical simulations (FDS) and different algorithmic models
- Develop a smoke toxicity safety guidance to support for inhabitants and fire fighters improved with previous acquired knowledge

DETECTION approach

It seems no direct fire detection functionality development intention in this pilot.

RESPONSE approach

The extraction of requirements for the Response phase in this pilot has been developed trying to take advantage of the full information and models generated in the pilot experience, storing results obtained to combine this knowledge together with the different proposed data sources (sensors, cameras, online maps), considering also tools to ease geographical treatment (GIS), adding desirable GPS localization of firefighters, first responders and resources in response phase.

As End Users requirement this pilot seems to require a central role-based access point to responders, available and stable, that let them a secure access to the information generated by the system (on demand maps catalogue, inventory reports, support about fire extinction strategies and even decision support), and also available to inhabitants, to follow guidance in an emergency case.

AS-IS VERSUS TO-BE SITUATION

AS-IS

To date, Germany has no truly operational firefighting aircraft. In most cases, helicopters of the German Federal Police or the German Armed Forces have to help. In many cases, however, they are only partially operational and can drop a maximum of 5,000 liters of water.

There is no standard, national fire department regulation for forest and vegetation firefighting. The communication and interaction of interfaces is largely regulated only locally and not in general.

Map material for fire departments is not comprehensively and uniformly processed. In addition, there is a lack of suitable protective clothing for fire fighters in a nationwide regard. Indoor firefighting clothing is not suitable for forest fire operations.

A large proportion of(East) German fires occur in areas contaminated by munitions. It is unclear to what extent the contaminated sites themselves can cause ignition. In addition, access to extinguish the areas is usually not possible because of the hazard. Removal of contaminated sites causes high costs and logistical effort.

Germany has had major problems with embers that smolder and can flare up again after a few days. Use of drones with thermal imaging cameras to detect ember nests recommended, but not implemented nationwide.

Dead wood exposure or removal in German forests is controversial. Proponents of leaving it argue that deadwood provides habitat and nutrients and contributes to forest regeneration, while opponents emphasize the risks of forest fires and the accessibility of forest areas

TO-BE

The aim is to characterize the types of fire that occur in relation to vegetation fires as well as to identify significant influencing factors for fire development. Research on vegetation and forest fires is intended to close gaps in knowledge about the chemical processes in progress and how the fire starts and spreads, considering climate and topographical influences.

Various measurement campaigns on material-specific safety-related parameters, fire behaviour and spread as well as self-ignition are carried out. The focus ison the characterization of smoke formation, spread and composition. In order to be able to assess the risk to people, doses of toxic and irritating smoke gases are determined considering the duration of exposure.

A distinction should be made between the risk to emergency services and the population in terms of spread and expected concentration in order to be able to derive concrete tactical approaches and protective measures for emergency services as well as for the civilian population. This approach provides the basis for the development of models, especially for numerical methods, for predicting the course of fire in forest areas. (Solutions to be investigated within TREEADS)

Summarised Impacts and Consequences:

- Better prediction of smoke and fire spread
- Control of air pollution
- Smoke toxicity limits for safe evacuation order
- Health and risk assessment for firefighters

- Environmentally friendly use of compressed air foams
- Scenario-based concepts for training of tactical units

FUNCTIONAL REQUIREMENTS

The following table shows the functional requirements of German pilot.

Table 15 Functional Requirements Germany

NUM	ID	Description	Detection	Response
1	**FR-IN1**	The system must be able to retrieve, store and manage the information generated by all the sensors used for detection	X	
1.1	**FR-IN1-1**	The system must be able to retrieve, store and manage information from cameras/optical sensors	X	
1.2	**FR-IN1-2**	The system must be able to retrieve, store and manage information from infrared cameras/optical sensors	X	
1.11	**FR-IN1-11**	The system must be able to retrieve, store and manage information from soil humidity sensors	X	
1.12	**FR-IN1-12**	The system must be able to retrieve, store and manage information from ambient temperature sensors	X	
1.13	**FR-IN1-13**	The system must be able to retrieve, store and manage information from ambient soil temperature sensors	X	
1.14	**FR-IN1-14**	The system must be able to retrieve, store and manage information from ambient airflow sensors	X	
1.15	**FR-IN1-15**	The system must be able to retrieve, store and manage information from atmospheric composition sensors	X	
2	**FR-IN2**	The system must be able to retrieve, store and manage information from other systems	X	X
2.5	**FR-IN2-5**	The system must be able to obtain, store and manage information from external GIS Source		X
2.6	**FR-IN2-6**	The system must be able to obtain, store and manage information from external WEB Source		X
2.8	**FR-IN2-8**	From weather information services	X	X

NUM	ID	Description	Detection	Response
3	**FR-IN3**	The system must be able to allow the input, storage and management of information		X
3.1	**FR-IN3-1**	Relative to characterized soil samples.		X
3.7	**FR-IN3-7**	Relative to custom parameters	X	X
3.8	**FR-IN3-8**	Relative to historical data from the region	X	X
3.9	**FR-IN3-9**	Relative to fire suppression strategies		X
3.10	**FR-IN3-10**	Relative to use of extinguishing agents		X
3.11	**FR-IN3-11**	Relative to use of general equipment		X
8	**FR-DAT5**	The system should manage terrain information	X	X
8.1	**FR-DAT5-1**	Terrain information should include data on characterized ecosystems.	X	X
8.2	**FR-DAT5-2**	Terrain information should include data on characterized biomes.	X	X
10	**FR-PROC1**	The system must have the ability to operate with different data managed by it, store and manage results	X	X
10.7	**FR-PROC1-7**	To obtain air quality	X	
10.8	**FR-PROC1-8**	To obtain airborne microparticles	X	
10.9	**FR-PROC1-9**	To predict the spread of fire and smoke		X
10.10	**FR-PROC1-10**	To enhance sensors retrieved information using information from other sources		X
10.11	**FR-PROC1-11**	To generate situation-aware risk models	X	
10.12	**FR-PROC1-12**	To generate maps of the extent and severity of fires		X
10.13	**FR-PROC1-13**	To estimate carbon emission for fire		X
10.14	**FR-PROC1-14**	To optimize fire suppression strategies		X
10.15	**FR-PROC1-15**	To optimize victims' evacuation		X

NUM	ID	Description	Detection	Response
10.16	**FR-PROC1-16**	To optimize environmental impact from the use of different extinguishing agents, retardants, and equipment in different scenarios		X
10.17	**FR-PROC1-17**	As a decision support system		X
13	**FR-CONF1**	It should be possible to configure parameterizable events in the system to monitor the level of fire risk.	X	X
14	**FR-CONF2**	The systems should allow the creation, combination and parameter's configuration using all indexes managed	X	
14.3	**FR-CONF2-3**	to create a situation aware risk model	X	
14.4	**FR-CONF2-4**	To enhance sensors retrieved information	X	
14.5	**FR-CONF2-5**	To generate data sources to feed prediction models	X	
16	**FR-CONF4**	The system must allow parameters configuration	X	X
16.2	**FR-CONF4-2**	Role access for specific services	X	X
17	**FR-OUT1**	The system should have a central support access point/dashboard capable of receiving requests related to the information managed by the system		X
18	**FR-OUT2**	The system must be able to manage display information during the response phase		X
18.4	**FR-OUT2-4**	On demand map's catalog		X
19	**FR-OUT3**	The system must provide access to custom developed services		X
19.4	**FR-OUT3-4**	Situation-aware risk models		X
19.5	**FR-OUT3-5**	Prediction of the spread of fire and smoke		X
19.6	**FR-OUT3-6**	A decision support system to help on field responders		X

NON-FUNCTIONAL REQUIREMENTS

The following table shows the functional requirements of German pilot.

Table 16 Non-functional Requirements Germany

NUM	ID	Description	Germany
1	**NFR-AV1**	System must be available to field actors during detection and response phase	X
3	**NFR-ACC2**	The system should have a stable interface to allow the connection with the human resources involved in extinguishing the fire.	X
6	**NFR-SEC**	Role access must be implemented using secure protocols	X
7	**NFR-IOP-DEV1**	The system should have sensors and devices installed to capture all the parameters to be considered in wildfire detection and response phases	X
8	**NFR-IOP-CON1**	The system should have connectivity with sensors and devices involved in the detection of parameters related to the detection and response phases of a wildfire	X
9	**NFR-IOP-CON2**	Communication between system connected participants (users, devices, platforms, connected resources, TREEADS services as decision support system) should be established using telematic means that always ensures communication.	X
9.4	**NFR-IOP-CON2-4**	Internet	X
16	**NFR-COMP2**	The information managed by the system should be stored in a repository based/standardized database on open standards	X
16.2	**NFR-COMP2-1**	Standardized database	X

7. Greece

DESCRIPTION

The intention of this pilot according to actual knowledge is to develop a system that optimizes procedures related with human and animal evacuation during a wildfire incident in an area with intense terrain and limited escape routes.

For this purpose, the system must be able to detect fire using sensors deployed in the forest (8BELLS) or onboarded cameras in drones (ACCELI) and manage this detection using an event-driven fire detections paradigm (FRONTIER).

Furthermore, information retrieves from this sensors/camera and other data retrieved from resources and responders (as location or resources status) must also feed specific models and algorithms (NOA, CERTH) to improves responders supporting tools, by one hand, providing complex information related to object recognition or target detection (CERTH, 8BELLS), burning area mapping (NOA), fire spread prediction, etc; and by other hand, supporting response and evacuation processes management (FRONTIER) with the use of specific algorithms for mission planning and swarm coordination (CERTH).

To ease sensor data access for the different solutions, a Middleware is proposed (8BELLS), and to ease access to the different solutions, interact with a custom Digital Marketplace (ADR) that includes these specific data/digital solutions.

Finally, this system should be available and stable for all the stakeholders during the evacuation, and the deployment of 5G PCS (8Bells) on trucks are proposed for this purpose on this pilot. Furthermore, End-users must be comfortable with communication and instant messaging application (8Bells), and with the devices proposed to be used on field, as AR Helmets (8BELLS) or tablets.

DETECTION approach

System must be able to detect fire using sensors deployed in the forest (8BELLS) or onboarded cameras in drones (ACCELI) and manage this detection using an event-driven fire detections paradigm (FRONTIER), accessing sensors data using a middleware (8BELLS)

RESPONSE approach

The extraction of requirements for the response phase in this pilot has been developed with a main idea: the system must use some critical data, related to the monitoring/known data that the system requires to work (sensors information, responders localization, terrain information, etc) together with configuration needs (alarm receivers, parameters) and the associated responses that could be of interest to support the evacuation in a wildfire scenario in this area (exits paths, spread prediction, etc) also considering technical requirements to make it viable, also with secure (role access) and performance conditions (real time, minimum capacity).

AS-IS VERSUS TO-BE SITUATION

AS-IS

The outpost at Xyloskalo cannot actually monitor the whole area of the Gorge since visibility from that point is very low.

The surveillance cameras system offers a general image but there is a need for improvement (e.g. network thickening).

There is no cell phone coverage in the gorge; wireless communication is extremely difficult in the area. In several locations throughout the path even the signal of the forest guards' portable transceivers is extremely weak.

The seasonal personnel is not always well trained to face a wildfire, or to easily locate the exact spot of an area (in case of a fire incident).

The available personnel can be considered limited since, indicatively last year, less than 20 people (forest guards and firefighters) worked on a daily basis in the Gorge.

Since the area is a National Park there are legislative constrains set regarding the vegetation that can be removed in order to form fire safety zones.

In case of a fire incident a lot of different bodies and agencies are involved with very limited knowledge of the area and their duties.

TO-BE

The main improvements within TREEADS premises focus on the technical capabilities to:

a. Better predict adverse weather conditions on the pilot site,
b. Timely detect potential wildfires via new, near real time survey technologies
c. To provide fast and weather informed guidance to the first responders for the visitors' evacuation.

FUNCTIONAL REQUIREMENTS

The following table shows the functional requirements of Greek pilot.

Table 17 Functional Requirements Greece

NUM	ID	Description	Detection	Response
1	**FR-IN1**	The system must be able to retrieve, store and manage the information generated by all the sensors used for detection	X	
1.1	**FR-IN1-1**	The system must be able to retrieve, store and manage information from cameras/optical sensors	X	
1.2	**FR-IN1-2**	The system must be able to retrieve, store and manage information from infrared cameras/optical sensors	X	

NUM	ID	Description	Detection	Response
1.4	**FR-IN1-4**	The system must be able to retrieve, store and manage information from VR interfaces	X	
1.8	**FR-IN1-8**	The system must be able to retrieve, store and manage information from smoke detectors	X	
1.16	**FR-IN1-16**	The system must be able to retrieve, store and manage information from air pressure sensors	X	
1.17	**FR-IN1-17**	The system must be able to retrieve, store and manage information from weather stations	X	
1.18	**FR-IN1-18**	The system must be able to retrieve, store and manage information from acoustic sensors	X	
3	**FR-IN3**	The system must be able to allow the input, storage and management of information		X
3.9	**FR-IN3-9**	Relative to fire suppression strategies		X
3.10	**FR-IN3-10**	Relative to use of extinguishing agents		X
4	**FR-DAT1**	The system should be able to manage information concerning fire response teams	X	X
4.1	**FR-DAT1-1**	Firefighters	X	X
4.2	**FR-DAT1-2**	Volunteers	X	X
4.4	**FR-DAT1-4**	Regional emergency services	X	X
5	**FR-DAT2**	Fire response team's information should include dynamic information		X
5.2	**FR-DAT2-2**	GPS Location		X
6	**FR-DAT3**	The system should be able to manage information concerning firefighting resources		X
6.1	**FR-DAT3-1**	Firetrucks		X
6.2	**FR-DAT3-2**	Helicopters		X
6.3	**FR-DAT3-3**	Water pumps		X
6.4	**FR-DAT3-4**	Specific fire extinguishers		X
6.5	**FR-DAT3-5**	Third party provided resources		X

NUM	ID	Description	Detection	Response
7	**FR-DAT4**	Firefighting resources information should include dynamic information		X
7.1	**FR-DAT4-1**	Related to their condition		X
7.2	**FR-DAT4-2**	GPS Localization		X
7.3	**FR-DAT4-3**	Type of resource		X
7.4	**FR-DAT4-4**	Quantitative measurements		X
7.5	**FR-DAT4-5**	Capabilities		X
7.6	**FR-DAT4-6**	Availability		X
10	**FR-PROC1**	The system must have the ability to operate with different data managed by it, store and manage results	X	X
10.3	**FR-PROC1-3**	To track/trace location of the responders		X
10.4	**FR-PROC1-4**	To obtain the location of the response teams		X
10.9	**FR-PROC1-9**	To predict the spread of fire and smoke		X
10.17	**FR-PROC1-17**	As a decision support system		X
10.18	**FR-PROC1-18**	To monitor wildfires in real time		X
10.19	**FR-PROC1-19**	To optimize the location of installed cameras in order to improve areas on monitoring/minimize device number		X
10.20	**FR-PROC1-20**	For meteorology in real-time monitoring	X	X
10.21	**FR-PROC1-21**	For real time tree ecophysiology observation		X
10.22	**FR-PROC1-22**	To obtain georeferenced fire detections	X	
10.23	**FR-PROC1-23**	To obtain real-time environmental impact caused by fire reports		X
11	**FR-PROC2**	The system must be able to manage fire detections	X	
11.1	**FR-PROC2-1**	With sensors as a start point	X	

NUM	ID	Description	Detection	Response
14	**FR-CONF2**	The systems should allow the creation, combination and parameter's configuration using all indexes managed	X	
14.5	**FR-CONF2-5**	To generate data sources to feed prediction models	X	
16	**FR-CONF4**	The system must allow parameters configuration	X	X
16.1	**FR-CONF4-1**	Notification alarm receivers	X	X
16.2	**FR-CONF4-2**	Role access for specific services	X	X
16.3	**FR-CONF4-3**	Information priorization and classification	X	X
16.4	**FR-CONF4-4**	For the creation of virtual control rooms	X	X
17	**FR-OUT1**	The system should have a central support access point/dashboard capable of receiving requests related to the information managed by the system		X
18	**FR-OUT2**	The system must be able to manage display information during the response phase		X
18.4	**FR-OUT2-4**	On demand maps' catalogue		X
19	**FR-OUT3**	The system must provide access to custom developed services		X
19.5	**FR-OUT3-5**	Prediction of the spread of fire and smoke		X
19.6	**FR-OUT3-6**	A decision support system to help on field responders		X
19.7	**FR-OUT3-7**	Support for the exchange of information between first responders and command control centre		X
19.8	**FR-OUT3-8**	Support media coverage		X
19.9	**FR-OUT3-9**	support to handle the relatives of victims connecting Social Networks and Citizen Platforms through APIs		X
19.10	**FR-OUT3-10**	Login, Check-in, or ticket system that allows registration of forest's area visitors		X
20	**FR-OUT4**	The system must be able to send notifications alarms	X	X

NON-FUNCTIONAL REQUIREMENTS

The following table shows the non-functional requirements of Greek pilot.

Table 18 Non-functional Requirements Greece

NUM	ID	Description
1	**NFR-AV1**	System must be available to field actors during detection and response phase
3	**NFR-ACC2**	The system should have a stable interface to allow the connection with the human resources involved in extinguishing the fire.
4	**NFR-ACC3**	The system should be equipped with a prioritized communication channel in case of wildfire detection or other related events.
4.2	**NFR-ACC3-2**	Between first responders and the Command Control Center involved
6	**NFR-SEC**	Role access must be implemented using secure protocols
7	**NFR-IOP-DEV1**	The system should have sensors and devices installed to capture all the parameters to be considered in wildfire detection and response phases
8	**NFR-IOP-CON1**	The system should have connectivity with sensors and devices involved in the detection of parameters related to the detection and response phases of a wildfire
9	**NFR-IOP-CON2**	Communication between system connected participants (users, devices, platforms, connected resources, TREEADS services as decision support system) should be established using telematic means that always ensures communication.
9.4	**NFR-IOP-CON2-4**	Internet
16.2	**NFR-COMP2-1**	Standardized database
17	**NFR-CAP**	The number of concurrent users of the information system must be greater than 30.
18	**NFR-PER1**	The flow information in the communication channel must be less than 5 minutes.
19	**NFR-PER2**	Real-time performance is mandatory in some cases

8. Taiwan

DESCRIPTION

The intention of this pilot according to actual knowledge is to be oriented to the collection, storage and management of information through the use of sensors inside boxes built with a material specifically designed to withstand critical fire conditions, through the performance of certain experimental tests.

It also seems that they will use these data to perform some processing related to prediction algorithms or risk maps' generation.

DETECTION approach

There is no direct fire detection functionality intention in this pilot.

RESPONSE approach

It does not seem that they are planning to develop any specific system aimed at giving support to those involved in extinction tasks in the response phase, although it does give us the feeling that the capture and processing of information that they consider could be useful in this stage, both at the level of prediction models and data (raw or inferred) to inject into other models of a holistic TREEADS.

The extraction of functional requirements for the response phase in this pilot has been developed with this idea in mind: to take advantage of the results obtained in their tests to be consumed in the response phase by any TREEADS agent, with no major impact on development.

AS-IS VERSUS TO-BE SITUATION

AS-IS

The wildfire caused by human activities cannot be controlled due to the wind speed or direction. Some risks include large amount of smoke, thereby reducing the distance of visual sight to the road user. The air pollution also affects the health of our neighbours.

TO-BE

The TREEADS project in Taiwan will provide data collection and transmission including temperature, humidity, wind speed and smoke by means of sensors. These data report the weather conditions before, during and after wildfire periods. Based on the data analysis, the holistic fire management can forecast the situations before wildfire, and also give the protecting solution by means of the early warning system. Currently, only the images taken by automatic in-situ camera are used for the restoration & adaption analyses.

As a result, the TREEADS system will be promised as useful solution for fire detection and wildfire protection.

In addition, considering the ecosystem applied to the fire management, the recycling of post wildfire wood ashes used for producing building materials will be conducted in this project. New concrete will be design and its performance will be validated the lab results in term of the thermal-induced properties.

FUNCTIONAL REQUIREMENTS

The following table shows the functional requirements of Taiwanese pilot.

Table 19 Functional Requirements Taiwan

NUM	ID	Description	Detection	Response
1	**FR-IN1**	The system must be able to retrieve, store and manage the information generated by all the sensors used for detection		X
1.1	**FR-IN1-1**	The system must be able to retrieve, store and manage information from cameras/optical sensors		X
1.5	**FR-IN1-5**	The system must be able to retrieve, store and manage information from wind speed sensors		X
1.7	**FR-IN1-7**	The system must be able to retrieve, store and manage information from humidity sensors		X
1.8	**FR-IN1-8**	The system must be able to retrieve, store and manage information from smoke detectors		X
1.12	**FR-IN1-12**	The system must be able to retrieve, store and manage information from ambient temperature sensors		X
1.17	**FR-IN1-17**	The system must be able to retrieve, store and manage information from weather stations		X
1.19	**FR-IN1-19**	The system must be able to retrieve, store and manage information from observation stations to measure fuel		X
9	**FR-DAT6**	The system should be able to store fire-detection notifications and/or response phase monitoring information in a database of historical incidents		X
10	**FR-PROC1**	The system must have the ability to operate with different data managed by it, store and manage results		X
10.9	**FR-PROC1-9**	To predict the spread of fire and smoke		X
10.24	**FR-PROC1-24**	To generate fire risk level maps		X

NUM	ID	Description	Detection	Response
10.25	**FR-PROC1-25**	For data analytics		X
13	**FR-CONF1**	It should be possible to configure parameterizable events in the system to monitor the level of fire risk.		X
18	**FR-OUT2**	The system must be able to manage display information during the response phase		X
18.5	**FR-OUT2-5**	Data Analytics		X

NON-FUNCTIONAL REQUIREMENTS

The following table shows the non-functional requirements of Taiwanese pilot.

Table 20 Non-functional Requirements Taiwan

NUM	ID	Description	Taiwan
7	**NFR-IOP-DEV1**	The system should have sensors and devices installed to capture all the parameters to be considered in wildfire detection and response phases	X
8	**NFR-IOP-CON1**	The system should have connectivity with sensors and devices involved in the detection of parameters related to the detection and response phases of a wildfire	X
9	**NFR-IOP-CON2**	Communication between system connected participants (users, devices, platforms, connected resources, TREEADS services as decision support system) should be established using telematic means that always ensures communication.	X
16	**NFR-COMP2**	The information managed by the system should be stored in a repository based/standardized database on open standards	X
16.2	**NFR-COMP2-1**	Standardized database	X

CONSOLIDATED TREEADS REQUIREMENTS

FUNCTIONAL REQUIREMENTS

The following table include a complete functional requirement aggregation based on pilot's information.

Table 21 Functional Requirements Aggregation Table

NUM	ID	Description	Norway	Italy	Romania	Spain	Austria	Germany	Greece	Taiwan
1	**FR-IN1**	The system must be able to retrieve, store and manage the information generated by all the sensors used for detection	X		X	X	X	X	X	X
1.1	**FR-IN1-1**	The system must be able to retrieve, store and manage information from cameras/optical sensors	X		X	X	X	X	X	X
1.2	**FR-IN1-2**	The system must be able to retrieve, store and manage information from infrared cameras/optical sensors	X		X	X	X?	X	X	
1.3	**FR-IN1-3**	The system must be able to retrieve, store and manage information from multispectral cameras				X				
1.4	**FR-IN1-4**	The system must be able to retrieve, store and manage information from VR interfaces							X	
1.5	**FR-IN1-5**	The system must be able to retrieve, store and manage information from wind speed sensors	X							X
1.6	**FR-IN1-6**	The system must be able to retrieve, store and manage information from wind direction sensors	X							
1.7	**FR-IN1-7**	The system must be able to retrieve, store and manage information from humidity sensors	X							X
1.8	**FR-IN1-8**	The system must be able to retrieve, store and manage information from smoke detectors	X			X			X	X
1.9	**FR-IN1-9**	The system must be able to retrieve, store and manage information from LiDAR			X					

1.10	**FR-IN1-10**	The system must be able to retrieve, store and manage information from incidents detectors				X				
1.11	**FR-IN1-11**	The system must be able to retrieve, store and manage information from soil humidity sensors						X		
1.12	**FR-IN1-12**	The system must be able to retrieve, store and manage information from ambient temperature sensors	X					X		X
1.13	**FR-IN1-13**	The system must be able to retrieve, store and manage information from ambient soil temperature sensors	X?					X		
1.14	**FR-IN1-14**	The system must be able to retrieve, store and manage information from ambient airflow sensors						X		
1.15	**FR-IN1-15**	The system must be able to retrieve, store and manage information from atmospheric composition sensors						X		
1.16	**FR-IN1-16**	The system must be able to retrieve, store and manage information from air pressure sensors							X	
1.17	**FR-IN1-17**	The system must be able to retrieve, store and manage information from weather stations							X	X
1.18	**FR-IN1-18**	The system must be able to retrieve, store and manage information from acoustic sensors							X	
1.19	**FR-IN1-19**	The system must be able to retrieve, store and manage information from observation stations to measure fuel								X
2	**FR-IN2**	The system must be able to retrieve, store and manage information from other systems	X	X	X			X		

2.1	**FR-IN2-1**	The system must be able to obtain, storing and manage information relative to Rainfall for the area	X					
2.2	**FR-IN2-2**	The system must be able to obtain, storing and manage information relative to first responders' location	X					
2.3	**FR-IN2-3**	The system must be able to obtain, storing and manage information relative resource's location						
2.4	**FR-IN2-4**	The system must be able to obtain, store and manage information from external database			X			
2.5	**FR-IN2-5**	The system must be able to obtain, store and manage information from external GIS Source		X			X?Maps?	
2.6	**FR-IN2-6**	The system must be able to obtain, store and manage information from external WEB Source		X			X?maps?	
2.7	**FR-IN2-7**	The system must be able to obtain, store and manage information from Copernicus Services		X	X			
2.8	**FR-IN2-8**	From weather information services					X	
2.9	**FR-IN2-9**	SMA Campania app emergency notifications		X				
3	**FR-IN3**	The system must be able to allow the input, storage and management of information	X			X	X	X
3.1	**FR-IN3-1**	Relative to characterized soil samples.	X				X	
3.2	**FR-IN3-2**	Relative to fire response teams	X					

3.3	**FR-IN3-3**	Relative to fire extinction resources	X				
3.4	**FR-IN3-4**	Relative to other resources					
3.5	**FR-IN3-5**	Relative to terrain information	X				
3.6	**FR-IN3-6**	Relative to forecast parameters		X			
3.7	**FR-IN3-7**	Relative to custom parameters		X		X	
3.8	**FR-IN3-8**	Relative to historical data from the region				X	
3.9	**FR-IN3-9**	Relative to fire suppression strategies				X	X
3.10	**FR-IN3-10**	Relative to use of extinguishing agents				X	X
3.11	**FR-IN3-11**	Relative to use of general equipment				X	
4	**FR-DAT1**	The system should be able to manage information concerning fire response teams	X	X	X		X
4.1	**FR-DAT1-1**	Firefighters	X	X	X		X
4.2	**FR-DAT1-2**	Volunteers	X	X			X
4.3	**FR-DAT1-3**	Civil protection	X				
4.4	**FR-DAT1-4**	Regional emergency services	X				X

4.5	**FR-DAT1-5**	Police	X				
4.6	**FR-DAT1-6**	Forest rangers	X				
4.7	**FR-DAT1-7**	Coast guard	X				
4.8	**FR-DAT1-8**	Helicopter crew			X		
4.9	**FR-DAT1-9**	Environmental agents			X		
4.10	**FR-DAT1-10**	Fire technicians			X		
4.11	**FR-DAT1-11**	Communication officers			X		
5	**FR-DAT2**	Fire response team’s information should include dynamic information	X	X	X	X	X
5.1	**FR-DAT2-1**	Schedules	X				
5.2	**FR-DAT2-2**	GPS Location	X	X	X	X	X
5.3	**FR-DAT2-3**	Specialization level	X		X	X	

5.4	**FR-DAT2-4**	Availability	X		X	X	
5.5	**FR-DAT2-5**	Number of troops	X		X	X	
6	**FR-DAT3**	The system should be able to manage information concerning firefighting resources	X	X	X	X	X
6.1	**FR-DAT3-1**	Firetrucks	X	X			X
6.2	**FR-DAT3-2**	Helicopters	X			X	X
6.3	**FR-DAT3-3**	Water pumps	X				X
6.4	**FR-DAT3-4**	Specific fire extinguishers	X				X
6.5	**FR-DAT3-5**	Third party provided resources	X			X	X
6.6	**FR-DAT3-6**	ATV’s		X			
6.7	**FR-DAT3-7**	Drones		X	X	X	
6.8	**FR-DAT3-8**	HAPs (high altitude platforms)			X		

6.9	**FR-DAT3-9**	Firefighter's parks/departments			X	X		
6.10	**FR-DAT3-10**	Bulldozers			X			
7	**FR-DAT4**	Firefighting resources information should include dynamic information	X	X	X	X		X
7.1	**FR-DAT4-1**	Related to their condition	X	X	X			X
7.2	**FR-DAT4-2**	GPS Localization	X	X	X	X		X
7.3	**FR-DAT4-3**	Type of resource	X	X	X	X		X
7.4	**FR-DAT4-4**	Quantitative measurements	X	X	X	X		X
7.5	**FR-DAT4-5**	Capabilities	X		X			X
7.6	**FR-DAT4-6**	Availability	X	X	X	X		X
8	**FR-DAT5**	The system should manage terrain information	X		X	X	X	
8.1	**FR-DAT5-1**	Terrain information should include data on characterized ecosystems.	X				X	

8.2	**FR-DAT5-2**	Terrain information should include data on characterized biomes.	X			X	
8.3	**FR-DAT5-3**	Terrain information should include data on the terrain's orography.	X	X	X		
8.4	**FR-DAT5-4**	Terrain information should include characterized data on the terrain's population (elderly people, etc.)		X			
8.5	**FR-DAT5-5**	Terrain information should include data on the terrain's floating population		X			
8.6	**FR-DAT5-6**	Terrain information should include data on the terrain's forest-urban areas maintenance status		X			
8.7	**FR-DAT5-7**	Terrain should include data on the terrain's dryness		X			
8.8	**FR-DAT5-8**	Terrain information should include data on the terrain's forestry infrastructures maintenance status		X			
8.9	**FR-DAT5-9**	Terrain information should include data on the wildfire area access paths (roads, paths)		X			
8.10	**FR-DAT5-10**	Terrain information should include data on terrain's water source's location			X		
9	**FR-DAT6**	The system should be able to store fire-detection notifications and/or response phase monitoring information in a database of historical incidents	X				X

10	**FR-PROC1**	The system must have the ability to operate with different data managed by it, store and manage results	X		X	X	X	X	X	X
10.1	**FR-PROC1-1**	To obtain fire speed propagation	X							
10.2	**FR-PROC1-2**	To obtain heat fluxes	X							
10.3	**FR-PROC1-3**	To track/trace location of the responders	X			X			X	
10.4	**FR-PROC1-4**	To obtain the location of the response teams	X						X	
10.5	**FR-PROC1-5**	To detect human presence/human footprints			X					
10.6	**FR-PROC1-6**	To obtain soil and vegetation terrain information				X				
10.7	**FR-PROC1-7**	To obtain air quality						X		
10.8	**FR-PROC1-8**	To obtain airborne microparticles						X		
10.9	**FR-PROC1-9**	To predict the spread of fire and smoke						X	X	X
10.10	**FR-PROC1-10**	To enhance sensors retrieved information using information from other sources						X		

10.11	**FR-PROC1-11**	To generate situation-aware risk models			X	
10.12	**FR-PROC1-12**	To generate maps of the extent and severity of fires			X	
10.13	**FR-PROC1-13**	To estimate carbon emission for fire			X	
10.14	**FR-PROC1-14**	To optimize fire suppression strategies			X	
10.15	**FR-PROC1-15**	To optimize victims' evacuation			X	
10.16	**FR-PROC1-16**	To optimize environmental impact from the use of different extinguishing agents, retardants, and equipment in different scenarios			X	
10.17	**FR-PROC1-17**	As a decision support system	X		X	X
10.18	**FR-PROC1-18**	To monitor wildfires in real time		X		X
10.19	**FR-PROC1-19**	To optimize the location of installed cameras to improve areas on monitoring/minimize device number				X
10.20	**FR-PROC1-20**	For meteorology in real-time monitoring				X

10.21	**FR-PROC1-21**	For real time tree ecophysiology observation							X	
10.22	**FR-PROC1-22**	To obtain georeferenced fire detections				X	X		X	
10.23	**FR-PROC1-23**	To obtain real-time environmental impact caused by fire reports							X	
10.24	**FR-PROC1-24**	To generate fire risk level maps								X
10.25	**FR-PROC1-25**	For data analytics								X
11	**FR-PROC2**	The system must be able to manage fire detections	X	X		X	X		X	
11.1	**FR-PROC2-1**	With sensors as a start point	X			X	X		X	
11.2	**FR-PROC2-2**	Launched by smoke detectors	X			X				
11.3	**FR-PROC2-3**	With an emergency phone call as a starting point	X	X		X	X			
11.4	**FR-PROC2-4**	With a dedicated app emergency notification tool as a start point		X			X			
11.5	**FR-PROC2-5**	With a public web as a start point					X			

12	**FR-PROC3**	The system should be able to exploit information from an historical database to provide elaborated information during the wildfire.?	X?				
13	**FR-CONF1**	It should be possible to configure parameterizable events in the system ~~that generate alarms~~ to monitor the level of fire risk.	X		X		X
14	**FR-CONF2**	The systems should allow the creation, combination and parameter's configuration using all indexes managed		X	X	X	
14.1	**FR-CONF2-1**	To provide times of danger based on general forecast and custom on premise parameters		X			
14.2	**FR-CONF2-2**	to set up custom metrics and KPI's		X			
14.3	**FR-CONF2-3**	to create a situation aware risk model			X		
14.4	**FR-CONF2-4**	To enhance sensors retrieved information			X		
14.5	**FR-CONF2-5**	To generate data sources to feed prediction models		X	X	X	
15	**FR-CONF3**	The system must allow to set delimited territory areas in terms of risk and vulnerability		X			
15.1	**FR-CONF3-1**	This Areas should include information about possible intervention requirements		X			

15.2	**FR-CONF3-2**	This Areas must include stored information about means and resources				X				
15.3	**FR-CONF3-3**	This Areas could include information about deployment of means and resources				X				
16	**FR-CONF4**	The system must allow parameters configuration	X			X		X	X	
16.1	**FR-CONF4-1**	Notification alarm receivers	X			X			X	
16.2	**FR-CONF4-2**	Role access for specific services						X	X	
16.3	**FR-CONF4-3**	Information priorization and classification							X	
16.4	**FR-CONF4-4**	For the creation of virtual control rooms							X	
17	**FR-OUT1**	The system should have a central support access point/dashboard capable of receiving requests related to the information managed by the system	X	X	X	X	X	X	X	
18	**FR-OUT2**	The system must be able to manage display information during the response phase	X		X	X		X	X	X
18.1	**FR-OUT2-1**	the location of the response teams	X		X	X				
18.2	**FR-OUT2-2**	The location of each member of the fire response teams			X	X				

18.3	**FR-OUT2-3**	Vulnerability per area information		X			
18.4	**FR-OUT2-4**	On demand maps' catalogue	X	X	X	X	
18.5	**FR-OUT2-5**	Data Analytics					X
19	**FR-OUT3**	The system must provide access to custom developed services		X	X	X	
19.1	**FR-OUT3-1**	Multispectral images on demand		X			
19.2	**FR-OUT3-2**	Multispectral image processing services		X			
19.3	**FR-OUT3-3**	5G connectivity using HAPs		X			
19.4	**FR-OUT3-4**	Situation-aware risk models			X		
19.5	**FR-OUT3-5**	Prediction of the spread of fire and smoke			X	X	
19.6	**FR-OUT3-6**	A decision support system to help on field responders			X	X	
19.7	**FR-OUT3-7**	Support for the exchange of information between first responders and command control centre				X	

19.8	**FR-OUT3-8**	Support media coverage			X
19.9	**FR-OUT3-9**	support to handle the relatives of victims connecting Social Networks and Citizen Platforms through APIs			X
19.10	**FR-OUT3-10**	Login, Check-in, or ticket system that allows registration of forest's area visitors			X
20	**FR-OUT4**	The system must be able to send notifications alarms	X	X	X

NON-FUNCTIONAL REQUIREMENTS

The following table include a complete non-functional requirement aggregation based on pilots' information.

Table 22 Non-functional Requirements Aggregation Table

NUM	ID	Description	Norway	Italy	Romania	Spain	Austria	Germany	Greece	Taiwan
1	**NFR-AV1**	System must be available to field actors during detection and response phase	X	X	X	X	X	X	X	
1.1	**NFR-AV1-1**	Also, without WLAN connectivity available					X			
2	**NFR-ACC1**	System must be accessible to field actors using a personal device		X	X	X	X			
2.1	**NFR-ACC1-1**	From an App (android? OS??)		X			X			
2.2	**NFR-ACC1-2**	From a web browser								
3	**NFR-ACC2**	The system should have a stable interface to allow the connection with the human resources involved in extinguishing the fire.	X		X	X		X	X	
4	**NFR-ACC3**	The system should be equipped with a prioritized communication channel in case of wildfire detection or other related events.	X						X	
4.1	**NFR-ACC3-1**	between the local government and the fire department	X							
4.2	**NFR-ACC3-2**	Between first responders and the Command Control Center involved							X	
5	**NFR-INT**	Responders' personal devices must correctly receive and report fire alarms	X			X				

NUM	ID	Description	Norway	Italy	Romania	Spain	Austria	Germany	Greece	Taiwan
6	**NFR-SEC**	Role access must be implemented using secure protocols						X	X	
7	**NFR-IOP-DEV1**	The system should have sensors and devices installed to capture all the parameters to be considered in wildfire detection and response phases	X		X	X	X	X	X	X
8	**NFR-IOP-CON1**	The system should have connectivity with sensors and devices involved in the detection of parameters related to the detection and response phases of a wildfire	X		X	X	X	X	X	X
9	**NFR-IOP-CON2**	Communication between system connected participants (users, devices, platforms, connected resources, TREEADS services as decision support system) should be established using telematic means that always ensures communication.	X	X	X	X	X	X	X	X
9.1	**NFR-IOP-CON2-1**	4G/5G Mobile connectivity	X	X	X	X	X			
9.2	**NFR-IOP-CON2-2**	WLAN based connectivity using radiofrequency networks to provide communication between security forces				X	X			
9.3	**NFR-IOP-CON2-3**	Using HAPs as an EDGE 5G Mobile Aerials Networks				X				
9.4	**NFR-IOP-CON2-4**	Internet	X		X	X	X	X	X	

NUM	ID	Description	Norway	Italy	Romania	Spain	Austria	Germany	Greece	Taiwan
10	**NFR-IOP-PR1**	The system should have access to aerial means capable of transporting sensors and/or cameras	X		X	X	X			
10.1	**NFR-IOP-PR1-1**	unmanned aerial means as drones	X		X		X			
10.2	**NFR-IOP-PR1-2**	helicopters	X		X		X			
10.3	**NFR-IOP-PR1-3**	HAPs				X				
11	**NFR-IOP-PR2**	All aerial assets used by the system should be geo-referenced and always plotted.			X	X	X			
12	**NFR-IOP-SYS1**	The system should be integrated with external data sources		X	X					
12.1	**NFR-IOP-SYS1-1**	With a regional database		X	X					
12.2	**NFR-IOP-SYS1-2**	With a centralized database		X						
13	**NFR-IOP-SYS2**	The system should be integrated with external Systems		X		X				
13.1	**NFR-IOP-SYS2-1**	WebGis based Decision Support System https://itergis.regione.campania.it/		X						
13.2	**NFR-IOP-SYS2-2**	QGIS based systems				X				
14	**NFR-IOP-SYS3**	System must be integrated with Copernicus services		X	X	X				

NUM	ID	Description	Norway	Italy	Romania	Spain	Austria	Germany	Greece	Taiwan
15	**NFR-COMP1**	The information should be retrieved using Open-Source Framework	X							
15.1	**NFR-COMP1-1**	The information should be retrieved using Arrowhead Framework (the IoT Open-Source Framework)	X							
16	**NFR-COMP2**	The information managed by the system should be stored in a repository based/standardized database on open standards	X					X		X
16.1	**NFR-COMP2-1**	The information should be stored in a repository based on open standards (ISO 10303) in STEP data format.	X							
16.2	**NFR-COMP2-1**	Standardized database						X	X	X
17	**NFR-CAP**	The number of concurrent users of the information system must be greater than 30.							X	
18	**NFR-PER**	The flow information in the communication channel must be less than 5 minutes.							X	
19	**NFR-PER2**	Real-time performance is mandatory in some cases							X	
20	**NFR-CAP2**	The system should be able to process high volume data								

CONCLUSIONS AND IMPLICATIONS

The exhaustive analysis conducted in the pilots of TREEADS has revealed critical points and significant improvement opportunities. Particularly, the shift in the regime and type of wildfires underscores the imperative need to take a step further and implement additional measures to enhance the current situation. The TREEADS project emerges as a strategic and effective response to prevent and better prepare for potential catastrophes, with a specific focus on detection and response, crucial aspects in the current requirements document.

One highlighted aspect in the analysis is the increasing frequency, magnitude, and geographical scope of extraordinary wildfire events. The study "*Defining Extreme Wildfire Events: Difficulties, Challenges, and Impacts*"[(Fantina Tedim, 2018)] emphasizes the severity of these events, illustrating how some large-scale wildfires have had significant ecological and socioeconomic impacts worldwide. The lack of consensus in the terminology and conceptualization of these extraordinary events complicates the comparison of findings and coordination among operational agencies, policymakers, and the research community.

The citation emphasizes the urgent need for a clear definition based on unambiguous language and objectively measurable parameters. This becomes even more crucial in a climate change context, where climate processes are expected to favour the incidence of extraordinary wildfires. It is essential to develop a comprehensive definition that follows a transdisciplinary approach to establish a more robust foundation for research, policies, and operational efforts. The perceived nature of the problem and the precision of its definition can influence the level of decisions and the solutions considered.

In this regard, the TREEADS project offers a unique opportunity to address these challenges. By implementing specific measures focused on early detection and efficient response, the project can play a crucial role in reducing the risk associated with these extraordinary wildfires. Collaboration across diverse disciplines, operational agencies, and policymakers, supported by a clear and agreed-upon definition, will be essential for the long-term success of these initiatives.

Furthermore, the identification of specific areas for improvement from existing pilots provides a solid foundation for the ongoing development of the project. Lessons learned and experiences gained from the pilots should be proactively integrated into the large-scale implementation of the TREEADS project. This will ensure effective adaptation to changing wildfire conditions and enhance response capabilities in emergency situations.

In conclusion, the implementation of the TREEADS project emerges as an essential strategy to address the growing threat of extraordinary wildfires. By overcoming the identified limitations in the pilots and leveraging lessons learned from past events, we can move towards a more effective and coordinated approach in the prevention, detection, and response to these critical events. Continued investment and commitment in projects like TREEADS are imperative to safeguard not only natural resources but also the safety and well-being of communities affected by these devastating extraordinary wildfires.

These requirements will guide the technical partners in their efforts to develop the TREEADS holistic fire management platform for prevention, detection and response, and restoration of environmental disasters.

Please Notice this is a live document, and it is going to be updated as more information and data become available.

REFERENCES

Fantina Tedim, V. L. (15 de January de 2018). *Defining Extreme Wildfire Events: Difficulties, Challenges, and Impacts*. from https://www.mdpi.com/2571-6255/1/1/9

A Holistic Fire Management Ecosystem for Prevention, Detection and Restoration of Environmental Disasters

The Members of the TREEADS Consortium:

Short Name	Country	Short Name	Country	Short Name	Country
FRN	NO	**INNOV**	CY	**DCNA**	AT
Jotne	NO	**FI**	EL	**IFR**	AT
BAM	DE	**GBD**	BE	**FGK**	AT
Capgemini Eng.	ES	**EFB**	EL	**BFG**	AT
DH	ES	**LAMMC**	LT	**STRESS**	IT
USAL	ES	**OneSeven**	DE	**ACaMIR**	IT
SQD	BE	**VIPO**	NO	**Sorrento**	IT
CARTIF	ES	**WAS**	NO	**PUI**	FR
UdG	ES	**CBS**	DK	**FAFCYLE**	ES
NCSRD	EL	**K3Y**	BG	**DdA**	ES
SIMAVI	RO	**MAGG**	IT	**TUC**	EL
OvGU	DE	**NOA**	EL	**MAICh**	EL
ADR	EL	**MEWF**	RO	**DAAC**	EL
CERTH	EL	**ASFOR**	RO	**NTUST**	TW
8bells	CY	**SMURD**	RO	**DTU**	DK
ACCELI	CY	**JOAFG**	AT		

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