SILVANUS

D 9.3 - Report on Formal Assessment of Trial Period 1

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 101037247

Project Acronym	SILVANUS
Grant Agreement number	101037247 (H2020-LC-GD-2020-3)
Project Full Title	Integrated Technological and Information Platform for Wildfire Management
Funding Scheme	IA – Innovation action

DELIVERABLE INFORMATION

Deliverable Number:	D9.3
Deliverable Name:	SILVANUS Report on Formal Assessment of Trial Period 1
Dissemination level:	PU
Type of Document:	R
Contractual date of delivery:	31/03/2024 (M30)
Date of submission:	05/04/2024
Deliverable Leader:	EDP
Status:	FINAL
Version number:	V0.8
WP Leader/ Task Leader:	WP 9 – ASFOR/ Task 9.2 - EDP
Keywords:	#wildfires, #prevention, #detection, #restoration, #demonstration
Abstract:	Trial Period 1 of demonstrations in SILVANUS pilots occurred from M15 to M27(December 2023). On the path of D9.2, the present deliverable describes the formal assessment of the results achieved both in pilots and in User Products developments. Lessons learnt and key performance values are presented and compared to the targets early defined in D9.1. Future actions are also stated aiming at an even more outreach during Trial Period 2, incorporating all the comments from the first review period.

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Document History			
Version	**Date**	**Contributor(s)**	**Description**
V0.1	20.09.2023	Ricardo Lucas (EDP)	Initial report structure and table of contents
V0.2	11.01.2024	João Passagem Santos (EDP)	Report structure update
V0.3	26.02.2024	João Passagem Santos (EDP)	Prefill document and chapters
V0.4	11.03.2024	João Passagem Santos (EDP)	Document content refinement and formatting
V0.5	18.03.2024	João Passagem Santos (EDP)	Authors Revision and completion
V0.6	26.03.2024	Technical coordination	Reformulation of document organization
V0.7	04.04.2024	all	Final contributions and internal revision
V0.8		Lead Authors	Version for submission
V0.9	19.08.2024	All	Changes implemented as requested by reviewers

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List of acronyms and abbreviations

ACRONYM	Description
AP	Action Point
AR	Augmented Reality
BPBD	Badan Penanggulangan Bencana Daerah (Disaster Management Authority)
CA	Consortium Agreement
CPD	Civil Protection Department
DDS	Dynamic Data Store
DSS	Decision Support System
DoA	Description of Action
DX.Y	Deliverable X. Y (X refers to the WP and Y to the deliverable in the WP)
EAB	External Advisory Board
EC	European Commission
ECAS	European Commission Authentication Service
EIM	Exploitation and IP Manager
EI	Expected impact
ER	Expected result (ex ante)
EU	European Union
FFMC EFI	Fine Fuel Moisture Content Extreme Forecast Index
FFMC SOT	Fine Fuel Moisture Content Shift of Tails
FWI EFI	Forecast Index
FWI SOT	FWI Shift of Tails
GA	General Assembly
GIS	Geographic Information Systems
ICOIACT 2023	International Conference on Information and Communications Technology 2023
IFM	Integrated fire management
IoT	Internet of Things
IPRs	Intellectual Property Rights
KoM	Kick-off Meeting
KPI	Key Performance Indicators
ML	Machine Learning
MR	Measurement result (ex post)
NDVI	Normalized difference vegetation index
PAC	Project Administrative Coordinator
PCE	Pilot Case Exercise
PLA	Protected Landscape Area
PLAB	Protected Landscape Area Beskydy
PM	Project Manager
PQP	Project Quality Plan
QAC	Quality Assurance Coordinator

List of acronyms and abbreviations

ACRONYM	Description
QAM	Quality Assurance Manager
QAP	Quality Assurance Plan
SAL	Storage Abstraction Layer
ROS	Random Oversampling
RP	Reporting Period
SC	Steering Committee
SIC	Scientific and Innovation Coordinator
TL	Team Leader
ToC	Table of Contents
UAV	Unmanned Aerial Vehicle
UGV	Unmanned Ground Vehicle
UP	User Product(s)
VR	Virtual Reality
WP	Work Package
WPL	Work Package Leader

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5	FINCONS SPA	FINC	Italy
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Executive Summary

The deliverable summarises the activities carried out from April to December 2023, in relation to the organisation and execution of SILVANUS pilots, also to be referred as field exercises or tabletop exercises.

These exercises intended to evaluate, on each pilot context, the different, user products available in Trial Period 1 with the aim of improving them for Trial Period 2, specifically for their use in the field exercises.

Table 1 shows the different user products tested.

The UPs demonstrated in the several pilots (chronologically ordered) are presented in the table on the right.

Table 1: User Product in Pilots

	HR	SK	RO	FR	CZ	IT2	EL	ID	IT1	AU
UP1-AR/VR training toolkit for trainers			x	x						
UP2-Fire Danger Tool		x				x			x	
UP3-Fire detection based on social sensing				x		x	x	x	x	x
UP4-Fire detection from IoT devices	x			x		x	x		x	x
UP5-Fire detection from UAV/UGV	x	x		x	x	x	x		x	x
UP6-Fire Spread Forecast		x				x	x		x	
UP7-Woode - Biodiversity profile mob. App.				x	x			x		
UP8-Citizen engagement & info sharing App		x		x	x		x	x	x	

Both UPs and Pilots were evaluated in objective terms, considering KPIs defined in early SILVANUS documents, that enable to assess their progressive alignment with project objectives. The following figures express, during first trial period, the progress of UPs towards project objectives (left), as well pilots' fulfilment of project expectations and their own pilot objectives (right).

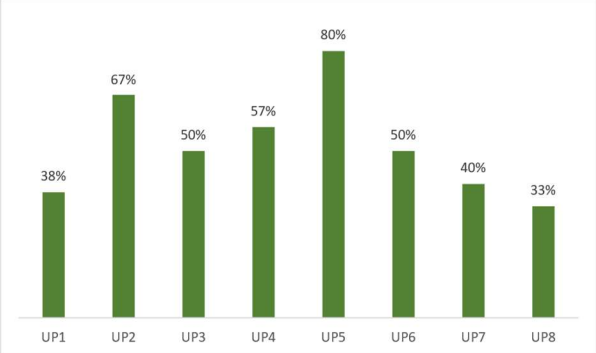

Figure 1: UP KPIs progress

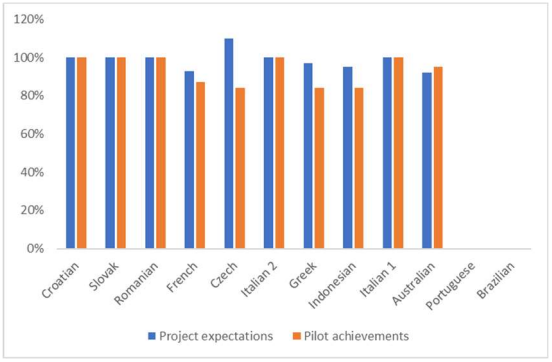

Figure 2: Pilot KPI progress

After piloting and engaging in several discussions on the Integrated Fire Management concept proposed by SILVANUS, it was concluded that splitting some UPs would be beneficial. So, the consortium will start Trial Period 2 with 27 UPs, being part of them building blocks of a large system, as happens with the Decision Support System modules – see page 41.

After compiling the experience from the first trial, **111 lessons** were gathered in Section 5 for future piloting activities, with the aim of reducing risks and maximizing impact on end-users and stakeholders. It is also relevant to mention that most of the **Project KPIs** linked with Project objectives were already **addressed by the pilots**. In concrete terms, 34 out of 52 Project KPIs were addressed, from those more than two thirds exceed 75%. This points to a good positioning of the consortium for the final trial.

Expected Impacts already addressed in Trial period 1 were addressed as a sub-chapter in the Conclusion section. 6 out of the 8 Expected Impacts were addressed, although the Decision Support System will have a crucial role in improving SILVANUS proposition.

In the Conclusion section, a roadmap of simple yet efficient actions is proposed to ensure the success of the second period trial. This roadmap aims to drive UPs market uptake, facilitate piloting activities with stakeholders, and achieve project objectives. The core idea is to engage each partner in a sequence of actions where their performance will be visible and beneficial to other partners, fostering a collaborative and impactful journey.

1 Introduction

SILVANUS is a project, funded by the EC under the H2020 Green Deal call-topic H2020-LC-GD-2020-1-1, that aims to build a climate resilient forest management platform that will provide support and improve wildfire management.

Being an Innovation Action project that aims to excel the state-of-the-art, SILVANUS takes piloting activities to urge its User Products (UPs) reaching near ready-to-market status along raising the actual level of efficiency of preparedness, detection and response, and recovery through Integrated Fire Management (IFM).

The deliverable summarises the activities carried out from **April to December 2023**, in relation to the organisation and execution of SILVANUS pilots, also referred to as “field exercises” or “tabletop exercises”, as indicated in Figure 3.

Of the eleven pilots, only the Portuguese and Brazilian pilots did not have the opportunity to carry out demonstrations, due to their internal constraints which are presented here.

In early 2023, the Portuguese cluster of partners, including EDP, AdP, TP, and IST-ID, invested in identifying and contacting national wide stakeholders interested in SILVANUS solutions for the prevention of forest fires in critical infrastructures and the use of Farming 4.0 for prevention and recovery phases. Stakeholders were identified from partner networks and public contact lists, and around fifty expressed interest in following up SILVANUS developments, events and social media.
These activities, during in the first trial period, revealed a strong interest from key stakeholders, including local firefighters, local government, agroforestry associations, landowners, community organizations, shepherds' associations, consortium representatives, and environmental organizations such as Guardiões da Serra da Estrela and Rewilding Portugal. This fostered a collaborative and multidisciplinary approach with contributions ranging from community-level dissemination of project information.
However, the studies corresponding to Phase A of the Portuguese Pilot, namely biomass estimation and vegetation growth estimation around critical infrastructure depended on LiDAR+multispectral imagery capture from drone flights. This type of flight was only possible after LABELEC joined the consortium (Amendment 1), which caused a significant delay. Most of the SILVANUS user products were, at that time, still in a phase of evaluation of interest for concrete Portuguese stakeholders, leading to successive delays and overlaps with other pilot demonstrations and SILVANUS events. Nevertheless, the work described for Phase A and Phase C continued, resulting in the acquisition of more than ten thousand high-definition images, the publication of two scientific articles, and the development of two models specifically for utilities managing critical infrastructure in dense vegetation areas.

On the Brazilian pilot, the project faced challenges in establishing a location, with initial discussions for the Pantanal pilot being interrupted due to difficulties in obtaining collaboration from public authorities and non-governmental organizations. Belém region was another alternative but similar difficulties emerged. Ultimately, the decision was made to conduct the pilot in Rio de Janeiro, which is the location with better infrastructure, having already engaged institutions interested to exchange experiences with the SILVANUS project and ready to support the pilot logistics.

Timeline	Host organisations	Pilot exercise type/mode	Participating organisations
April 2023	HRVATSKA VATROGASNA ZAJEDNICA	Field exercise, physical	VTG, CTL, SGSP, 3MON, UASVG, ASFOR UISAV, RINI, MD
April 2023		Field exercise, physical	VTG, SGSP, FRS MB, 3MON, UISAV, ITTI, ASFOR, EXUS, EDP, TRT, **TUZVO**
September 2023		Tabletop exercise, physical	SIMAVI, ASFOR, **FptSMURD**
September 2023	PUI	Field exercise, physical	VTG, CTL, TP, HM, CERTH, 3MON, MDS, SIMAVI
October 2023		Field exercise, physical	VTG, 3MON, TUZVO, SGSP, UISAV, KEMEA
OCTOBER 2023	asset	Tabletop exercise hybrid	VTG, FINCONS, UISAV, CMCC, CERTH, EXUS, CTL, ATOS, TRT, EAI, Z&P, ITTI, UASVG, PNRT
October 2023		Tabletop exercise hybrid	VTG, AUA, UTH, SGSP, PUI, KEMEA, HRT, CERTH, ATOS, EXUS, TRT, CTL, UISAV, AMIKOM
November 2023	AMIKOM	Field exercise, physical	VTG, SGSP, Z&P, MD, ITTI, UISAV, INTRA, IST
November 2023	TEPILORA	Tabletop exercise hybrid	FINCONS
November 2023	CSIRO	Field exercise, physical	VTG, Z&P, KEMEA, SGSP, ITTI, UISAV, CTL, ASSET, FRS MB, TP

Figure 3: Pilot exercises in trial phase 1 (from D9.2)

The details of the specific actions were reported in D9.2 and this deliverable, D9.3, aims to report the formal assessment of the pilot outcomes. The deliverable will complement the Impact Assessment Methodology that was developed and published in D2.3 (delivered at M18) and will formally review the qualitative and quantitative attributes and parameters of the pilots' outcomes. Following the demonstrations of different UPs – see Figure 4 -, that were developed to collect feedback from the end-users and relevant stakeholders, the formal evaluation of SILVANUS pilots will also adopt evaluation of UPs. The technological demonstrations that were carried out across the pilots have been quantified and will be matched against the Key Performance Indicators (KPIs) that were reported for each UP in D2.3 and agreed on the scope in T9.6 for the pilots.

Additionally, as two sets of pilot activities were carried out (namely the field exercises and tabletop exercises), it is vital to note that the UP demonstrations from the field exercises are being quantified. The evidence gathered from the field has been used to conduct the tabletop exercise to promote the uptake of UPs and gather feedback from the relevant stakeholders. This interactive process led not only to deep improvement of SILVANUS demonstration processes from one pilot to another but especially on the UPs. The latter experienced some specialization, from the initial list presented below into a larger one by split.

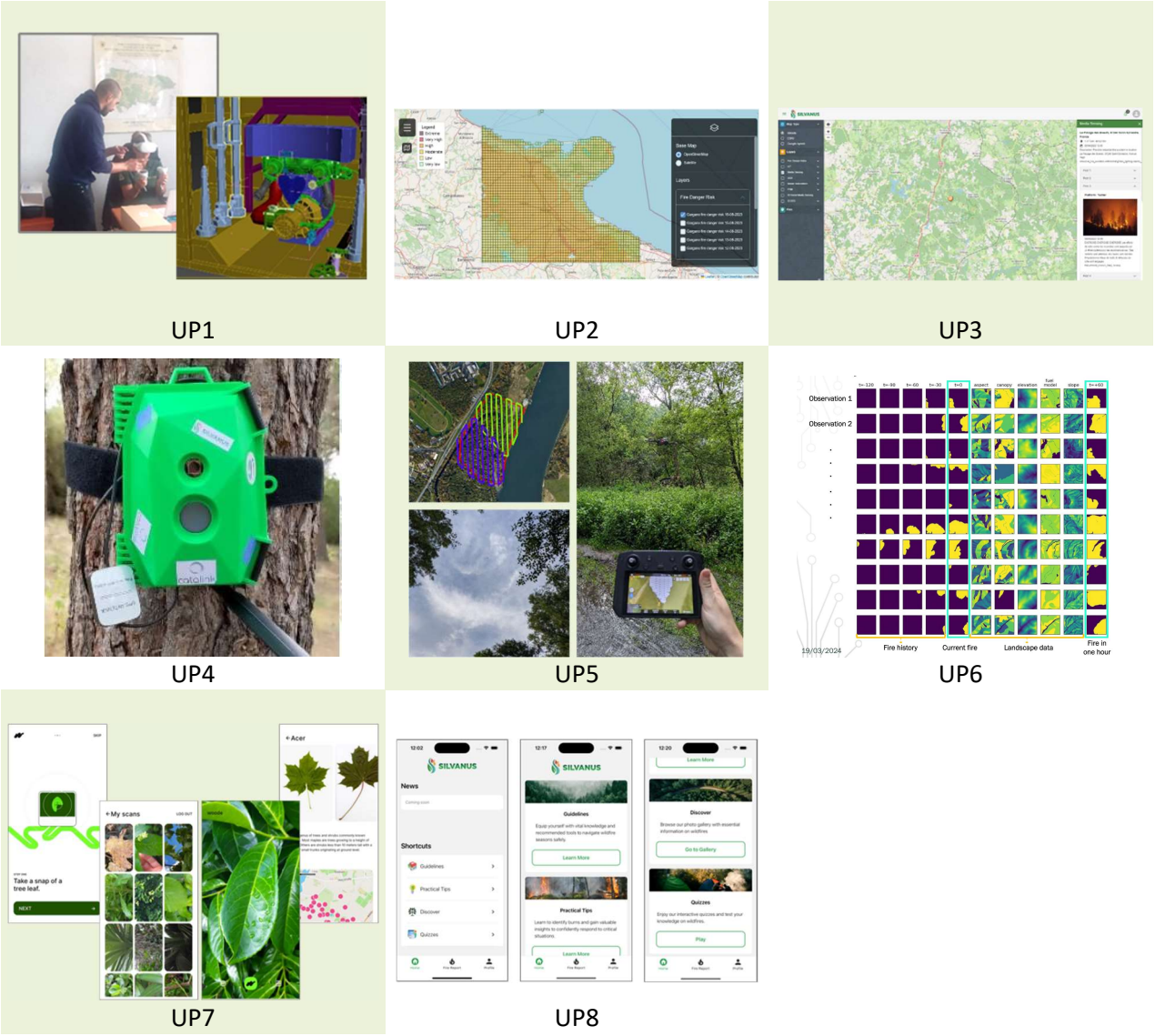

Figure 4: SILVANUS UP in a glance

One example of this specialization, which led to UP split, is in UP4 tackling fire detection. While CTL continued to work on ground IoT devices, ATOS/EVIDEN took a different path for development, by using images taken from UAVs.

Deliverable objectives

The formal assessment methodology adopted in SILVANUS follows the principle to evaluate the different phases of integrated fire management (IFM) equally to ensure all the products and services developed for Phase A (Prevention and Preparedness), B (Detection and Response), and C (Restoration and Adaptation) are appropriately reflected in the formal evaluation. Finally, the deliverable also aims to consolidate the lessons learnt from the UP evaluation to improve the planned demonstration of field exercises in 2024.
To sum-up, this deliverable will address **three objectives** in the following sections:

1. Evaluate, on each pilot context, the different user products available in Trial Period 1 with the aim of improving them for their use in the field exercises.
2. Provide adequate feedback to SILVANUS's products and services, for their improvement strategy in Trial Period 2.

3. Make evidence of how demonstrations committed already with project objectives and offer lessons learnt that can leverage the results achieved regarding SILVANUS's products and services uptake.

Deliverable structure

This document is structured in 7 main sections. After the current one, Section 2 will cover how the formal assessment methodology has been applied detailing the approach and methods used to gather and analyse the information provided both from pilot owners as from user product developers. Our findings take on Sections 3 to 6 applying a bottom-up approach, this means going from UPs level to project level. Section 3 presents the results achieved by the technical validation of the UPs, by gathering the end-users' feedback from which an improvement strategy is drawn. In Section 4, the various Pilots' results are presented, and a set of lessons learnt applicable to Trial period 2 presented per sub-section in the 5th Section. Project objectives are recovered in Section 6, having the purpose of identifying at what level they were already achieved and what measures should be taken to increase project's impact. Conclusions, in the final section, summarize the key points and offer insights and recommendations based on the report's findings. Additionally, Annex 1 reports the form used to gather part of the information from the pilots present in this report. Finally, Annex 2 presents the Pilot KPI list.

2 Formal Assessment Methodology

The objective of the present methodology is to provide a clear and structured approach to the assessment of User Products (UPs) and Pilots that ran in SILVANUS during Trial Period 1.

It will leverage on the work previously produced both for UPs and pilots, covering the roles of all involved actors, from UP and pilot owners to end-users and local stakeholders – who have produced important feedback. The status coming from D9.3 will be important not only to define strategies for the coming trial period, but also to prepare the economic viability assessment of products, their market uptake and recommendations either for standardization or policy.

In case of UPs, the first version of the impact assessment framework described in D2.3 and drawn in Figure 5 was used. The results presented here will consolidate the key performance indicators and respective targets, listed in D2.3 and agreed with each UP owner for the first trial period.

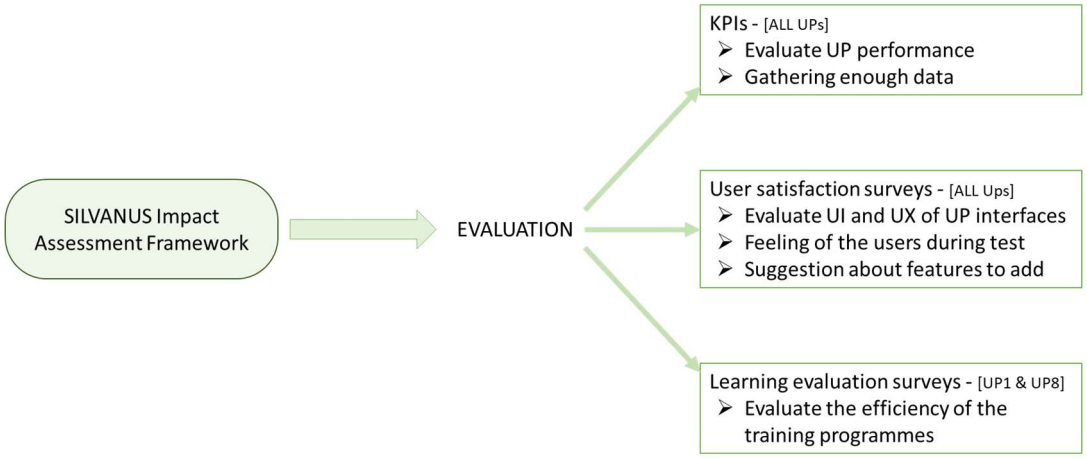

Figure 5: Schema of SILVANUS first version of the impact assessment framework for UPs, D2.3

On the other hand, in Task 9.6 a series of meetings with pilot owners, fostered a survey that later was discussed and refined with each pilot owner to assess its outcomes. The result was a list of KPIs, and respective targets customized for each pilot, which enables to make evidence of the results achieved in each one. The methodology used in Task 9.6 for piloting assessment can be summarized in the following diagram.

	Process of systemic evaluation of the effectiveness of pilot demonstration activities	Process of collection of lessons learned for the needs of pilot replicability studies
Before a pilot	Formulation of PEMs for effectiveness assessment	Collecting lessons learned from previous projects and SILVANUS pilots
	Effectiveness assessment	
	Reporting of effectiveness assessment results	Reporting lessons learned from previous projects and SILVANUS pilots
During a pilot	Participation in a pilot and collecting information for effectiveness assessment purposes	Collecting lessons learned from SILVANUS pilot
After a pilot	Effectiveness assessment in ex post formula	
	Reporting of ex post effectiveness assessment results	Reporting lessons learned from SILVANUS pilot

Figure 6: Task 9.6 piloting assessment methodology

In deliverable D9.3, both approaches are combined to produce a coherent assessment framework for all the Trial period 1, with real and useful results and interpreting the outcomes described in D9.2. To this end, a bottom-up approach is taken, carrying information, in the form of KPIs or users/ stakeholders' feedback, from UP level up to Green Deal's Expected Impacts.

As not all the information was available in both D2.3 and Task 9.6 surveys, one more survey was issued on the scope of Task 9.2 supporting this current deliverable. This last survey, disseminated among pilot owners, collected the important feedback regarding several aspects, namely the feedback from the end-users and from stakeholders. It is briefly presented in the next figure and can be found in Annex 1.

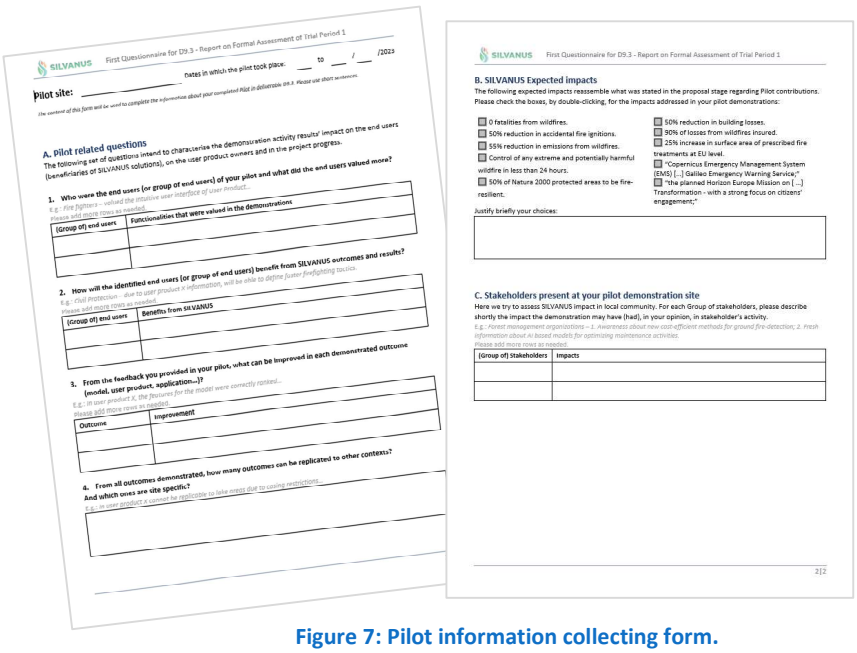

Figure 7: Pilot information collecting form.

Finally, in the scope of Task 9.6, Pilot owners also provided important feedback in what concerns lessons learnt from Trial Period 1, as indicated in Figure 6. Those will support the planning of pilot activities in Trial Period 2, reducing demonstration risks and increasing the success probability.

Hence, the Formal Assessment methodology can be expressed in the following framework, drawn in Figure 8. The arrows mean the flow of information, which is consolidated in D9.3.

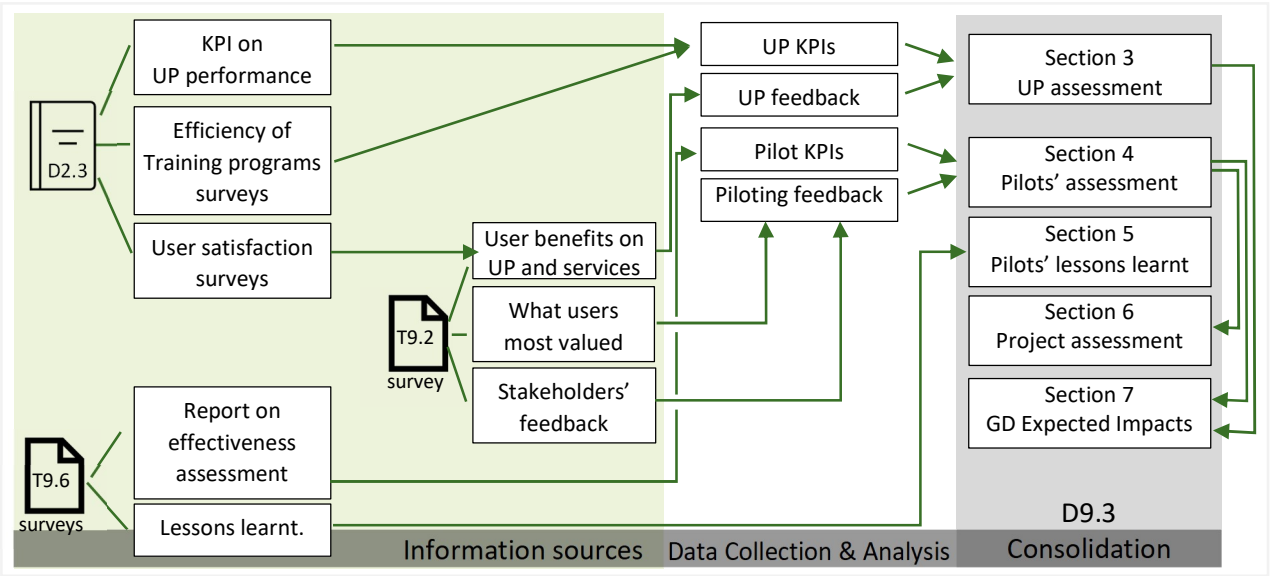

Figure 8: Framework applied in Trial Period 1's Formal Assessment.

2.1 Data collection and assessment criteria

Data was already available from the field and from the surveys completed, so, no storage was needed for KPI processing.

Measurable indicators and targets are defined for both UPs and Pilots. This allows for the immediate inference of the level of accomplishment for each KPI by a UP or pilot. In cases where KPIs are not accomplished, a justification will be presented.

For UPs, the number of KPIs associated differs from one to another. For an overview, the ratio of KPIs accomplished for each UP will be processed.

For Pilots, KPIs are grouped into two criteria: 1) how much a pilot ensures achievement of general project expectations formalised in the DoA, 2) how much a pilot ensures achievement of its expectations, formalised in a pilot operational readiness documentation (Task 9.6). Each criterium value results from the totalization of the grouped KPIs and thus for each pilot both criteria values will be expressed, plus the ratio of KPIs accomplished.

The previous methodology can also be utilized to incorporate non-numeric information, including feedback from stakeholders and end-users, for both UPs and Pilots' activities. This information, when shared with the consortium beneficiaries, will be instrumental in defining a strategy for application in Trial period 2, as outlined in sections 3 and 4 respectively. Furthermore, pilot owners could apply the lessons learnt, from Section 5, to enhance their preparation for the second round of demonstrations on their own sites.

Moving on to high-level indicators, the project objectives with their related KPIs take precedence. These indicators are closely linked to piloting, which essentially means that they are covered in criterium 1, mentioned earlier. Project KPIs can objectively be assessed at the conclusion of the project, but at this stage, one can gain a good indication of whether the conditions are favourable for their achievement. In this regard, qualitative feedback shall be provided in addition to the preliminary calculated values.

For the Expected Impacts, same thought of Project KPIs' applies. Nevertheless, while in D2.3 the set approaches were defined for the contributions of each UP, in this document will be registered the already performed contributions from both the UP and the pilots.

3 User Products' technical validation and future developments.

User Products (UPs) are the most exploitable outcomes from SILVANUS. They bring a new approach to the problem of wildfires in all phases. The SILVANUS User Products (UPs) that were demonstrated during Trail period 1 are summarized in Table 2, highlighting the progress from previous State-of-the-Art (SotA).

Table 2: UPs list demonstrated during Trial Period 1

User Product	State-of-the-art and innovation introduced
UP1 AR/VR training toolkit for trainers	**Existing technology (before SILVANUS):** There were some solutions in the market for firefighter training using VR (Virtual Reality), AR (Augmented Reality), and XR (Extended Reality)
	Innovation introduced: A complete virtual environment has been created for one specific pilot already. It will include air and ground support. Differently from the existing commercial products SIMAVI's solution is tailored to the local conditions and sets of tools available.
UP2 Fire Danger Tool	**Existing technology (before SILVANUS):** The application of machine learning (ML) methods for wildfire prediction has been extensively studied, and in the development of UP2, the work of Kondylatos et al. 2022[1] was used as a foundation. Specifically, the ML model was trained using Convolution LSTM, which considers the spatial and temporal correlation between 25 fire predictors. The data provided by them covers historic fires in the Mediterranean region of Greece and neighbouring parts of Albania and Western Turkey.
	Innovation introduced: The ML model, previously studied in the literature, has never been deployed in an operation-ready platform like Silvanus, so the feature scaling technique used by Kondylatos et al. was modified to enhance the model's robustness when applied to pilot sites with diverse climates compared to the Mediterranean region where the model was trained. A configurable pipeline is created by partner CMCC to calculate the daily fire danger index for pilot sites, using 25 predictors stored in the Dynamic Data Store (DDS) as input for the ML models. The pipeline retrieves the predictors for a specific pilot site and day from the DDS, feeds them to the ML model for fire danger index prediction, and stores the map in (Storage Abstraction Layer) SAL and DDS for display on the Silvanus dashboard.
UP3 Fire detection based on social sensing	**Existing technology (before SILVANUS):** There were a few services specialized in social media crisis management. However, most of these continue to work as stand-alone applications or working in a proprietary environment, namely for Intelligence Firms.
	Innovation introduced: CERTH is supporting the detection phase with the development of a social media monitoring module that focuses on citizen observations about potential fire events and the analysis of the collected textual and visual information, to **detect location-related concepts in the text** and **fire-related concepts in the image**. Moreover, the application is being fully integrated in SILVANUS platform.
UP4 Fire detection	**Existing technology (before SILVANUS):**1 Smoke detection has been extensively studied in various contexts, including the use of Close Circuit TV (CCTV) footage to monitor industrial chimneys[2]. Additionally, Shakhnoza et al[3]. have developed algorithms specifically designed to detect fire and smoke in outdoor CCTV videos.

[1] Kondylatos, S., Prapas, I., Ronco, M., Papoutsis, I., Camps-Valls, G., Piles, M., et al. (2022). Wildfire danger prediction and understanding with Deep Learning. Geophysical Research Letters, 49, 2022GL099368. https://doi.org/10.1029/2022GL099368

[2] Cao, Y., Tang, Q., Lu, X., Li, F., & Cao, J. (2020). STCNet: Spatio-Temporal Cross Network for Industrial Smoke Detection. ArXiv, abs/2011.04863.

[3] Shakhnoza, Muksimova et al. "Novel Video Surveillance-Based Fire and Smoke Classification Using Attentional Feature Map in Capsule Networks." Sensors (Basel, Switzerland) vol. 22,1 98. 24 Dec. 2021, doi:10.3390/s22010098

from IoT devices/ at the edge	However, a **notable limitation of CCTVs is their reliance on an external power supply**, which can restrict their functionality. In the broader domain of fire detection in videos or imagery, Thomson, W. et al.[4] have proposed an architecture that excels in both full-frame binary classification and superpixel localization, offering a robust approach to identifying fire-related phenomena. In addition, **flame and smoke sensors** have also been used to collect valuable data. They mainly have been **used in industrial settings** such as refineries or manufacturing facilities. Due to their limited operational range, **they are often complementary to the Machine Learning (ML) solutions**.
	Innovation introduced: This **IoT collects data from sensors**, such as temperature and cameras, but **also applies lightweight ML algorithms on the collected images to detect fire/smoke outbreaks**. All the computations happen **on the edge** (in the device) and **in near-real time**, which **reduces detection time** and can **alert** the responsible **authorities sooner**. Furthermore, the device can be placed in the field, as it is expected for it to **work autonomously (without external power supply)** and **can take leverage of the available mobile networks** for the **transmission of the data**. Lastly, the IoT components **can be combined with UxV devices for fire/smoke detection on demand**.
UP5 Fire detection from UAV/UGV	**Existing technology (before SILVANUS):** In the beginning of the decade, Research highlighted the use of UAVs for initial fire detection and UGVs for ground support[5]. The principle was to have UAVs equipped with thermal sensors detecting fires and sending geo-located alerts to UGVs, which then computed optimal trajectories for monitoring and firefighting[6].
	Innovation introduced: This UP refers to Fire detection from Unmanned Air Vehicle (UAV) from TRT partner and Unmanned Ground Vehicle (UGV)from CSIRO partner. The main innovation brought for these kinds of devices is the capability of having a SILVANUS platform integrated functionality that can program the routes of each UAV and UGV. In market terms, it means having a swarm of heterogeneous devices integrated in a larger civil protection platform as described in SILVANUS platform architecture.
UP6 Fire Spread Forecast	**Existing technology (before SILVANUS):** The use of wildfire modelling software is crucial for predicting fire spread, analysing past fire events, and improving firefighters training[7]. These models can be categorized in: i) Statistical models, which are based on past fire events without considering the physics controlling the process. ii) Semi-empirical models, which are based on physical laws and enhanced with empirical factors. iii) Physical models, which are based on the physical principles of heat transfer. Fire models such as FARSITE and BehavePlus are comprehensive fire modelling systems that integrate multiple empirical and deterministic models or sets of mathematical equations to predict fire growth and behaviour[8]. More recently, Machine Learning (ML) methods have been used to develop classifying algorithms for predicting future fire

[4] Thomson, W. et al. "Efficient and Compact Convolutional Neural Network Architectures for Non-temporal Real-time Fire Detection" 2020, 19th IEEE International Conference on Machine Learning and Applications (ICMLA 2020): 136-141.

[5] https://deepai.org/publication/autonomous-fire-fighting-with-a-uav-ugv-team-at-mbzirc-2020

[6] Moulay A. Akhloufi et al., "Unmanned Aerial Vehicles for Wildland Fires: Sensing, Perception, Cooperation and Assistance", Drones 2021, 5(1), 15; https://doi.org/10.3390/drones5010015

[7] R. Hansen, Pilot Study: Modeling of wildfires, MS Thesis, Blekinge Institute of Technology, 2008.

[8] R.D. Stratton, Guidance on Spatial Wildland Fire Analysis: Models, Tools, and Techniques, United States Department of Agriculture Forest Service, Technical Report RMRS-GTR-183, 2006.

	behaviour based on historical fire event data[9][10][11], using a variety of methods and algorithms. However, ML systems have some disadvantages, including the unavailability of training data, the need for large amounts of computational power, and difficulties in establishing real-world accuracy estimates[8].
	Innovation introduced: The method brought by EXUS partner, addresses the limitations of ML methods for fire prediction identified above. The approach provides a seamless operation of the fire spread prediction module within the SILVANUS platform, capable of automatically retrieve the relevant input parameters and data stored in the SILVANUS cloud from up-to-date repositories, and thus requiring minimal effort and training to operate. Further, the model was optimized to reduce its computational requirements. UP6 model itself is comparable to state-of-the-art approaches., using a neural network architecture and considering similar input parameters.
UP7 Woode - Biodiversity profile mobile application	**Existing technology (before SILVANUS):** In early 2020's, several mobile applications had been already designed to help users create biodiversity profiles and descriptions of vegetable species (e.g. iNaturalist, PlantNet…). However, their drawbacks were much concerned to algorithm accuracy in recognising species and undetailed information issues in less-documented areas.
	Innovation introduced: This VTG mobile app provides biodiversity tagging and analysis for improved awareness and support, with a significant database with ground truths, entailing crowdsourced and augmented data, based on deep learning-based classification and recognition solutions. The novelty of the proposed application is the ability to function when operated under uncontrolled environment and requires no additional intervention from the landscape owners and foresters to complete the processing.
UP8 Citizen engagement and information sharing application	**Existing technology (before SILVANUS):** The mobile application idea and the opportunity for collection of data for the app occurred during SILVANUS proposal with no parallel, on the proposed terms, before.
	Innovation introduced: • Validated content from firefighters available directly to citizens. • Fire reporting integration. • Warning messages for evacuation routes.

To assess how well UPs are meeting their goals, Deliverable D2.3 defined a clear set of Key Performance Indicators (KPIs) that are as objective as possible. These KPIs also play a crucial role in evaluating the impact by setting specific targets that could be assessed during pilot activities. This ensures that if sufficient data is available, analysis may produce useful results. Also, it guarantees that the performance of the UP aligns with the proposed pilot's and project's objectives.

This section recovers the KPIs definition from D2.3 and presents results achieved from all the field exercises performed. Moreover, it provides some feedback sentences from end-users, which can help improving the performance of the products. This can give birth to products' upgrade strategies aiming to reach Trial Period 2 with a more matured offer, minimized development risks and already facilitating exploitation strategy design.

[9] W. Chen, Y. Zhou, E. Zhou, Z. Xiang, W. Zhou, J. Lu, Wildfire Risk Assessment of Transmission-Line Corridors Based on Naïve Bayes Network and Remote Sensing Data, Sensors 2021, Vol. 21, p. 634. https://doi.org/10.3390/s21020634

[10] O. Rios, M. Valero, E. Pastor, E. Planas, A Data-Driven Fire Spread Simulator: Validation in Vall-llobrega's Fire, Frontiers in Mechanical Engineering, Vol. 5, 2019. https://doi.org/10.3389/fmech.2019.00008

[11] R. Alkhatib, W. Sahwan, A. Alkhatieb, B. Schütt, A Brief Review of Machine Learning Algorithms in Forest Fires Science, Applied Sciences, Vol. 13, p. 8275, 2023. https://doi.org/10.3390/app13148275

The structure of this section consists of a sub-section per UP, which containing a table to compare the outcomes of the pilots with the KPI, provided by the UP owners. A table with the feedback given by the end-users. Ending with a table reporting the strategy from UP leaders, after considering end users' feedback.

3.1 UP1: AR/VR training toolkit for trainers

This section refers to Augmented Reality and Virtual Reality training toolkit for trainers, from SIMAVI

Table 3: KPIs for UP1 "AR/VR training toolkit for trainers"

KPI	Description	Value after Trial Period 1
N° of training scenarios created >= 3	At least 3 training scenarios must be created.	3
N° of training environments created >= 3	At least 3 different virtual environments must be created	The development is in progress. One virtual environment has been created for the Romanian Pilot.
Implement multiplayer support for at least 3 users	At least 3 different users will be able to attend a training scenario (multiplayer support)	The development is in progress. The multiplayer solution has been implemented and will be tested within the Phase 2 for more than 3 users.
N° of scenarios with audio interface support applied in VR >= 3	The users attending at least 3 scenarios in multiplayer mode and support multiple audio interfaces at the same time	This KPI will be assessed in Phase 2.
Audio stream response rate <= 3	The users attending the scenario in multiplayer mode must be able to communicate using audio with delays no more than 3 seconds.	This KPI will be assessed in Phase 2.
Audio reconnection retries while internet gets resumed within 1 minute >= 3	The audio must be able to reconnect once the internet connection will be resumed. There must be at least 3 retries within 1 minute.	This KPI will be assessed in Phase 2.
Update of multiplayer synchronization while internet is reliable < 1 second	The multiplayer user actions must be updated in <1 second between users (assuming the internet connection is reliable)	This KPI will be assessed in Phase 2.
N° of firefighters trained > 17	The goal is to have at least 17 firefighters trained by the first version of the product. Every trained firefighter will have to fill the learning evaluation survey.	In Trial Period 1, the firefighters have been trained during the technical workshops organized in the Romanian Pilot. The training will be organized in Phase 2 for more than 17 firefighters, when the operational scenario will be fully implemented.

End-users feedback and strategy for upgrade

Table 4: End-users feedback- UP1

Pilot	Outcome	Feedback
Romania	VR technology	The stakeholders expressed their need to have the possibility of developing their own scenarios within the VR environment and to be able to have different levels of interaction with the environment, according to the operational command structure during the intervention.
	AR technology	AR glasses would need to include information from different sources that are available during the intervention, such as wind direction and weather information.

UP Owner Strategy for Trial Period 2
The Trial Period 2 strategy for UP1 consists of: i. Continue the implementation of the operational scenarios (modelling, simulators) ii. Getting information from different sources (UAVs, thermo-vision, GIS, visual cameras, satellite images), checking the information correctness iii. Implementing effective communication with commander / Command centre iv. Supporting the end-users to create their own scenarios, choosing the location, by altering the environment parameters or by adding objects, equipment to the actual scenes (authoring tool) v. Developing the training plan for Phase 2

3.2 UP2: Fire danger tool

This section refers to forecast of the Fire Danger Index (FDI) provided by the CMCC.

Recall and Precision are commonly used statistics in the literature to assess the performance of the network on the test dataset after the training. The ML model has been trained on high resolution dataset of Greece (and neighbouring region of Albania and western Turkey) to be applied on for the pilot region for FDI forecast. The KPI's are listed in the table below.

Table 5: KPIs for UP2 "Fire danger tool"

KPI	Description	Value after Trial Period 1
Number of pilots >= 3	UP2 will be tested in at least 3 Pilots	UP2 pipeline is currently being tested for one of the pilot sites (namely, Gargano). For other pilots, the pipeline is currently being developed.
Sensitivity/recall of the test dataset > 85%	Sensitivity/recall is a measure of how well a ML model can detect positive instances, in particular what proportion of actual positives is identified correctly. It does so by dividing the correctly predicted positive samples by the total number of positives, either correctly predicted as positive or incorrectly predicted as negative. The sensitivity/recall must be higher than 85%.	0.878

KPI	Description	Value after Trial Period 1
Specificity of the test dataset > 60%	Specificity measures the proportion of true negatives that are correctly identified by the ML model. It does so by dividing the correctly predicted negative samples by the total number of negatives, either correctly predicted as negative or incorrectly predicted as positive. The specificity must be higher than 60%.	0.935

End-users feedback and strategy for upgrade

Table 6: End-users feedback- UP2

Pilot	Outcome	Feedback
Slovakia	Fire Danger Tool	Should provide information on fire danger in detailed scale using the data from local weather stations. It should be completed with weather and fuel moisture information gathered under the tree crown closure.
Gargano, Italy 2		The pipeline has been developed to gather fire predictors to produce a fire danger probability map for a given day. Details provided in section 3.6 KPIs.
Tepilora, Italy 1		The pipeline for Gargano pilot can be extended to include Tepilora subjected to the availability of the data in DDS (or other datastore
Portugal		The pipeline for Gargano pilot can be extended to include Portugal subjected to the availability of the data in DDS (or other datastore)

UP Owner Strategy for Trial Period 2
To the next Phase, UP2 **will**: i. Improve the accuracy of the ML-based inference engine by exploiting different ML models trained over Greece @1km of spatial resolution with different configurations of hyperparameters or a reduced set of predictors and select which one suits better**.** ii. Extend the data gathering and processing pipeline (T4.1), that provides input data to the ML inference engine, for supporting other pilots beyond the Gargano (IT)**.** iii. Effectively relocating the inference engine to other pilots. iv. Integrate UP2 with SAL to facilitate the exchange of the outcomes across other SILVANUS components.

3.3 UP3: Fire detection based on social sensing.

This section refers to Fire detection based on social sensing from CERTH.

Table 7: KPIs for UP3 "Fire detection based on social sensing".

KPI	Description	Value after Trial Period 1
N° of tests made >= 6 (1 per pilot)	UP3 must be tested at least once in each of the 6 pilots that have been identified to be supported. Test can be offline (at any point, using benchmarks datasets or annotation from the pilot users) or online (during a pilot demonstration).	Participated in 5 pilots: • Greece (PSTE) - Chalkida • France (lead PUI) - Limoges • Italy (lead ASSET) - Gargano National Park • Indonesia (lead AMIKOM) - Palangkaraya, Banjarmasin, Yogyakarta

KPI	Description	Value after Trial Period 1
		• Australia (lead CSIRO) - Brisbane UP3 is expected to participate in the Italian pilot program in Sardinia lead by PRNT during the last reporting period. Thus, eventually, UP3 will be involved in a total of six pilots.
F-measure of relevance prediction > 90%	The harmonic means of precision (how many of the posts classified as relevant are relevant) and recall (how many of the relevant posts are classified as relevant) must be more than 90%.	The relevance estimation for Greek language achieved: • Accuracy: 0.895 • Precision: 0.849 • Recall: 0.894 • F-measure: 0.871 The relevance estimation for English language achieved: • Accuracy: 0.975 • Precision: 0.979 • Recall: 0.971 • F-measure: 0.974 The relevance estimation for Italian language achieved: • Accuracy: 0.950 • Precision: 0.901 • Recall: 0.941 • F-measure: 0.920
Accuracy of fire detection in images > 75%	More than 75% of the collected social media images must be correctly classified as images that show fire or not.	Fire detection accuracy: 93.74% Smoke detection accuracy: 86.42%
Precision of fire events detection (% correctly identified) > 80%	More than 80% of the fire events detected by UP3 must be real incidents.	Through experimentation with a historical Twitter dataset covering fires in the Greece region from 2019 to 2021, the baseline method of fire event detection modules identified 47 events, of which 41 were confirmed as real fires, achieving an accuracy of approximately 87.2%.
Retrieval time (from publication to collection) < 5 minutes	The duration between the publication of a social media post (time that it is posted online) and its retrieval by the crawler of UP3 must be less than 5 minutes.	CERTH is unable to bear the financial burden of increasing the monthly rate limit set by the new X API changes, resulting in the current 30-minute crawling frequency. Nevertheless, in the scenario of commercial exploitation, CERTH has the capability to achieve nearly real-time crawling, significantly lowering the interval to well below 5 minutes.
Analysis time (from collection to	The duration between the retrieval of a social media post by UP3 and its complete analysis and storage to a	The complete analysis of a social media post and storage to a database take approximately 1-10seconds.

KPI	Description	Value after Trial Period 1
enhancement and storage) < 2 minutes	database must be less than two minutes.	
Event detection time (from publication to event (warning) generation) < 10 minutes	The duration between the publication of a social media post and the generation of a warning about an event that was detected based on this post must be less than 10 minutes.	The time taken for event detection is closely tied to the retrieval time of social media posts. Hence, the fire event detection time is currently set at a 30-minute frequency. Nevertheless, in the context of commercial exploitation, CERTH possesses the capability to achieve a fire detection time lower than 10 minutes
F1 score of location extraction > 92%.	More than 92% F1 score for the locations (NER) in English or other popular languages, more than 89% Precision for less represented ones.	Location extraction achieved: English (F1-score): 94.31% Italian (F1-score): 88.2% Greek (F1-score): 89.1% French (F1-score): 89,.6%

End-users feedback and strategy for upgrade

Table 8: End-users feedback- UP3

Pilot	Outcome	Feedback
France (PUI)	Social Media Sensing	During the French pilot that took place in St Sylvestre Mountain organised by PUI within September 2023, CERTH demonstrated the pipeline used for capturing, aggregating, and displaying X's reporting a fire. The system crawls X's API (or posts on a Facebook group, or a particular website). If it detects potential reports, based on certain keywords, they are captured and unpacked (date, location, X text). Once this is done, the reports are aggregated and analysed. Those marked as real are then forwarded to the SILVANUS Cloud, which allows the dashboard to display them on the map. 24 posts on "X" (Tweet) were prepared to facilitate the communication on the social media. The information on the social media was very relevant. There were questions regarding the forest fires in France.
Greece		Social Media Sensing, UP3 produced several synthetic X's (Tweets) representing fire-related scenarios and generated a corresponding fire event. Subsequently, successfully posted these X's on X (Twitter) and meticulously crawled the data through the dedicated X crawler. The evaluation of this data was conducted through the user interface of SILVANUS via the Media Sensing layer. Social media remains an effective tool for obtaining real-time information and enhancing overall situational awareness during a fire incident.
Indonesia		Social sensing provides validation for other fire detection methods, and specially it refutes false positives such as heated roofs being detect as fire.
Italy		PNRT (Tepilora): during the meetings with stakeholders, the opportunities related to social media sensing were illustrated. Furthermore, during the tabletop exercise held in November 2023 in

Pilot	Outcome	Feedback
		Bitti, FINCONS explained how the early wildfire detection using crowdsourcing technology works by showing the simulation conducted in Gargano and Greece. It has been a crucial opportunity for stakeholders to fully understand the functioning and value of the social sensing because they were able to experience first-hand the dynamics of the system, understand the interactions between various elements/actors, and evaluate the impact of decisions to be made.
Australia		CSIRO generated approximately 30 synthetic X's (tweets) representing citizen X's relating to imagined fire events in and around the pilot area (Queensland Centre for Advanced Technology, Pullenvale, Brisbane, QLD). The social media sensing algorithm picked up these X's and they were able to be localised on an online map, including both the location of the X and the location of the fire event if it appeared in the X. This is a useful piece of information to integrate with other fire detection technologies.

UP Owner Strategy for Trial Period 2
The Trial Period 2 strategy for UP3 consists of: i. Updating the crawler to align with the latest X API rate limits, incorporating an activity monitoring module to initiate crawling during high activity in X and pause it during reduced activity. ii. Providing updated versions for several analysis modules, including relevance estimation for the French language iii. Incorporating new analysis modules into the Social Media Analysis Toolkit. iv. Implementing a social media fire detection module. v. Integrating UP3 with SAL to facilitate the exchange of fire event information among SILVANUS modules.

3.4 UP4: Fire detection from IoT devices

This section refers to Fire detection from IoT devices from CTL and to Fire detection from devices at the edge from ATOS/EVIDEN and was presented in tabletop exercises -Italy 2(Gargano) and Greece.

Table 9: KPIs for UP4 "Fire detection from IoT devices"

KPI	Description	Value after Trial Period 1
N° of tests made >= 6 (at least 1 per selected pilot)	UP4a must be tested at least once for each one of the 6 pilots where the UP will be deployed. Test could be both offline and online depending on the data collected, namely retrospective, benchmark datasets for the fire detection or acquired sensor data from the designated pilot site.	Participated in 3 field exercises (Croatia, France, and Australia), with 2 different tests being carried in Australia (static IoT and IoT on moving UGV). Also, offline data were collected from Italy, for the tabletop exercise, which contained smoke from 2 different sources and were used for the testing of the ML detection models contained in the IoT. Total tests: 6 (in 3 pilots and 1 tabletop exercise)
False alarm rate < 15%	It is very usual for IoT devices installed "on the wild" to get a great deal of data and many of	Fire detection false alarm rate: 5%

KPI	Description	Value after Trial Period 1
	the cases to produce False Alarms. This increased significantly when dealing with smoke particles and smoke detection, as fog and cloud particles could be misclassified as True Positives (TP), producing erroneous alarms. For the MVP, where only fire detection is going to be developed in UP4a, it is expected that fire events will have a false alarm rate below 15%, as fire is significantly different from the forest area (yellow and red instead of green).	Smoke detection false alarm rate: 17%
True positives > 70%	It is expected that the True Positives of a fire event would be more than 70%, and it will reach even higher rates, when gathering data for each use case and fine-tuning the fire model.	Fire detection true positives: 90% Smoke detection true positives: 93%
Missing rate < 5%	It is expected that the missing rate for the fire detection model in UP4a will be lower than 5%, as the model is severely relying on the colour of the image and yellow/red particles are considerably different from the green/brown colour of the designated areas.	Fire detection missing rate: 10% Smoke detection missing rate: 7%
Number of identifications > 80%	More than 80% of the fire events detected by UP4a must be real fire incidents.	Fire detection true positives: 90% Smoke detection true positives: 93%
Time needed to correctly identify ignition and notify firefighters and citizens < 1 minute	Considering that the camera on UP4a will gather 3 to 5 frames per second and the communication delay via the cellular network might reach up to 10 seconds, it is expected that the duration between the fire ignition and the notification of the firefighters and citizens will not exceed the 1 minute.	**Measurements for 6fps** Data collection: ~ 6.6s Data processing: ~ 2.24s Data transmission: Wi-Fi: ~ 11.2s 3G: ~ 37.2s Total time: 20.5 - 46s
Firefighters time to act after ignition notification < 30 minutes	The duration between the generation of fire ignition warning and its broadcast to the SILVANUS platform, until the first fire responders reach the area is expected to be less than 30 minutes.	-

End-users feedback and strategy for upgrade

Table 10: End-users feedback- UP4 "Fire detection from IoT devices"

Pilot	Outcome	Feedback
Croatia	Fire detection IoT and Mesh in the Sky	This UP was in the prototype phase of development, and was not available during the pilot, so it was not possible to provide feedback.
France	Detection of the fire (CTL)	The technology seems to work but the device is too fragile, needs to be improved in its protection of sensors, and requires a Wi-Fi or GSM network which does not always exist; This needs to be improved. Remote sensor maintenance and monitoring should also be tested.

Pilot	Outcome	Feedback
Italy 2 (Gargano)		It should be considered installing devices with an adequate level of protection (rain, humidity, wind, etc.). The autonomy should be considered, which could be guaranteed by a solar PV panel or by a battery that lasts at least 2-3 weeks. The connection to the internet should be feasible by SIM card instead of Wi-Fi.
Greece		Users have shown great interest in IoT devices designed for smoke and fire detection. These devices have proven to be highly accurate in detecting potential hazards, as evidenced by successful pilot projects. However, there are several challenges that need to be addressed for widespread adoption. The installation process, the quantity of devices required, the establishment of a network of sensors, and ensuring hardware security are all concerns that have been raised. These potential barriers must be carefully considered and resolved to enable the practical and effective use of IoT devices for smoke and fire detection in the future.
Australia	Fire detection	Two smoke machines were employed in a forest setting to simulate a fire. Two types of trials were performed, firstly the sensor attached to a tree trunk was shown to detect smoke at approximately 5 metres. Secondly, the sensor was attached to the UGV and was demonstrated to detect smoke within the forest on the moving vehicle from approximately 10 metres, and in the presence of occlusions from the forest. All detections showed a confidence of > 90%, and no false detections were reported. These detections were automatically forwarded to the SILVANUS platform.

UP Owner Strategy for Trial Period 2
For the second Trial Period UP4 has been split into two different subproducts, namely, UP4a Fire detection from IoT devices and UP4b Fire detection at the edge. The Trial Period 2 strategy for UP4a consists of: i. Test improved IoT in some upcoming pilots. ii. Continue improving ML fire/smoke detection algorithms and IoT functionalities. iii. Continue improving IoT case to better fit its components and better withstand different weather conditions. iv. Study ways to recharge IoT battery (e.g., using solar panels). v. Contact tests to measure the detection distance of the IoT in different conditions. vi. Finish integrations with SAL/UI/KB The Trial Period 2 strategy for UP4b is: i. Continue improving ML fire/smoke detection algorithms. ii. Finish integrations with SAL/UI/KB.

3.5 UP5: Fire detection from UAV/UGV

This section refers to Fire detection from Unmanned Air Vehicle from TRT and Unmanned Ground Vehicle from CSIRO.

Table 11: KPIs for UP5 "Fire detection from UAV/UGV"

KPI	Description	Value after Trial Period 1
N° of tests made >= 10	UAV: At least 10 flights, with different drones and different upload/download system with different video/photo resolutions from different angle of the fire/smoke. UGV: At least 10 trial runs with different robots (Spot legged robot and Titan tracked robot) generating 3D maps with tree biomass density estimation and smoke/fire detection.	UAV: 25 flights, different angles in different terrain with different forest and vegetation coverage. UGV: six demonstrations were performed during the Australian pilot in front of the delegates, and many more in the lead up. Multiple robots were used, 3D maps were generated together with forest analytics, and smoke detection was performed with Catalink's smoke detector onboard.
Mean % of false alarm < 10	UAV: False alarm could be caused by mist, fog, smoke from a chimney, light that do not originate from fire, campfire. The mean percentage of false alarm sent by the UP should be lower than 10%. UGV: The mean percentage of false alarm sent by the UP should be lower than 10%.	UAV: There were no false alarms because only data collection and creating data transfer path to the SILVANUS platform was tested. False alarm measurement is outside of the UP perimeter, UP5b focuses on drone coordination and trajectory optimization. UGV: the onboard smoke detector had no false alarms during the demos and reported a confidence of smoke detected of over 90%.
Accuracies	UAV: The fire must be detected by drone on an area no more than 50x50 m with 75-95% of accuracy, no more 100x100 m with 60-85% of accuracy. UGV: the accuracy depends on the sparsity of the forest, but in general, similarly to UAVs, fire must be detected by the UGV on an area no more than 50x50 m with 80% of accuracy.	UAV: Doing the tests, the drone was capable to collect photos and videos of various fires (small test fires) and simulated fires with smoke from different heights with different sensors (RGB, thermal) The smoke detector reported a confidence of over 90%, in the presence of dense trees. Accuracy measurement is outside of the UP perimeter, UP5b focuses on drone coordination and trajectory optimization.
Detection time < 10 minutes	UAV: The detection time must be no more than 10 minutes from the departure of the drone. UGV: This is dependent on the distance between fire front and point of initial deployment of the robot. In practical scenarios, this is expected to be less than 10 minutes for efficient response.	UAV: Trajectory optimization was confirmed to run in a few minutes and to be compatible with real-time use. The detection time, however, was not measured because the focus of the UPD is to be able to collect the right data and to create the data ingestion pipeline to SILVANUS platform. UGV: the time to drive through 50m of the mapped forest was approximately 10 minutes. The time taken to detect smoke using the

KPI	Description	Value after Trial Period 1
		onboard smoke detector by Catalink was in the order of seconds.
Spread Prediction Improvement	UGV: the fire spread prediction will be based on the humidity and biomass density estimation extracted from 3D reconstructed lidar data.	UGV: CSIRO demonstrated humidity sensing and mapping using the vehicle-mounted mobile manipulator. It demonstrated forest analytics reconstructed from lidar data which included: canopy coverage, leaf area density and tree density estimation. These are more salient measures for fire spread prediction than biomass.

End-users feedback and strategy for upgrade

Table 12: End-users feedback- UP5

Pilot	Outcome	Feedback
Slovakia, Italy 2 (Gargano), Greece	UGV, UAV coordination	Fast trajectory optimisation with sweeping patterns coupled with area subdivision for fleet coordination works and offers a convenient automation service to pilots as well as way to achieve efficient resource use in terms of drone flight autonomy. Demonstration feedback include emphasis on the importance of having fast computation to be able to react quickly, the ability to avoid drone collisions by having a margin of safety between trajectories and the growing impact of flight path automation when the number of drones grows.
Slovakia	UGV	Increasing operating time and remote control and manoeuvrability, real-time image data (RGB, IR) transfer to operational centre, sharing among deployed rescue services
	UAV	Real-time video streaming and data-sharing, real-time processing of the ortho photo map, connectivity in mountain territory, Mesh in the Sky user product should be deployed to substitute the combination UAV + StarLink
	GINA	Integration with outputs from camera smoke detection system, UAV, UGV, fire danger assessment results, fire spread prognosis, automatized location of vehicles and personnel at the incident site.
France	Robot 3MON	The robot's movements in steep and unstable areas need to be improved
Czech	UGV	increasing of operating time and remote control and manoeuvrability
	UAV	real-time video streaming and data-sharing, connectivity in mountain territory
Australia	Autonomous exploration	Speed – it currently travelled slowly while deciding where to move
	Multirobot navigation	Simplicity – currently in the map merging you must be careful which map merges onto which other map, so the user experience is too fragile

UP Owner Strategy for Trial Period 2
The Trial Period 2 strategy for UP5 will consist in: i. Continuing to test drone capabilities and data transfer pipelines of drone collected sensor footage to the SILVANUS platform. ii. Further R&D work on area coverage trajectory optimization and area subdivision algorithms as well as industrialization of the optimization modules: input format genericity, work balance optimization, safety margins, etc. iii. Continuing to work on the mesh in the Sky (future UP12) possibility and to test the UAV swarm deployment of several drones at once to improve the time for mapping. iv. Continue to deploy UGV for pilots to gather more experiences and recommendations from field so that it could be implemented in the robot research in the future with possibility to incorporate SILVANUS platform when it will be ready. v. For the second Trial Period split this user product in two: UP5a- UGV monitoring and UP5b - UAV monitoring

3.6 UP6: Fire spread forecast.

This section refers to Fire spread forecast from EXUS.

Table 13: KPIs for UP6 "Fire spread forecast".

KPI	Description	Value after Trial Period 1
N° of scenarios simulated >= 3	By "scenario" it is meant the topography and forest and fuel characteristics for a specific area completed with information on actual weather situation. Therefore, the fire spread model will be tested in at least 3 pilot locations.	1
Accuracy compared to the state-of-the-art software predictions after 1 hour > 80%	Accuracy is complex to measure for fire spread, as several parameters are involved: direction of spread, burnt area, location of fire front. Here it is used burnt area as a proxy for accuracy: the burnt area predicted by the fire spread model and state of the art software, e.g., the area between the initial fire front and the fire front after 1 hour, shall be within 80% of each other.	93% As measured between the prediction of FSM on unseen data vs the prediction of FlamMap for the same conditions.

End-users feedback and strategy for upgrade

Table 14: End-users feedback- UP6

Pilot	Outcome	Feedback
Slovakia	Fire spread prognosis	Should integrate the information on fuel moisture and local weather situation, fuel spatial distribution and quantity based on field survey results, et least in countries having such data
Greece	fire spread forecast tool	The fire spread forecast tool, UP6, has emerged as a critical tool for firefighters and civil protection agencies. Its ability to provide rapid results, in minutes or even seconds, holds immense value for the overall response mechanism. However, the accuracy of these forecasts is a crucial concern for ensuring reliable simulations. Furthermore, the challenge of accurately predicting fire propagation in varying weather conditions has been a significant issue

Pilot	Outcome	Feedback
Indonesia	Fire propagation in peat forest	There are several differences in managing peat forest and other forest types (for example boreal forest, coniferous forest, etc.), which means the SILVANUS Platform also should be able to handle peat forest management. Handling fire in peat forest also need extra equipment.

UP Owner Strategy for Trial Period 2
Trial Period 2 strategy for UP6 consists of: i. Enhancing the functionality of the fire spread model by considering additional inputs, such as barriers (e.g., roads and water bodies) that can inhibit the spread of the fire and canopy information for more accurate simulation of different fire behaviours. ii. increase the utility of the fire spread model, by providing additional outputs. The prediction of the fire front at certain times in the future will be complemented by outputs such as flame length, rate of spread and others. iii. Providing the user with a better experience, through better integration with the SILVANUS platform and visualization/operation through the dashboard.

3.7 UP7: Woode - Biodiversity profile mobile application

This section refers to Biodiversity profile mobile application from VTG.

Table 15: KPIs for UP7 "Biodiversity profile mobile application

KPI	Description	Value after Trial Period 1
N° of training samples in the database > 10000	The aim is creating a large corpus of data related to the types of trees. This will enable the deep learning algorithms to provide more accurate results in classification and detection tasks. Minimum amount of 10000 images will be included in the training set database.	The Pilots contributed greatly to the creation of the training set database. Diversity of forests and their trees in visited pilot areas enabled collection of large amounts of different types of leaves. By applying augmentation techniques on collected dataset, the current training set is over 10000 images.
N° of species in the database > 100	The training dataset will include over 100 tree species to cover most of the trees present in European forests, especially those included in targeted pilot sides.	The dataset of trees gathered during the SILVANUS pilots contains over 100 tree species.
Minimum number of photos required for the identification of the species >= 2	The FirePrevention and Awareness Support mobile application (FIPAS) mobile application will require minimum of 2 images of tree leaf to accurately identify the type of the tree. However, the deep learning algorithms and tailored solution for enhancement of the training data will be developed and optimised to such degree that the application should	The current development aims to enable successful recognition with one picture being uploaded through the mobile application. The work in this area is still underway.

KPI	Description	Value after Trial Period 1
	return correct result even with one image provided, in most of the cases.	
Correctly identified > 90%	The computer vision and deep learning units will be developed and optimised to achieve over 90% of detection accuracy.	The pilots played important part in increasing the training set to improve the accuracy of the recognition. The optimisation of the machine learning algorithms is still in progress.
No identification < 5%	The FIPAS application will be designed to classify most of the input images, with only less than 5% window allowed for no identification.	The pilots played important part in increasing the training set to improve the accuracy of the recognition. The optimisation of the machine learning algorithms is still in progress.

End-users feedback and strategy for upgrade

Table 16: End-users feedback- UP7

Pilot	Outcome	Feedback
France	Biodiversity monitoring and collection of data	Should integrate the possibility to enter user location manually in case there is no internet connection. Possibility to upload the pictures from the photo library would be also essential.
Czech	Biodiversity monitoring and collection of data	Growing interest to include AI feature showcasing the impact of the fire on the forest.
Indonesia	Biodiversity monitoring	Forest condition in each country is different, especially in terms of forest type such as rainforest. The species detection might be difficult to cover all species in such forest. The improvement of Woode database to the species in the rainforest at least able to identity many various species.

UP Owner Strategy for Trial Period 2
Trial Period 2 strategy for UP7 consists of: i. Keeping improving and enhancing functionalities of the Woode application. ii. Including updated geo-location feature enabling to enter user location manually in case of usage in the remote area with internet coverage. iii. Including the development and integration of the AI generative module that will generate video content based on uploaded picture, to demonstrate in the visually appealing way how destructive impacts can fire have on forests. iv. Including the enhancement and optimisation of the machine learning and social features. v. **Engage the consortium in identifying functionalities that may be included in the app to facilitate exploring the relationship between forest biodiversity and fire resilience or other aspects.**

3.8 UP8: Citizen's engagement programme and mobile app

This section refers to Citizen's engagement programme and mobile app from MDS/UISAV.

Table 17: KPIs for UP8 "Citizen's engagement programme and mobile app"

KPI	Description	Value after Trial Period 1
N° of citizen engaged > 500	Social media engagement for forest management authorities, landowners, public authorities, and visitors of eight (8) pilot sites (as outlined in Section 1.3.3 of the DOA) through at least three (3) platforms. The activities include promotion of citizen engagement activities and use of citizen-engagement-toolkit through 500 local authorities and extend invitations to external stakeholder advisory group from the list of past projects.	UP8b was not put into public use for the Trial Period 1. Testing of the application is made on invitation only. UP8a was downloaded 87 times in total from the Google Play and Apple App Store.
N° of citizen-engagement-tool-kit assessment provided > 200	Citizen-engagement-tool-kit assessment will be provided by at least 200 of the already engaged users in UP8.	UP8a has been tested by at least 87 users who downloaded the app. At the moment, we cannot specify the number of engaged users since we do not collect assessment forms from users who downloaded the app.
N° of members consulted through public forum for the evaluation of public campaign > 2000	At least 2000 members consulted through public forum for the evaluation of public campaign.	UP8 was discussed during Slovak pilot with practitioners, public sector representatives, volunteers (about 40 fire fighters and 100 public sector/volunteers). UP8 was discussed during Czech pilot with practitioners and public (40). UP8 was discussed in the Greek pilot organized by the HRT. The number of participants was 95. The participants involved in the French pilot were approx. 30 to 40 people in total at the pilot site. Additionally, the consortium members met at the Limoges city hall with public servants and interested citizens after the pilot was conducted. There the application was also discussed with various people and verbal feedback was collected. UP8a was also disseminated in a workshop with students at the Anglia Ruskin University in Cambridge, with a public of approx. 60 people (as part of a parallel project.)
N° of evaluation	A number of surveys will be issued throughout the project. Three surveys have already been conducted among the partner organisation	UP8a collected a total of 103 surveys. - 41 surveys made from the Greek and French pilots.

KPI	Description	Value after Trial Period 1
surveys gathered > 100	investigating partner competencies and modes of citizen engagement activities in place. Further surveys will be issued to collect experienced needs of those involved in various stages of wildfire protection (from those involved in raising awareness about risks of wildfire and prevention strategies, to first responders and firefighters and authorities in charge). Considering the above, the number of evaluation surveys will be higher than 100.	- 20 surveys gathered from the Cambridge workshop. - 42 surveys gathered from the Silvanus partners
Number of modules in the CEP mobile App >= 3	There will be at least three different modules in CEP App. Namely: User Management Module, Notification Module, and Content Visualizations.	Content Visualizations, Fire reporting and notification module
Number of other CEP activities >= 3	In addition to the CEP App, the SILVANUS CEP is envisaged to include multiple other modes of engagement including social media (e.g., Twitter and LinkedIn), Mass Media (e.g., participation in radio and TV programs or publication of popular scientific articles), Public Events (e.g., presentations at related fairs, and other public gatherings), and Campaigns (e.g., at schools, or social campaigns directed at broader audiences).	Slovak TV (STV1) popularization series "Experiment" (aired on April 15th, 2023) hosted Zoltan Balogh and Andrea Majlingova to discuss forest fire dangers and approaches of SILVANUS project. A workshop in the Anglia Ruskin University in Cambridge was made the 27th of February, where we disseminated the app (UP8a) and collected feedback from the students participating in the workshop (20).

End-users feedback and strategy for upgrade

Table 18: End-users feedback- UP8

Pilot	Outcome	Feedback
Slovakia	Mobile App	Should be structured to working groups, standards for communication the fire incident with firefighters or any other relevant stakeholders should be specified. Lack of internet connection in some forest areas made the fire reporting service unavailable. Fire Reporting provides more information about a possible fire in the area. Fire reporting using a mobile app is not feasible at the present (due to legislation, potential misuse or need to verify plausibility of each report). Connecting Fire reporting to the 112 Emergency Call Center would be currently potentially possible only by translating the data from the report to an SMS form.
	SILVANUS Platform	The UPs should be integrated, and the integrated platform services should be tested during the pilot demonstration in each pilot site in 2024.
France	Mobile App	The pilot was conducted in Limoges and the application took place on the pilot demonstration site. Five phones were distributed to interested citizens with the request of testing the app and then answering a questionnaire. At this stage, the app was further developed, also using the feedback from the Greek

Pilot	Outcome	Feedback
		pilot. Ten questionnaires were submitted, and the results are described as following: The relevance and usefulness of the content was rated by all participants as very high (2 participants with 4/5 and 8 participants with 5/5) and no inaccurate information or bugs were reported. The overall functionality was reported by 5 people to be 4/5, by 4 people with 5/5 and by one person with 3/5. So, the overall app was reported to be very satisfactory by basically all participants. We also collected some information for further development stages. These include to implement direct calls for help, social media integration, and more notifications.
Czech	Mobile App	An active demonstration of the Fire Reporting module was given directly in the forest. First a smoke was artificially initiated in the woods. Then two distinct users, simulating tourists, took pictures of the smoke, filled in a fire report, and submitted the information which was instantly shown on the dashboard in the mobile command centre. The findings concerning the Fire Reporting module are the following: Additional customization options have been identified, including enhanced visualization of detailed information on the map and the establishment of collaborative working groups. One notable challenge encountered was accurately pinpointing fire locations on the mobile app's map due to difficulties in orienting oneself within the forest and identifying surrounding reference points such as roads and hills. Furthermore, a feature allowing users to add and switch between various map layers, was considered a desirable addition. In the next demonstration involvement of a bigger group of users is planned to show integration and aggregation of information from multiple users. An option to revoke a Fire Report was requested as a possible option. Modification of a Fire Report was also discussed. To mark a spotted fire location a user could have a possibility to map an area (i.e., a polygon) not just a point as a fire location. Possibility to communicate with municipalities, resp. Their representatives of villages and towns would be welcome. Types of forms and reports to be discussed further.
Greece	Mobile App	Citizen Engagement and Fire Report: The Citizen mobile application and Citizen Engagement Program were highly captivating aspects of the Greek pilot. The importance of educating and training the population for wildfire events cannot be overstated, as it plays a significant role in increasing awareness, preparedness, response, and restoration efforts. The program, along with the mobile application, was regarded as extremely interesting and beneficial. The mobile application not only supports the detection and monitoring of fire incidents, but also empowers citizens to become active responders. Additionally, the application proves to be an effective means of reaching out to and engaging with young people, surpassing the limitations of traditional methods. Feedback was collected using

Pilot	Outcome	Feedback
		questionnaires. 31 participants used the app and submitted the questionnaire, which allowed to draw conclusions about the usefulness and acceptance of the application. 27 out of 31 participants believed that the app can greatly contribute to society, and they liked the content in the app (each with scores of 4/5 and 5/5). 97% of participants answered the question "Do you think a Mobile App can help manage wildfires" with Yes. We also collected feedback regarding further development of the application, such as implementing the app in more languages, fire notifications and SOS communication.

UP Owner Strategy for Trial Period 2

UP8 consists of UP8a (the mobile application) and UP8b (the fire reporting module). So far, the application is available in both Google play store and Apple app stores. However, this only includes the functionalities from UP8a. For the pilots in phase 2, we plan on integrating UP8a and UP8b into one application and publish it to both app stores. This enables us to test the entirety of UP8 on pilot and demonstration sites. In June, the app consisting of both UPs will be tested in Czechia and we intend to demonstrate the application in more pilots which are yet to be confirmed. Feedback collected from former pilots, such as notification management, will be tackled in that phase since it requires the fire reporting module to be embedded in the application.

Trial Period 2 strategy for UP8a (Mobile Application) consists of:

i. Further educational and awareness content and more languages to increase the potential impact of the application**.**

ii. **The citizen engagement application will be enhanced to include an early warning system. This new feature will allow users who have registered on the app to receive real-time alerts on their mobile devices when a fire is detected in their vicinity. These alerts will enable citizens to respond more swiftly and efficiently in emergency situations. Additionally, we are integrating the display of evacuation routes on the map to guide users on how to safely escape from a fire-affected area.**

Adding country and pilot-specific content and modules, such as a module for farmers or hikers. Trial Period 2 strategy for UP8b (Fire Reporting Module) tackles the following findings:

i. Lack of Internet connection in the forest areas and mountains and connection bitrate is usually low**.**

ii. Inside the forest the users may have difficulty to recognize the direction and distance of the reported fire. It is also important to bring new features like fire notification, information channel subscriptions and interconnecting with SILVANUS services through EmerPoll framework.

Trial Period 2 strategy for UP8b (Fire Reporting Module) consists of:

i. Mitigating the mentioned finding by enabling offline map overlay of internet coverage and integrating digital compass helping a user to estimate direction of reported event.

ii. Improving backend services for Geolocated data (reports only from local area).

iii. Enabling receiving warnings and notifications about a fire in user or user's property area

iv. Improving user experience of the developed app.

v. Since only fire reporting functionality was demonstrated on specific pilot sites, the citizen warning functionality will be integrated into the UP8b module to be demonstrated during the forthcoming demonstrations.

3.9 Major outputs from User products technical validation and future developments

The UPs have fulfilled the first trial period with a strategy to move ahead, fixing technical bugs, improving, or expanding functionalities. All of these was possible due to strong collaboration from the pilots. As reported in the next sections, many of the developments to the UPs also contributed to expanding the scope of the pilots.

Table 19 shows the progress achieved for each SILVANUS UP compared to their defined targets. These targets are defined for the developed final product, so progress shows current state of development. Each user product has its own context, which may depend on pilots' support, this is the case e.g., of UP6 – Fire spread forecast, which really needs cases to proceed with evaluation of the module even though only two KPIs are defined.

Table 19: Progress of SILVANUS UPs based on pre-established targets.

	UP1	UP2	UP3	UP4	UP5	UP6	UP7	UP8
KPIs assigned	8	3	8	7	5	2	5	6
KPIs target values reached	3	2	4	4	4	1	2	2
Progress:	**38%**	**67%**	**50%**	**57%**	**80%**	**50%**	**40%**	**33%**

There is still effort ahead for the user product owners and developers as can be seen from the percentages mentioned. From another perspective, the target values may need to be reconsidered in Trial Period 2, due to new paths of UP development that emerge as the project progresses and new ideas pullulate.

As the development of SILVANUS platform moves on, to build a Decision Support System (DSS) based IFM, so do some development DSS related modules. The DSS itself may be considered as a User Product -UP9 – and for the sake of integration, all dependent modules shall be named after it.

Similar discussions during piloting activities led to the following splits and creation of user products, expressed in Table 20.

Table 20: New user products to be considered in Trial Period 2

NEW UP	Description	Responsible
UP1	AR/VR training toolkit for trainers	SIMAVI
UP2a	Fire ignition models	SIMAVI
UP2b	Fire danger index	CMCC
UP3	Fire detection based on social sensing	CERTH
UP4a	Fire detection from IoT devices	CTL
UP4b	Fire detection at the edge - from UAV data	ATOS
UP5a	UGV monitoring of wildfire behaviour	3MON
		CSIRO
UP5b	UAV monitoring of wildfire inspection	TRT
UP6	Fire spread forecast - Modelling	EXUS
UP7	Biodiversity profile mobile application	VTG
UP8a	Citizen's engagement application	MDS
UP8b	Citizen application for situational awareness and information sharing (Fire Reporting and Fire Warnings)	UISAV
UP9a	DSS - Resource allocation of response teams (DSS-RAR)	INTRA
UP9b	Health impact assessment (DSS-HIA)	UTH
UP9c	Evacuation route planning (DSS-ERP)	UTH

NEW UP	Description	Responsible
UP9d	Forest management planning and restoration (DSS-FMPR)	AMIKOM
UP9e	Continuous monitoring of rehabilitation strategy index (DSS-CMRSI)	AMIKOM
UP9f	Biodiversity Index Calculation (DSS-CMRSI)	AMIKOM
UP9h	Integrated Data Insights	CTL
UP9i	Priority Resource Allocation based on Forest Fire Probability (DSS)	AMIKOM
UP9j	Multilingual Forest Fire Alert System	AMIKOM
UP9k	DSS Deep Learning Model for Wild-fire Severity Prediction using EO4Wildfires	AUA
UP9l	DSS SIBYLA	TUZVO
UP10	SILVANUS forward command centre	DELL
UP11	SILVANUS platform and dashboard Geographical information system	ITTI
UP12	MESH in the sky	RINI

4 Pilot performance assessment.

This section details all the performance indicators from each pilot based on the demonstration activities that took place in SILVANUS between April and November 2023. The aim is to provide a clear assessment of the demonstration activities' effectiveness, involving the User Products (UPs) identified in Table 21 and, in case of the Slovak pilot, some additional locally developed applications.

Table 21: UP mapping per pilot country for Trial Period 1

	UP1	UP2	UP3	UP4	UP5	UP6	UP7	UP8	Other
Croatian				x	x				
Slovak		x			x	x		x	x
Romanian	x								
French	x		x	x	x		x	x	
Czech's					x		x	x	
Italian 2		x	x	x	x	x			
Greek			x	x	x	x		x	
Indonesian			x				x		
Italian 1		x	x	x	x	x		x	
Australian			x	x	x				

In each pilot section, the benefits of SILVANUS UPs (assessed by local end-users) are described along with outcomes. The information was given by pilot owners in the survey presented in Section 2.

During the first trial period, under Task 9.6 scope, SGSP conducted a series of interviews with pilot owners. The main objective of the interviews was to identify, formulate and collect Key Performance Indicators for every pilot KPIp. KPIp is defined as a quantifiable measure used to evaluate the success of a pilot activity[12]. DoA updated demonstration objectives were considered by defining the and KPI_{DO}.

The definition of all these KPIs can be found in Annex 2, under the template proposed to the pilot leaders and applies to both field exercises and tabletop exercises.

Pilot effectiveness assessment during Period #1 concerned first round of essential full-scale project pilots. For each of those pilots, the values achieved can be found in sub-section 4._.2. The evaluated KPIs go from 0 to 1, since they were defined in Task 9.6 activities, as Measurement result **[MR]** (ex post)/Estimation result **[ER]** (ex ante). **However, the objective is to create conditions, in Trial Period 2, to reach an MR =1**.

In the tables of pilot KPIs, **Criterium 1** allows to answer questions on how much a pilot ensures achievement of general project expectations formalised in the DoA. **Effectiveness Criterium 2** allows to answer questions on how much a pilot ensures achievement of its expectations formalised in a pilot operational readiness documentation. The KPI values have the following meaning:

Table 22: Pilot KPI values meaning.

KPI value	The value meaning
0.0	a pilot did not have influence on the KPI analysed
0.3	a pilot output had potential to achieve the KPI analysed (it may/might do it, but it has not achieved so far)
0.5	a pilot outcome did match indirectly the KPI analysed
0.7	a pilot outcome allowed to match the KPI analysed partly
1.0	an outcome allowed to match the KPI analysed completely

KPI_P – Pilot KPI, for phases A, B or C

KPI_{DO} – Demonstration Operation KPI

KPI_{ODE} – Dissemination and Exploitation KPI

For KPI< 1, a Trial Period 2 improvement is proposed. But even with KPI=1, some pilot owners chose to indicate MR<1, signalling an improvement strategy, detailed in rightmost column, for the Trial Period 2.

[12] Oxford Languages online dictionary

4.1 Croatia´s Pilot - Integrated next generation forest fires management systems

4.1.1 Pilot description

Pilot site: Šapjane, Croatia
From 18th to 19th April 2023

Učka Nature Park encompasses Mount Učka and a part of the Ćićarija mountain range. It is located along the northern Adriatic coast at one of the most northerly points of the Mediterranean, right where Istria meets the continental part of Croatia.

The Croatian pilot focused its field exercises on Phases A and B.

Figure 9: Demonstration actions in the Croatian Pilot

In this pilot the following UP were tested:

Table 23: User Products in Croatia´s Pilot

User Product	Description
UP4	Fire detection from IoT devices
UP5	Fire detection from UAV/UGV

4.1.2 Pilot key performance indicators and lessons learnt.

The formal assessment methodology to systemically evaluate the effectiveness of pilot demonstration activities was elaborated after the Croatian Pilot took place. For this reason, the effectiveness assessment has been conducted in ex post formula, in practical terms it means the presented values come as measured based.

Operational objectives of the demonstration:
(Taken from D9.2)

- Mapping of the area,
- Coordination of local and regional firefighting forces with aerial firefighting forces,
- Deployment of drones, UGVs, video cameras, IoT sensors, a mobile meteorological station and a separate command post.

The operational objectives were reached in a large extent although not completely as KPIs #1, #7 and #9 in Table 24 show.

Table 24: Croatian Pilot performance

	KPIs	PEMs	[ER] (ex ante)	[MR] (ex post)	KPI value	Improvements in Trial Period 2
1	KPI_{PA1-1}	Pilot concerned forests in the Primorsko-goranska County (Croatia). Relevant area was analysed regarding to firefighting reconnaissance, UAV flights and monitoring by UGV.	-	0.7	1.0	Pilot concerned more endangered -different Croatian county (Splitsko-dalmatinska). UAV flights and UGV monitoring
2	KPI_{PA1-2}	Pilot in Croatia was one of regional demonstration in EU-country planned on the base of the Grant Agreement.	-	0.7	1.0	Activities integrated in Mediterranean forest fires education center (Vučevica)
3	KPI_{PA4-1}	Pilot activities were reported using three ways: in SILVANUS Newsletter vol. 4 on	-	0.7	1.0	Pilot activities will be reported on national TV

	KPIs	PEMs	[ER] (ex ante)	[MR] (ex post)	KPI value	Improvements in Trial Period 2
		the project website, on the Twitter (X Platform) and LinkedIn.				
4	**KPI_{PA4-2}**	Local public administration and firefighting authorities participated in the pilot. They were familiarised with citizen-engagement-toolkit which is being elaborated in SILVANUS project.	-	0.7	1.0	In the project will be engaged and will participate national firefighting intervention unit
5	**KPI_{PA5-1}**	Pilot activities allowed to specify and visualise scenarios for the modelling of wildfires with positive potential for implementation to the training programme during next phase of the project.	-	0.3	1.0	Pilot activities and user products combined with Croatian FMC (firefighting management system) tools
6	**KPI_{PB1-2}**	Catalink presented edge (IoT) devices for fire detection (sensors – UP3).	-	0.7	1.0	Presentation of Catalink IoT user product/system for fire detection
7	**KPI_{PB5-1}**	Use of UAVs, sensors and UGV allowed to reduce number of firefighters required to cover the forefront of wildfire regarding to fire detection, fire reconnaissance and direct firefighting.	-	0.7	1.0	Presentation of RINI Mesh in the Sky user product/system for fire detection, fire reconnaissance and direct firefighting.
8	**KPI_{PB9-1}**	Use of UAVs allowed to monitor field resources deployed within a 5km distance	-	1.0	1.0	-
9	**KPI_{DO1}**	1 complementary scenario was formalised. The scenario concerned detection of fire spot, operation of the separate command post as well as emergency communication.	-	0.7	1.0	Expected to be repeated
10	**KPI_{DO2}**	Several external experts representing fire service, public administration and technology providers participated in the pilot.	-	0.7	1.0	Expected to be repeated
11	**KPI_{DO3}**	The pilot ascribed to the first cycle of project pilots organised for Phase A, and Phase B.	-	0.7	1.0	Expected to be repeated
-	-	Sum (Effectiveness Criterium 1):	-	7.6	1.0 (100%)	
1	**KPI_{p-M1}**	1 complementary scenario was formalised. The scenario concerned fire detection with the use of edge (IoT) devices, use of ground robots and Mesh in the Sky technology to establish emergency communication.	-	1.0	1.0	-
2	**KPI_{p-M2}**	More than 5 external experts from fire service and public administration participated in the pilot to oversee relevant demonstration activities.	-	1.0	1.0	-
3	**KPI_{p-M3}**	The pilot fully considered phases expected in Description of Action for the project (Phase A and Phase B).	-	1.0	1.0	-
4	**KPI_{p-M5}**	Pilot allowed to implement UP4, UP5 and UP6.	-	1.0	1.0	-
5	**KPI_{p-M6}**	The good practices were implemented directly to pilot activities and regarded detection of fire spots using edge (IoT)	-	1.0	1.0	-

	KPIs	PEMs	[ER] (ex ante)	[MR] (ex post)	KPI value	Improvements in Trial Period 2
		devices (Phase A) as well as the use of UAVs and UGV for the response needs (Phase B).				
6	**$KPI_{p\text{-}M9}$**	Fire service was involved in pilot activities.	-	0.7	1.0	Special wildland fire forces involved in pilot activities
7	**$KPI_{p\text{-}O1}$**	Pilot Owner, Pilot Observer and Pilot Players were indicated in person.	-	1.0	1.0	-
8	**$KPI_{p\text{-}I4}$**	All UPs were accessible on the market or via B2B agreements between local security entities and technology providers.	-	1.0	1.0	-
9	**$KPI_{p\text{-}I6}$**	Use of UAVs, edge (IoT) devices and UGV allowed to reduce number of firefighters required to cover the forefront of wildfire regarding to fire detection and fire reconnaissance.	-	0.7	1.0	Expected to be repeated
10	**$KPI_{p\text{-}S1}$**	Pilot Players used mobile operational centre (the separate command post)	-	1.0	1.0	-
-	-	Sum (Effectiveness Criterium 2):	-	9.4	1.0 (100%)	

4.1.3 Qualitative feedback and pilot outcomes.

During trial period 1, this pilot focused mostly in one type of end-user: the firefighters and that is why the next table reflects only this end-user benefits.

Table 25: Benefits to end-users from Croatian Pilot field exercise

End-users involved	Benefits from SILVANUS
Firefighting organizations	Connecting and integrating existing UPs (Fire-management system, video-surveillance), with new technologies developed by the project (fire-fighting command centres, Mesh in the sky, satellite surveillance)

There were demonstrated functionalities that reduce the time required to obtain a clear overview of potentially harmful wildfires and decrease the time needed for a correct reaction. As a first conclusion, the Copernicus Emergency Management System (EMS) should be integrated into national Fire Management Systems.

Notably, no significant issues were identified with the UPs. UP owners took this first demonstration opportunity to interact with the stakeholders present and get their impressions and expectations.

For the Croatian Firefighting Association (fire-fighters) the exercise raised awareness about new technologies, methods and means to prevent and suppress wildland fires, namely using UP5's UAV and UGV systems for monitoring and fire extinguishing, deployment and route planning of UAVs for data collection and mapping (UP5), or mesh in the sky with effective communication, and finally Smoke and fire detection. The Association also valued the user interface of UPs, while they got acquainted with new models and functionalities of UGV and UAV.

SILVANUS may leverage on Croatian Firefighting Association network of associated county firefighters to disseminate project results.

4.2 Slovakia´s Pilot - Policy recommendations on restoration of forest landscape

4.2.1 Pilot description

Pilot site: Podpolanie – Polana Biospheric Reserve, Slovakia
From 24th to 26th April 2023

In the Slovakia Pilot, the demonstration showcased the transition from surface/ground fire to crown fire. Since surface fire is the most common type of fire in Slovakia, its transition to crown fire represents the worst-case scenario. This situation requires the deployment of not only fire trucks but also helicopters for fire localization and suppression.

The Slovakia´s pilot focused its field exercises on Phases A, B and C.

Figure 10: Demonstration location in Slovakia´s pilot

In this pilot the following UP were tested:

Table 26: User Products in Slovakia´s Pilot

User Product	Description
UP2	Fire Danger Tool
UP5	Fire detection from UAV/UGV
UP6	Fire Spread Forecast
UP8	Citizen engagement and information sharing application

4.2.2 Pilot key performance indicators and lessons learnt.

As happened to the Croatian Pilot, the formal assessment methodology for systematically evaluating the effectiveness of Slovak pilot demonstration activities was developed afterwards. As a result, the effectiveness assessment has been conducted retrospectively, i.e., the presented values are based on measurements.

Operational objectives of the demonstration:
(Taken from D9.2)

- Demonstrate a holistic and integrated approach to wildfire management.
- Enhancing resilience to wildfires through training, leveraging on an integrated technological platform for decision support in wildfire management.
- Utilizing big-data software and algorithms to prevent and manage forest fires, incorporating wireless communication and drone surveillance.

KPIs #5 and a few other, show that there is still room for improvement in fulfilling the operational objectives, although realizing in can be leveraged on the effort already invested.

Table 27: Slovak Pilot performance

	KPIs	PEMs	[ER] (ex ante)	[MR] (ex post)	KPI value	Improvements in Trial Period 2
1	**KPI_{PA1-1}**	Pilot concerned forests in BR Polana (Slovak Republic). Relevant area was analysed regarding to firefighting reconnaissance, UAV flights, monitoring by UGV and CCTV tools. The forests were	-	0.7	1.0	In October 2024, the second cycle of pilot activities is going to be implemented in the Slovak Pilot Site territory.

	KPIs	PEMs	[ER] (ex ante)	[MR] (ex post)	KPI value	Improvements in Trial Period 2
		mapped and implemented to SILVANUS dashboard.				Mapping the Pilot area deploying technology integrated in SILVANUS platform (UPs)
2	**KPI_{PA1-2}**	Pilot in Slovak Republic was one of regional demonstration in EU-country planned on the base of the Grant Agreement.	-	0.7	1.0	In October 2024, the second cycle of pilot activities, including phases A, B and C, is going to be implemented in Pilot area deploying as much of SILVANUS UPs as possible.
3	**KPI_{PA4-1}**	Pilot activities were reported using three ways: in SILVANUS Newsletter vol. 4 on the project website, on the Twitter (X Platform) and LinkedIn.	-	0.7	1.0	Reporting the second cycle of demonstration activities of the Slovak Pilot are going to be reported in SILVANUS Newsletter, TUZVO Newsletter, regional TV broadcasting, on the Twitter, LinkedIn, Instagram.
4	**KPI_{PA4-2}**	Local forest and firefighting authorities participated in the pilot. They were familiarised with citizen-engagement-toolkit which is being elaborated in SILVANUS project.	-	0.7	1.0	The round table discussions are organized by Slovak CASD with relevant stakeholders, authorities involved in forest and landscape management. There is also going to be organized a workshop in October 2024 which will be associated with Slovak Pilot demonstration. SILVANUS UPs are going to be demonstrated and evaluated.
5	**KPI_{PA5-1}**	Pilot activities allowed to specify and visualise multiple scenarios for the modelling of wildfires with positive potential for implementation to the training programme during next phase of the project.	-	0.3	1.0	PhD. thesis is under elaboration at TUZVO, which is dealing with problem of firefighters and incident commanders training using the progressive ICT technology, UGV, VR/AR, modelling and simulation. This should be defended in August 2025. This is elaborated as a conceptual material for the needs of Fire and Rescue Service.
6	**KPI_{PB1-2}**	When use UAV during pilot activities, the equipment was integrated with visual sensing technology.	-	0.7	1.0	In next pilot cycle the UAV technology will be integrated with visual sensing technology again.
7	**KPI_{PB2-3}**	Use of multiple fire detection solutions (CCTV, drones, firefighting reconnaissance) verified reduction of false alarm rate for fire detection	-	0.7	1.0	In next pilot cycle (2024), the multiple fire detection solutions (CCTV, drones, firefighting reconnaissance) are going to be deployed to verify the wildfire occurrence and reduce the false alarm rate in fire detection

	KPIs	PEMs	[ER] (ex ante)	[MR] (ex post)	KPI value	Improvements in Trial Period 2
8	**KPI_{PB5-1}**	Use of UAVs, CCTV and UGV allowed to reduce number of firefighters required to cover the forefront of wildfire regarding to fire detection, fire reconnaissance and direct firefighting.	-	0.7	1.0	In next pilot cycle (2024), there are going to be deployed UAVs, CCTV and UGV to support the decision-making process of command staff when deciding on fire tactics and number and spatial distribution of available sources and resources to cover the forefront of wildfire to start the firefighting activities.
9	**KPI_{PB9-1}**	Use of UAVs, CCTV and UGV allowed to monitor field resources deployed within a 5km distance	-	1.0	1.0	-
10	**KPI_{DO1}**	1 complementary scenario was formalised. The scenario concerned systematic detection of fire spot, transmission of the information to the operational centre as well as deployment of drones and the M17 helicopter.	-	0.7	1.0	Complementary scenarios are going to be formalised and implemented. Those will be concerned on systematic detection of fire spots, transmission of the information to the operational centre and deployment of UAVs for monitoring the fire site.
11	**KPI_{DO2}**	Several external experts representing fire service, forest service and technology providers participated in the pilot.	-	0.7	1.0	In next pilot cycle (2024), technological partners, fire services, forest service, nature conservancy and environment protection services as well as civil protection services and municipality representatives are going to be invited to attend the demonstration, workshop and provide their evaluation on the Pilot activities demonstrated as well as SILVANUS UPs deployed.
12	**KPI_{DO3}**	The pilot ascribed to the first cycle of project pilots organised for Phase A, Phase B and Phase C.	-	0.7	1.0	In the next pilot cycle (2024), demonstration activities for Phase A, B, And C will be provided.
13	**KPI_{ODE3-2}**	The pilot organisation considered demonstrations of technologies (25.03.2023) and Meeting on the results of the pilot Study (26. 04. 2023) with different types of stakeholders.	-	0.7	1.0	The Pilot activities in 2024 are composed round table discussions with relevant stakeholders' representatives, state administration bodies representatives, field exercises with demonstration of SILVANUS UPs and workshop for stakeholders attending the Pilot activities demonstration, whose feedback is going to be analysed and summarized.

	KPIs	PEMs	[ER] (ex ante)	[MR] (ex post)	KPI value	Improvements in Trial Period 2
-	-	Sum (Effectiveness Criterium 1):	-	9.0	1.0 (100%)	
1	**$KPI_{p\text{-}M1}$**	1 complementary scenario was formalised. The scenario concerned systematic detection of fire spots, transmission of the information to the operational centre as well as deployment of drones and the M17 helicopter.	-	1.0	1.0	-
2	**$KPI_{p\text{-}M2}$**	More than 5 external experts from fire service and forest service participated in the pilot to oversee relevant demonstration activities.	-	1.0	1.0	-
3	**$KPI_{p\text{-}M3}$**	The pilot fully considered phases expected in Description of Action for the project (Phase A, Phase B and Phase C).	-	1.0	1.0	-
4	**$KPI_{p\text{-}M5}$**	Pilot allowed to implement UP2, UP5, UP6 and UP8.	-	1.0	1.0	-
5	**$KPI_{p\text{-}M6}$**	The good practices were implemented directly to pilot activities and regarded detection of fire spots using CCTV (Phase A), the use of UAVs and UGV for the response needs (Phase B) and trusted organisational solutions for forest restoration (Phase C).	-	1.0	1.0	-
6	**$KPI_{p\text{-}M9}$**	Forest service and fire service were involved in pilot activities.	-	0.7	1.0	Different type of stakeholders involved in forest management, nature conservancy, environment protection, civil protection, professional and volunteer fire services, municipality representatives, state administration representatives are going to be involved in pilot demonstration activities and evaluation of SILVANUS platform benefits.
7	**$KPI_{p\text{-}O1}$**	Pilot Owner, Pilot Observer and Pilot Players are indicated in person.	-	1.0	1.0	-
8	**$KPI_{p\text{-}I4}$**	All UPs were accessible on the market or via B2B agreements between local security entities and technology providers.	-	1.0	1.0	-
9	**$KPI_{p\text{-}I6}$**	Use of UAVs, CCTV and UGV allowed to reduce number of firefighters required to cover the forefront of wildfire regarding to fire detection, fire reconnaissance and direct firefighting.	-	0.7	1.0	The UAVs, CCTV and UGV will be deployed to allow reduction in number of firefighters required to cover the forefront of wildfire as well as for fire detection, fire reconnaissance and direct firefighting activities.
10	**$KPI_{p\text{-}S1}$**	Pilot Players used mobile operational centre located basically in forest service	-	1.0	1.0	-

	KPIs	PEMs	[ER] (ex ante)	[MR] (ex post)	KPI value	Improvements in Trial Period 2
		premises to monitor and manage all activities in the threatened area.				
-	-	Sum (Effectiveness Criterium 2):	-	9.4	1.0 (100%)	

4.2.3 Qualitative feedback and pilot outcomes.

In Podpolanie, two site-specific tools were showcased[13]. The first tool involves **fire danger prediction** by leveraging data from local weather stations and conducting detailed geospatial analyses. The second tool encompasses the development of **Slovak fuel models**, which include the spatial distribution and quantity of fuel, based on comprehensive research findings and field surveys.

In the Slovak pilot, a wide range of benefits resulting from the application of SILVANUS findings were identified and documented in Table 28.

Table 28: Benefits to end-users from Slovak Pilot field exercise

End-users involved	Benefits from SILVANUS
Professional firefighters	SILVANUS UPs as alone or integrated in the SILVANUS platform provides the professional firefighters with information on fire danger and its spatial distribution in the territory. AI is going to be provided fire spread prognoses, which belongs to the key information to plan the fire tactics and enough sources and resources to fight the fire effectively and in as short time as possible to prevent widespread damage to life and health of persons, their property, and the environment. UAVs and UGVs provide, via monitoring and mapping, information on current situation in the field. GINA supports the navigation to fire site, geodata support when deciding on fire tactics and deployment of firefighting sources and resources in the field. Citizen's engagement Mobile app allows the citizens to notify the fire in the earlier stages of its spread what will be reflected in lower range of resulting damage if the firefighters would be informed and able to start the firefighting activities asap. Enhancing the situation with building the GSM network, via Mesh in the Sky user product will ensure the communication channels with military firefighters and helicopter pilots.
Volunteer firefighters	SILVANUS UPs can increase effectiveness of their intervention in rural and mountain territories, increase their real-time awareness, information and geodata support and provide the tool for communication with professional firefighters in the field.
Military firefighters	SILVANUS UPs provide information on fire dangers which is necessary for localisation of fire monitoring activities by military aerial vehicles. Information on fire spread is a key information on planning the sources and resources to fight the fire as in the form of aerial attack as ground attack. Enhancing the situation with building the GSM network, via Mesh in the Sky user product will ensure the communication channels with professional firefighters.
Civil protection authorities	SILVANUS UPs provide tools for communication and interaction with people and communities, increased real-time awareness, and fire danger assessment and spread prognoses support the optimization of the evacuation routes and evacuation process planning.

[13] Information provided in T9.2 survey.

End-users involved	Benefits from SILVANUS
State Nature Conservancy employees	SILVANUS UPs support the biodiversity mapping, UAVs provides cost efficient and real-time mapping of the areas of interest. The Mobile app has several utilisations related mostly to dangerous events in the nature to notify the rescue services.
Forest managers and owners	SILVANUS UPs support the biodiversity mapping. The fire danger assessment results are a key prerequisite for planning the fire patrolling activities, building the fire prevention features in the field. UAVs provides cost efficient and real-time fire monitoring of the forest localities with high fire danger. Fire spread prognosis allows the foresters to provide the fire prevention measures in the localities which are going to be affected by fire to protect forest.
Local, Regional Authorities	SILVANUS UPs support the understanding and perception of risks at the local and regional level, the needs of entities operating at these levels, whose activities are related to the provision of emergency services or the protection of natural resources, as well as the protection of the population itself. Those can be accepted to be a part of the regional development strategies.
Tourists, visitors	SILVANUS UPs provide fire danger assessment which outputs in map form build public awareness on providing activities with open fire in the localities with higher fire danger. Valuable for this group of stakeholders is especially the Mobile app which allows them to notify the fire in the wildland, to get information and to communicate with responsible rescue services on safe behaviour, evacuation from the locality during the fire.

From the demonstration results a positive impact was inferred over a large range of stakeholders**.**

The SILVANUS deployment in the Slovak Pilot introduced a new approach for **professional firefighters**. It included cost-efficient methods for ground fire-detection and real-time mapping of fire spread using a swarm of drones. The demonstration also highlighted the establishment of communication channels in areas without GSM, radio communication network, and connection, using UAVs and StarLink systems. As a result, there will be a public procurement of UAVs to be included in the equipment of every District Directorate of Fire and Rescue Service by the end of 2023. Additionally, there is a focus on using UGV for mapping the fire site under the tree crown closure and for transporting firefighting equipment and injured personnel over long distances in the field. The fire spread prognosis product is planned to optimize fire tactics and the deployment of water sources and resources at the incident scene. The fire danger assessment map outputs will be used for planning fire patrolling activities. Furthermore, there is strong consideration for sharing information and geodata on incident locality and fire behaviour from different data sources such as GIS data stores, UGV, UAV, helicopter optic and IR cameras, among others.

Volunteer firefighters will benefit from fire danger assessment map outputs for optimizing fire patrolling activities and preparedness during high fire danger days. They will also have new communication channels with professional firefighters and **Military firefighters** during fire interventions and the ability to share information and geodata on incident locality and fire behaviour from different data sources. Additionally, they will be involved in new tactics procedures when using helicopters for firefighting, including cooperation with other professionals and volunteers.

Local civil protection authorities will benefit from fire danger assessment outputs to build public awareness at the local and regional levels. Additionally, they will utilize fire spread prognosis for real-time evacuation of individuals endangered by fire, in cooperation with **local and regional authorities**. State Nature Conservancy employees will use fire danger assessment map outputs for planning fire patrolling activities.

Forest managers and **Forest Field owners** will benefit from various tools and outputs, including the use of UAVs for low-cost fire monitoring and preventive measures, as well as for mapping forest resources and

infrastructure. They will also have access to the Optix camera smoke detection system for preventive fire monitoring and monitoring during fire situations minimizing their impact on natural habitats. Additionally, they will utilize fire danger assessment map outputs for planning fire patrolling activities. Furthermore, they will have access to alternatives for forest management according to pre-defined priorities in Sibyla, along with visualization of the forest and its biodiversity according to these alternatives in VR/AR.

The **State Nature Conservancy's employees** highly value various technological tools and systems that significantly contribute to their conservation efforts. Firstly, UAVs are used to monitor and map inaccessible mountain areas, providing valuable insights into these remote and often challenging terrains. This capability allows for a more comprehensive understanding of the natural landscape and its conservation needs. Additionally, the Mobile App plays a crucial role in providing real-time awareness and notifications regarding dangerous wild animals in the localities frequently visited by tourists. This proactive approach enhances safety for both the wildlife and the visitors, fostering a harmonious coexistence between humans and the natural environment. Moreover, the utilization of wildfire risk assessment data is pivotal in localizing fire patrolling activities in forests. By leveraging this data, the Conservancy can strategically allocate resources and personnel to areas at higher risk, effectively mitigating potential fire incidents. Lastly, the incorporation of fire spread prognosis data is essential for the construction of firebreaks to protect biotopes of national or European significance. This proactive measure serves to safeguard and preserve these ecologically important areas, contributing to the overall conservation efforts of the State Nature Conservancy.

Tourists and visitors may be interested on the mobile app, designed in SILVANUS, to notify them of wildfires, provide information on safe behaviour, and guide them on evacuation from fire-risky localities. Additionally, they will have access to fire danger assessment outputs to prevent risky activities in localities with higher fire danger index, ensuring their safety and peace of mind.

4.3 Romania´s Pilot – Accidental fires resulting from weather conditions and firefighting coordination.

4.3.1 Pilot description

Pilot site: Rodna Mountains, Romania
From 14th to 15th September 2023

"Rodna" Mountains National Park is the second largest national park in the country, with an area of 47.177 ha, of which 3.300 hectares were declared to be a Biosphere Reserve in 1979. The importance of this protected area in geology and geomorphology is due to the mountains and the presence of numerous species of flora and fauna, endemic and relict glacial.

The Romania´s pilot focused its tabletop exercises on Phase A.

Figure 11: VR Demonstration

In this pilot the following UP were tested:

Table 29: User Products in Romania´s Pilot

User Product	Description
UP1	AR/VR training toolkit for trainers

4.3.2 Pilot key performance indicators and lessons learnt.

Also, for the Romanian pilot, the formal assessment methodology for systematically evaluating the effectiveness of the pilot demonstration activities was developed afterwards. As a result, the effectiveness assessment has been conducted retrospectively, together with the Romanian pilot owner based on pilot's documentation.

Operational objectives of the demonstration:
(Taken from D9.2)

- Proactively assess and address challenges to enhance preparedness for the demonstration.
- Establish a robust communication framework to facilitate smooth collaboration and information exchange among all involved parties.
- Establish a well-defined scenario that addresses stakeholders' needs and informs necessary acquisitions for a successful pilot demonstration.
- Gather valuable feedback from stakeholders to refine and optimize the VR technology for enhanced performance during the pilot demonstration.

The operational objectives were reached to a good extent, considering this pilot was a set of tabletop exercises. For 2024, Romanian pilot will organize a forest fire exercise. The values are shown in Table 30.

Table 30: Romanian Pilot performance

	KPIs	PEMs	[ER] (ex ante)	[MR] (ex post)	KPI value	Improvements in Trial Period 2
1	**KPI_{PA1-1}**	Area of the Rodnei Mountains national park was analysed for the pilot purposes.	-	1.0	1.0	-
2	**KPI_{PA1-2}**	Romanian pilot was example of regional demonstration site to be analysed within the project from EU country.	-	0.7	1.0	During March-October 2024, the second cycle of pilot activities, including phases A and B is going to be implemented in the Pilot area, deploying as much of SILVANUS UPs as possible.
3	**KPI_{PA4-3}**	External stakeholders took invitations and participated in the pilot (AISU Bistrița, Rodna National Park Administration, Voluntary Service for Emergency Situations, SIMAVI, Local Firefighters).	-	1.0	1.0	-
4	**KPI_{PA5-1}**	Wildfire scenarios were evaluated by external stakeholders for the training purposes.	-	0.7	1.0	The training of firefighters planned for July-August 2024 will be conducted before the in-field exercise planned for September 2024.

	KPIs	PEMs	[ER] (ex ante)	[MR] (ex post)	KPI value	Improvements in Trial Period 2
5	**KPI_{PA5-2}**	Pilot has a form or workshop for first responders in crisis management and disaster resilience.	-	0.7	1.0	Another meeting is planned for July 2024 for setting up the in-field exercise, that will include this type of outcome.
6	**KPI_{PA5-3}**	Pilot attendees (external experts) made preliminary evaluation of training elements.	-	1.0	1.0	-
7	**KPI_{PA5-4}**	Several first responders and fire fighters were trained in the usage of elements of SILVANUS platform.	-	0.7	1.0	Another meeting is planned for July 2024 for setting up the in-field exercise, that will include this type of outcome.
8	**KPI_{PA6-1}**	Historical data was analysed for the development of scenarios and impact modelling affected by wildfires in pilot region.	-	1.0	1.0	-
9	**KPI_{PB5-1}**	Use of UAV allowed to reduce the deployment of firefighter personnel to the forefront of wildfire in terms of facilitating reconnaissance activities.	-	0.7	1.0	During September 2024, the in-field exercise is going to be implemented, deploying as much of SILVANUS UPs as possible, including possibility UAVs.
10	**KPI_{PB7-1}**	UAV (as supplier solutions) was evaluated for the integration of wearable devices that equipped fire service entities.	-	0.7	1.0	During September 2024, the in-field exercise is going to be implemented, deploying as much of SILVANUS UPs as possible, including, possibility, the use of UAVs.
11	**KPI_{PB9-1}**	Use of UAV allowed to monitor field resources deployed within a 5km distance.	-	1.0	1.0	-
12	**KPI_{PB9-2}**	Classical alert form was used (organoleptic way).	-	0.7	1.0	The fire signalling adopted in the scenario that will be implemented in September 2024 is that a tourist will signal the fire via phone call.
13	**KPI_{DO1}**	Separate scenarios were elaborated to reflect upon different causes of wildfires.	-	1.0	1.0	-
14	**KPI_{DO2}**	More than 20 external experts to be invited to oversee the pilot demonstration activities.	-	1.0	1.0	-
15	**KPI_{DO3}**	The pilot ascribed to first round of project pilots.	-	1.0	1.0	-
16	**KPI_{ODE1-3}**	Pilot attendees are potential experts who represent 3 fields of expertise (fire fighters, national park administration, technology provider).	-	0.7	1.0	This will also be the case during the September 2024 fire simulation exercise.
11	**KPI_{ODE3-2}**	Workshop was collocated to demonstration activities (Day 1).	-	1.0	1.0	-
-	-	Sum (Effectiveness Criterium 1):	-	14.6	17.0 (100%)	
1	**KPI_{p-M1}**	Pilot formalised several partly complementary scenarios to reflect upon different causes of wildfires.	-	1.0	1.0	-

	KPIs	PEMs	[ER] (ex ante)	[MR] (ex post)	KPI value	Improvements in Trial Period 2
2	**KPI_{p-M2}**	More than 5 external experts participated in the pilot to oversee relevant demonstration activities.	-	1.0	1.0	-
3	**KPI_{p-M3}**	The pilot fully considered phases expected in Description of Action for the project.	-	1.0	1.0	-
4	**KPI_{p-M5}**	Pilot allowed to implement UP1 (VR/AR solution) developed in the project.	-	1.0	1.0	-
5	**KPI_{p-M6}**	As regards to pilot attendees, the pilot implemented at least 3 good practices related to wildfire management for each pilot phase expected.	-	1.0	1.0	-
6	**KPI_{p-M9}**	Some entities (fire brigade, national park administration) considered in wildfire management plans were involved in pilot activities.	-	1.0	1.0	-
7	**KPI_{p-O1}**	Pilot Owner, Pilot Observer and Pilot Players were indicated in person.	-	1.0	1.0	-
8	**KPI_{p-O2}**	Pilot allowed to organise tabletop exercise for first responders in crisis management.	-	1.0	1.0	-
9	**KPI_{p-O4}**	Pilot allowed to train at more than 10 first responders and fire fighters in the usage of SILVANUS platform (VR/AR).	-	0.7	1.0	Scheduled for July 2024.
10	**KPI_{p-I1}**	Pilot Owner ensured that all functionalities of UP1 had necessary conditions and infrastructure to be verified during the pilot.	-	1.0	1.0	-
11	**KPI_{p-I4}**	UP1 hardware is commonly accessible for local security entities in the market.	-	1.0	1.0	-
12	**KPI_{p-S3}**	Pilot Owner and Pilot Players fully expressed their responsibilities and tasks related to the project.	-	1.0	1.0	-
-	-	Sum (Effectiveness Criterium 2):	-	11.7	12.0 (100%)	

4.3.3 Qualitative feedback and pilot outcomes.

The feedback from the end-users involved in the pilot, is summarized in Table 31and mainly shows a positive appreciation for SILVANUS UPs.

Table 31: Benefits to end-users from Romania Pilot

(Group of) end-users	Benefits from SILVANUS
Firefighters Bistrita county (IGSU)	Firefighters can undergo extensive virtual training sessions to enhance their decision-making skills, teamwork, and familiarity with different firefighting strategies. The VR environment allows them to handle various equipment, simulate emergency scenarios, and refine their coordination with team members. By being trained before the pilot demonstration with the VR solution, the firefighters will be able to respond to the incident with more accuracy and coordination.
Rodna National Park Administration	AR technology would greatly improve communication and on-the-spot assessment of the necessary infrastructure for intervention. In addition, it has

	the potential to greatly increase the safety level of the entire team involved during the intervention.
Voluntary Service for Emergency Situations (SVSU)	The stakeholders appreciated that in the context of a forest fire intervention, a VR solution can significantly enhance capabilities by providing an advanced and immersive toolset for firefighting personnel by revolutionizing the way inter-institutional teams respond to and manage forest fires.

The subject of awareness raise through more efficient monitoring and prevention was the main outcome of the pilot, along with first contact with new technologies for the fire intervention process.

The next steps from the tabletop exercises involve the use of technology to prepare involved stakeholders for an efficient intervention that will lead to no fatalities and the possibility to contain any potential wildfire in less than a day. Additionally, improved coordination and monitoring between local stakeholders is expected to lead to a 50% reduction in accidental fire ignitions. These actions may contribute in Trial Period 2 to the Expected Impacts of the project.

4.4 France´s Pilot – Forest fire with industrial accident in highly explosive plant

4.4.1 Pilot description

Pilot site: St Sylvester, France
From 28th to 30th September 2023

The French Pilot is located in the Municipality of St. Sylvester – EPC site: Le Pacage des Boeufs. Many industries with high risk to human lives (for example SEVESO industries) are located near residential or rural areas. Managing a major accident in a delicate situation of forest fire is a challenge, and with the production of smoke cloud and explosive, it is always important to minimize further risks.

Figure 12: Installation of fire hose to the ground robot

The French pilot focused its field exercises on Phases A, B and C.

In this pilot the following UPs were tested:

Table 32: User Products in France´s Pilot

User Product	Description
UP1	AR/VR training toolkit for trainers
UP3	Fire detection based on social sensing
UP4	Fire detection from IoT devices
UP5	Fire detection from UAV/UGV
UP7	Woode - Biodiversity profile mobile application
UP8	Citizen engagement and information sharing application

4.4.2 Pilot key performance indicators and lessons learnt.

As the pilot was organised after the formal assessment methodology to systemically evaluate the effectiveness of pilot demonstration activities had been elaborated, the effectiveness assessment was conducted in both formulas (ex post and ex ante). Pilot Owner, Pilot Observer and Task Leader prepared

pilot evaluation template and a survey for evaluation of pilot effectiveness and replicability studies in SILVANUS project, collected information from own observations and from pilot attendees, and made the assessment.

Operational objectives of the demonstration:
(Taken from D9.2)

- Training FR in VR/AR, simulation of real fire.
- Test on the field with people, school children, municipality.
- Detection of the fire.
- Reconnaissance, analysis of the air, mapping, detection.
- Anticipation of the spread, information to the command post.
- Interface of users.
- Fire Detection Based on Social Sensing (monitoring social media posts)

The operational objectives were reached in a fair extent, with many improvements identified during the field exercises which will be considered for Trial Period 2, the values are shown in Table 33.

Table 33: French Pilot performance

	KPIs	PEMs	[ER] (ex ante)	[MR] (ex post)	KPI value	Improvements in Trial Period 2
1	**KPI_{PA1-1}**	623 000,0 sq. meters in St Sylvestre Forest & Limousine Forest (UNISYLVA) were analysed and mapped.	0.7	0.7	1.0	The location of the forest with the variety of trees was an excellent choice for the French pilot.
2	**KPI_{PA1-2}**	French pilot was one of regional demonstration in EU-country planned on the base of the Grant Agreement	0.7	0.7	1.0	Yes.
3	**KPI_{PA3-1}**	Historical weather data with 1-hour resolution was used (historical observations in the same dates of the pilot but last year (2022).	0.7	0.7	1.0	We could use updated data.
4	**KPI_{PA4-1}**	There was simulation of use of Twitter (PUI account) and social media during the pilot.	0.7	0.7	1.0	The use of X-Twitter through PUI account was a good communication tool during the pilot. It would be an advantage to have more social media during the pilot.
5	**KPI_{PA4-2}**	Citizen engagement mobile application with French version was implemented. St Sylvestre population and children (from schools in the St Sylvestre) were involved. Meeting with the mayor of Limoges was organised. Opening ceremony of the exhibition about prevention of fire and protection of biodiversity (SILVANUS posters) was organised.	1.0	1.0	1.0	-
6	**KPI_{PA4-4}**	Citizen engagement mobile application with French version was assessed. Citizen engagement mobile application (CEA tool) with French translation is available now.	0.7	0.3	0.43	their will help having the translation completed for Trial 2.
7	**KPI_{PA5-2}**	Demonstration and tests of UGV (reconnaissance), UAV, IoT (detection), fire truck, new PPE and tools for firefighters, training in VR, interface for users, detection by social sensing/media.	0.7	1.0	1.0 (1.43)	-

	KPIs	PEMs	[ER] (ex ante)	[MR] (ex post)	KPI value	Improvements in Trial Period 2
8	**KPI_{PB5-1}**	Fire detection with the use of UAV/UGV (3MON/UISAV) allowed to reduce the deployment of firefighter personnel to the forefront of wildfire.	0.7	1.0	1.0 (1.43)	-
9	**KPI_{PB5-2}**	Fire detection with the use of UAV/UGV (3MON/UISAV) allowed for drone demonstration with potentially positive influence on resilience in navigating natural terrain.	0.7	0.5	0.71	It would be good to have a new drone.
10	**KPI_{PB7-1}**	Following technologies were implemented: 1. AR/VR Toolkit (PUI also have a similar tool. Hence, one could validate the same provided by SIMAVI too); 2. Citizen engagement mobile application (CEA tool is available with French translation now). 3. Fire detection from IoT devices (CTL was present during the pilot and demonstrated relevant technology). 4. Fire detection using UAV/UGV (3MON/UISAV provided demonstration of the drones). 5. Fire spread forecast. 6. User interface (it was validated as developed by ITTI).	1.0	1.0	1.0	-
11	**KPI_{PB7-2}**	There was feedback, but not all suppliers gave it due to the pilot.	0.7	0.3	0.43	We have to ask more times to receive feedback from the participants.
12	**KPI_{PB9-1}**	There was monitoring of field resources deployed within distance related to the pilot location (site of fire: 46° 1’ 9” N 1° 22’ 30” E; for the site SEVESO: 46° 1’ 18 » N 1° 22’ 40 » E).	0.7	0.3	0.43	Yes, there was a monitoring, which shall be used again.
13	**KPI_{DO1}**	1 complementary scenario was implemented to reflect upon different causes of wildfires.	0.7	0.7	1.0	Yes, we may have one more and we managed to get more feedback.
14	**KPI_{DO2}**	There were external experts involved from ONF (Office of National Forest), sector municipalities, Prefecture – Civil Protection service, UNISYLVA foresters, fire services from Creuse, Haute-Vienne and Corrèze, military police, schools in the St Sylvestre sector, St Sylvestre population members, management of EPC (explosive company).	1.0	1.0	1.0	-
-	-	Sum (Effectiveness Criterium 1):	10.7	9.9	0.93 (93%)	
1	**KPI_{p-M1}**	Pilot scenario concerned a forest fire which starts in close proximity to an explosive manufacturing company.	1.0	1.0	1.0	-
2	**KPI_{p-M2}**	35 experts (stakeholders) were invited and participated to oversee the pilot demonstration activities.	1.0	1.0	1.0	-
3	**KPI_{p-M3}**	The pilot regarded Phase A and Phase B.	0.7	0.7	1.0	Yes. Phase C will be also mentioned
4	**KPI_{p-M5}**	Following technologies were demonstrated: IoT (detection), interface	1.0	1.0	1.0	-

	KPIs	PEMs	[ER] (ex ante)	[MR] (ex post)	KPI value	Improvements in Trial Period 2
		for users, wildfire platform, detection by social sensing/media.				
5	**$KPI_{p\text{-}M6}$**	Pilot implemented at least 3 good practices related to wildfire management for each pilot phase expected.	0.7	0.7	1.0	Yes
6	**$KPI_{p\text{-}M7}$**	15 pilot participants are engaged in pilot activities and reflect this in the pilot effectiveness assessment and replicability studies by completing relevant surveys.	0.5	0.3	0.6	We were 70 pilot participants. We will engage more for feedback.
7	**$KPI_{p\text{-}M8}$**	15 participants took part in evaluation survey, and 14 (93,33%) declared new knowledge.	0.7	0.5	0.71	Yes, we will engage more for feedback.
8	**$KPI_{p\text{-}O1}$**	Pilot Owner, Pilot Observer and Pilot Players were indicated in person.	1.0	0.0	0.0	Yes
9	**$KPI_{p\text{-}O2}$**	Participants declared that pilot had allowed to organise simultaneously at least 1 training session or workshop (for example VR google, UGV).	0.7	0.7	1.0	Expected to be repeated
10	**$KPI_{p\text{-}O3}$**	Participants declared achievement at least 80% of the pilot objectives specified in relevant Template Operational Readiness.	0.7	0.7	1.0	Expected to be repeated
11	**$KPI_{p\text{-}O5}$**	Pilot stakeholders noticed 4.5 value of overall rank for satisfaction.	0.7	0.7	1.0	Expected to be repeated
12	**$KPI_{p\text{-}I1}$**	Overall rank on conditions and infrastructure by participants was 4.4.	0.7	0.7	1.0	Expected to be repeated
13	**$KPI_{p\text{-}I2}$**	Overall rank on functionalities of SILVANUS tools implemented in the pilot was 4.2.	0.7	0.7	1.0	Expected to be repeated
14	**$KPI_{p\text{-}I3}$**	It was confirmed that UPs cooperated with themselves but did not compose an integrated system.	0.5	0.3	0.6	The technology providers must collaborate with the Pilot leaders and organizers and be proactively engaged to the upcoming exercise.
15	**$KPI_{p\text{-}I4}$**	80% participants declared that products dedicated to the pilot had been accessible for local security entities.	0.7	0.7	1.0	Expected to be repeated
16	**$KPI_{p\text{-}I6}$**	Basing on participants' opinion, technology allowed for average 65% reduction in the deployment of firefighter personnel to the forefront of wildfire.	0.7	0.7	1.0	Expected to be repeated
17	**$KPI_{p\text{-}S3}$**	80% participants declared that Pilot Owner, Pilot Observer and Pilot Players had fully expressed their responsibilities.	0.7	0.7	1.0	Expected to be repeated
18	**$KPI_{p\text{-}S4}$**	Overall rank of satisfaction on materials prepared for participants to make familiar with pilot's assumptions, organisation and proceeding was 4.7.	0.7	0.7	1.0	Expected to be repeated
19	**$KPI_{p\text{-}S5}$**	Overall rank of satisfaction on organisational activities carried out by Pilot Owner to prepare them for the pilot was 4.8.	0.7	0.7	1.0	Expected to be repeated
-	-	Sum (Effectiveness Criterium 2):	14.1	12.5	0.87 (87%)	

4.4.3 Qualitative feedback and pilot outcomes

Firefighters in the French Pilot were primary beneficiaries. Being firefighters the main end-users, the benefits identified mostly address their current needs, as described in Table 34.

Table 34: Benefits to end-users from French Pilot

(Group of) end-users	Benefits from SILVANUS
PUI FRANCE	As soon as the technologies are finalized, the early fire detection device will be offered to our partners in Peru and the Philippines
Fire service Haute-Vienne	The acquisition of a drone has been included in the 2024 budget.
OEDD Greece (volunteers' firefighters)	The use of an operational device to unwind the pipes in a faster way was requested from PUI by our partner OEDD.
Municipality of St Sylvestre	The municipality is very interested in the early detection of fires and information through social networks, especially for the protection of inhabited areas.

PUI France benefited from a diverse array of new technologies and had the opportunity to share these advancements with fire brigade teams beyond Europe. The Fire Service Haute-Vienne significantly benefited from the adoption of new technologies, emphasizing the importance of anticipation and early detection to swiftly deploy backup resources and contain the spread of fires. OEDD Greece, represented by volunteers' firefighters, benefited from the introduction of innovative intervention methods, particularly in forest areas, and the utilization of cutting-edge robots. Lastly, the Municipality of St Sylvestre expressed interest in the SILVANUS detection system and the associated citizen engagement app, recognizing their potential to safeguard high-risk sites and promptly disseminate critical information to the local population.

In conclusion, the timely detection of potential fires and the prospective implementation of SILVANUS' innovative methods, as evidenced in the successful French pilot, are poised to significantly diminish the propagation of fires, minimize the extent of burnt areas, and mitigate building losses.

4.5 Czech´s Pilot – Preparedness and response coordination in countering wildfires

4.5.1 Pilot description

Pilot site: Krásná, Czechia
From 03rd to 04th October 2023

The pilot case area is in the north-east part of the Czech Republic and east part of Moravian-Silesian Region, in the territory of Moravian-Silesian Beskids Mountains. Beskyds Mountains are the northern territory of Protected Landscape Area Beskydy (PLAB). The territory of Beskyds Mountains is home to the most visited tourist resorts in the Czech Republic.

Figure 13: Picture reported in CEA mobile application.

The Czech pilot focused its field exercises on Phases A, B and C.

In this pilot the following UP were tested:

Table 35: User Products in Czech´s Pilot

User Product	Description
UP5	Fire detection from UAV/UGV
UP7	Woode - Biodiversity profile mobile application
UP8	Citizen engagement and information sharing application

4.5.2 Pilot key performance indicators and lessons learnt.

As the pilot was organised after the formal assessment methodology to systemically evaluate the effectiveness of pilot demonstration activities had been elaborated, the effectiveness assessment was conducted in both formulas (ex post and ex ante). Pilot Owner, Pilot Observer and Task Leader prepared pilot evaluation template and a survey for evaluation of pilot effectiveness and replicability studies in SILVANUS project, collected information from own observations and from pilot attendees, and made the assessment.

Operational objectives of the demonstration:
(Taken from D9.2)

- Creation of demonstration scenarios and establishment of real-world drills for the evaluation of SILVANUS project outcomes.
- Engagement of stakeholders at periodic intervals to evaluate the outcomes adopting agile methodologies.

The operational objectives were fairly achieved, with some aspects related with people involvement to be improved, the values are shown in Table 36. In the Czech pilot, some KPIs exceeded the expected values due to unexpected outreach in each of the respective targets.

Table 36: Czech' Pilot performance

	KPIs	PEMs	[ER] (ex ante)	[MR] (ex post)	KPI value	Improvements in Trial Period 2
1	**KPI_{PA1-1}**	0.225 km^2 area was chosen (Krásná municipality, territory of Protected Landscape Area Beskydy, Moravian-Silesian Region, the Czech Republic).	0.7	0.7	1.0	For the 2024 will be used same territory like in the first period, this territory matches pretty well all requirements for the demonstration holding.
2	**KPI_{PA1-2}**	Pilot in Krásná municipality, territory of Protected Landscape Area Beskydy, Moravian-Silesian Region, the Czech Republic, was one of regional demonstration sites to be analysed within the project.	0.7	0.7	1.0	Expected to be repeated
3	**KPI_{PA4-3}**	There were experts from other past projects.	0.5	0.7	1.0 (1.4)	It is planned to invite experts from the past projects as well.
4	**KPI_{PA5-2}**	Following technologies were tested: UGV (reconnaissance), IoT (detection), fire truck, interface for users).	0.7	1.0	1.0 (1.43)	-
5	**KPI_{PB5-1}**	Participants declared up to 20% reduction in the deployment of firefighter personnel to the forefront of wildfire.	0.5	0.7	1.0 (1.4)	The demonstration scenario will be adjusted to the more proceeded SILVANUS UPs technologies in 2024 to test and validate UPs in cooperation with current

	KPIs	PEMs	[ER] (ex ante)	[MR] (ex post)	KPI value	Improvements in Trial Period 2
						firefighting techniques and procedures.
6	**KPI_{PB5-2}**	Participants declared up to 80% reduction in navigating natural terrain.	0.7	0.7	1.0	Expected to be repeated
7	**KPI_{PB9-1}**	Monitoring of field resources deployed within distance determined by pilot location (GPS 49.5958567N 18.4543853E).	0.7	0.7	1.0	Expected to be repeated
8	**KPI_{DO1}**	7 scenarios were demonstrated.	1.0	1.0	1.0	-
9	**KPI_{DO2}**	24 external experts were invited to oversee the pilot demonstration activities.	1.0	1.0	1.0	-
-	-	Sum (Effectiveness Criterium 1):	6.5	7.2	1.1 (110%)	
1	**KPI_{p-M1}**	7 scenarios were demonstrated.	1.0	1.0	1.0	-
2	**KPI_{p-M2}**	5 experts (stakeholders) were invited and participated to oversee the pilot demonstration activities.	1.0	1.0	1.0	-
3	**KPI_{p-M3}**	Large-scale pilot fully considered phase B and allowed for systematic evaluation of the project outcomes.	0.5	0.5	1.0	Continuous UPs evaluation will be carried out in 2024.
4	**KPI_{p-M5}**	Forest-fire detection system, SILVANUS Mobile-App and SILVANUS Dashboard were tested.	0.7	0.7	1.0	Yes, all these products were deployed and tested.
5	**KPI_{p-M6}**	80% participants have proven that the pilot had implemented at least 3 good practices related to wildfire management for phase B	0.7	0.7	1.0	Expected to be repeated
6	**KPI_{p-M7}**	Only 7 participants completed surveys related to pilot effectiveness assessment and replicability studies. Total number of participants was over 30.	0.7	0.3	0.43	The importance of the feedback will be highlighted to all participants, the number of responders will be kept in account.
7	**KPI_{p-M8}**	5 participants during survey (total number was 7) declared new knowledge.	0.7	0.3	0.43	The importance of the feedback will be highlighted to all participants, the number of responders will be kept in account.
8	**KPI_{p-O1}**	Pilot Owner, Pilot Observer and Pilot Players were indicated in person during first day of the pilot.	0.7	0.7	1.0	Expected to be repeated
9	**KPI_{p-O3}**	Participants declared achievement of at least 40% of the pilot objectives specified in relevant Template Operational Readiness.	0.7	0.3	0.43	Ongoing implementation of SILVANUS project will be reflected in 2024 demonstration.
10	**KPI_{p-O5}**	Pilot stakeholders noticed value 4.4 of overall rank for satisfaction on pilot organisation process.	0.7	0.7	1.0	Expected to be repeated
11	**KPI_{p-I1}**	Pilot stakeholders noticed value 4.5 of overall rank for satisfaction on conditions and infrastructure to verify functionalities of UPs dedicated for this specific pilot.	0.7	0.7	1.0	Expected to be repeated

	KPIs	PEMs	[ER] (ex ante)	[MR] (ex post)	KPI value	Improvements in Trial Period 2
12	**$KPI_{p\text{-}I3}$**	It was confirmed that UPs had cooperate with themselves but had been not integrated within a system.	0.5	0.3	0.6	The SILVANUS UPs integration will be tested in 2024.
13	**$KPI_{p\text{-}I4}$**	Not all participants declared that products dedicated to the pilot had been accessible for local security entities.	0.7	0.5	0.7	A cutting-edge technology can be challenge for the stakeholders and are more related to the available resources.
14	**$KPI_{p\text{-}I6}$**	The use of UGV allowed for average 20% reduction in the deployment of firefighter personnel to the forefront of wildfire.	0.5	0.3	0.6	The UGV will be tested and verified in the pilot demonstration again.
15	**$KPI_{p\text{-}S4}$**	Overall rank for participants' satisfaction on materials prepared for them to make familiar with pilot's assumptions, organisation and proceeding was 4.0.	0.7	0.7	1.0	Expected to be repeated
16	**$KPI_{p\text{-}S5}$**	Overall rank for participants' satisfaction on organisational activities carried out by Pilot Owner to prepare them for the pilot was 5.0.	0.7	0.7	1.0	Expected to be repeated
-	-	Sum (Effectiveness Criterium 2):	11.2	9.4	0.84 (84%)	

4.5.3 Qualitative feedback and pilot outcomes

A diverse set of stakeholders constitutes the audience for the Czech pilot. In the next table the main benefits are identified for the end-users targeted and later the impact.

Table 37: Benefits to end-users from Czech Pilot

(Group of) end-users	Benefits from SILVANUS
Firefighters	tools and information for more effective management of forest fires, increased real-time awareness and can be effectively integrated into standard operating procedures and firefighting. search and rescue techniques.
Emergency Services (Mountain Rescue, Police)	Tools that can increase effectiveness of their intervention in rural and mountain territories, increase their real-time awareness and provide tools for communication with people in affected territory
Forest managers and owners	increased internal communication, interaction with communities in their areas of interest and real-time awareness.
Local authorities	communication and interaction with inhabitants and communities, increased real-time awareness.
River basin managers	tools and information for more effective management of forest fires, increased real-time awareness and can be effectively integrated into standard operating procedures and firefighting. search and rescue techniques.

The Czech's Pilot demonstration has identified different impacts among stakeholders.

Local authorities have been able to utilize up-to-date technologies and tools to enhance their relations with residents, communities, and other stakeholders in their territory.

Volunteer firefighters have benefited from the promotion of up-to-date technologies and tools that can enhance the effectiveness of firefighting activities and be integrated into standard operating procedures and firefighting techniques.

Forest managers and owners have gained access to up-to-date tools that can be utilized for more effective forest management, including increased real-time awareness and the integration of various technologies and systems into a customer-friendly environment.

Additionally, **residents** have benefited from the promotion of a MobileApp that provides a useful tool for increasing real-time awareness and two-way communication with the municipality, communities, and other stakeholders in their area of interest.

Lastly, **tourists and visitors** have also benefited from the promotion of a MobileApp, which provides a useful tool for real-time awareness and two-way communication in the forest territory.

For the second round of demonstrations, SILVANUS project UPs and platform itself will improve the tools, increasing real-time awareness, providing data-sharing and two-ways communication of communities and stakeholders. In this way SILVANUS is leveraging on technology active users' participation regarding forest management and people's well-being.

4.6 Italy´s Pilot 2 – Parco del Gargano

4.6.1 Pilot description

Pilot site: Gargano National Park – Vico del Gargano - Province of Foggia, Italy
From 05th to 13th October 2023

Gargano is a historical and geographical sub-region in the province of Foggia, Apulia, southeast Italy, which attracts many tourists to its national park. The region consists of a wide isolated mountain massif made of highland and several peaks and forming the backbone of the Gargano Promontory projecting into the Adriatic Sea, the "spur" on the Italian "boot".

Figure 14: Smoke Grenade recorded by the IoT Gateway

Gargano region is highly prone to wildfires owing to its dense vegetation and rising global temperature which makes it an interesting region for pilot exercise. In the Gargano region between 2nd of June 2023 to 30th of September 2023 there were 1229 fire alerts.

Italy´s Pilot 2 focused its field exercises on Phases A and B.

In this pilot the following UP were tested:

Table 38: User Products in Italy´s Gargano Pilot

User Product	Description
UP2	Fire Danger Tool
UP3	Fire detection based on social sensing
UP4	Fire detection from IoT devices /edge
UP5	Fire detection from UAV/UGV
UP6	Fire Spread Forecast
UP8	Citizen engagement and information sharing application

4.6.2 Pilot key performance indicators and lessons learnt.

In accordance with the pilot form and formal assessment methodology to systemically evaluate the effectiveness of pilot demonstration activities, the pilot was not preliminarily considered as a venue to be

under full evaluation process. Thus, Task Leader prepared pilot evaluation template and made the assessment on the base of pilot documentation. Pilot Observer reported no objections to the assessment results.

Operational objectives of the demonstration:
(Taken from D9.2)

- Demonstrate the enhancement of fire management across the prevention and preparedness, active response, and restoration phases by implementing the innovative technologies and practices identified in SILVANUS.
- Evaluation of monitoring tools and techniques (including SILVANUS UPs) in addition to the standard direct observation.
- Improvement of awareness related to fire events on young people at schools, involving app to be used to indicate fire events.
- Use of monitoring devices and techniques, such as sensors to be installed in the area and satellite data, to reduce intervention time, after fire detection (the mapping of the pilot area using drones, the detection of a fire using drones and the IoT Gateway).
- Direct and computerized control and evaluation, in real time, of the intervention (the detection of a person in the forest using drones).
- Integration and assessment of SILVANUS UPs in a relevant environment.
- Engagement of different stakeholders such as municipalities, external experts, public authorities, private landowners, raising awareness and knowledge of post-fire restoration actions in terms of regulatory processes and good practices.
- Analysis of three types of restoration (planting new trees in a burned area and monitoring their growth).

The results achieved in the field exercises are very promising for a second round at Gargano's site. Different aspects need to be aligned namely regarding the KPI definition that may need to be updated on expanding the scope of the pilot to all three phases.

Table 39: Italian Pilot 2 performance

	KPIs	PEMs	[ER] (ex ante)	[MR] (ex post)	KPI value	Improvements in Trial Period 2
1	**KPI_{PA1-1}**	Part of Puglia forests was analysed and mapped.	-	0.7	1.0	Expected to be repeated
2	**KPI_{PA1-2}**	Puglia pilot was one of regional demonstration sites to be analysed within the project from eight (8) EU countries	-	0.7	1.0	Expected to be repeated
3	**KPI_{PA3-1}**	Results of modelling of seasonal weather forecast models were used to validate UPs during the pilot.	-	0.7	1.0	Expected to be repeated
4	**KPI_{PA3-2}**	SILVANUS Dashboard was interface established with connection to external earth observation data repositories and global climate repositories	-	0.7	1.0	Expected to be repeated
5	**KPI_{PA3-3}**	Puglia pilot allowed to use and validate fire danger index.	-	0.7	1.0	Expected to be repeated
6	**KPI_{PA4-1}**	Platform X was engaged for forest management authorities, landowners, public authorities.	-	0.7	1.0	Expected to be repeated
7	**KPI_{PA4-2}**	UP8 has been carried out by ASSET organizing short courses in 3 schools in May 2023 in collaboration with Civil Protection, one 16-hour training course	-	0.7	1.0	Expected to be repeated

	KPIs	PEMs	[ER] (ex ante)	[MR] (ex post)	KPI value	Improvements in Trial Period 2
		addressed to Civil Protection volunteers will take place in November 2023.				
8	**KPI_{PA4-3}**	Invitations were extended to external stakeholder advisory group.	-	1.0	1.0	Expected to be repeated
9	**KPI_{PA4-4}**	Citizen-engagement-toolkit was assessed by users during pilot activities.	-	0.7	1.0	Expected to be repeated
10	**KPI_{PA5-1}**	Pilot reported the activities carried out on training and engagement in schools.	-	0.7	1.0	Expected to be repeated
11	**KPI_{PA5-4}**	Pilot output may be used for the purposes of trainings for fire fighters.	-	0.3	1.0	Coordination aspects will need to be articulated with involved entities
12	**KPI_{PA6-1}**	Historical data was used to make pilot assumptions and to calibrate UPs to be used during the pilot.	-	0.7	1.0	Expected to be repeated
13	**KPI_{PB1-1}**	Pilot output (especially experiences from UAV flights) may be used to increase in the flight time compared to the current market standards based on low-cost on-board data analytics integrated within the platform.	-	0.3	1.0	A replanning of the drone flight needs to comply with the regulatory-environmental context of Parco Gargano.
14	**KPI_{PB1-2}**	Pilot allowed to integrate aerial platform with sensor technology to increase capabilities in wildfire detection from air.	-	0.7	1.0	Expected to be repeated
15	**KPI_{PB2-3}**	Integrated use of sensors may be useful when reducing false alarm rate for fire detection.	-	0.3	1.0	Modelling will be reworked with specific partners
16	**KPI_{PB5-1}**	Use of UP3 and UP5 allowed for 80% reduction in the deployment of firefighter personnel to the forefront of wildfire.	-	1.0	1.0	Expected to be repeated
17	**KPI_{PB5-2}**	Experiences from practical use of UAV may be helpful in increasing resilience in navigating natural terrain.	-	0.3	1.0	Same as line 13
18	**KPI_{PB9-1}**	Use of UAV and SILVANUS Dashboard made possible to monitor field resources deployed within a 5km distance.	-	1.0	1.0	-
19	**KPI_{PB9-2}**	UPs tested during the pilot allowed to implement several forms of alert.	-	0.7	1.0	Expected to be repeated
20	**KPI_{PB9-3}**	Integration of UPs to SILVANUS Dashboard proved achievement of the requirements regarding Legacy system interface with at least four (4) different modalities (such as APIs, file systems, process integration)	-	1.0	1.0	-
21	**KPI_{DO1}**	Pilot scenarios were partially formalised to state background for pilot activities.	-	0.7	1.0	Expected to be repeated
22	**KPI_{DO2}**	More than 20 external experts were invited to oversee the pilot demonstration activities.	-	1.0	1.0	-
23	**KPI_{DO3}**	The pilot ascribed to the first cycle of project pilots organised in an agile manner.	-	0.7	1.0	Expected to be repeated
24	**KPI_{ODE3-1}**	Pilot output may be used for the purposes of preparation of a research paper.	-	0.3	1.0	To be internally articulated in the scope of WP10
25	**KPI_{ODE3-2}**	Complex character of the pilot based on connection of multiple forms of presentation.	-	0.7	1.0	Expected to be repeated

	KPIs	PEMs	[ER] (ex ante)	[MR] (ex post)	KPI value	Improvements in Trial Period 2
-	-	Sum (Effectiveness Criterium 1):	-	17.0	1.0 (100%)	-
1	**$KPI_{p\text{-}M1}$:**	Pilot formalised scenario elements that may be integrated during a next pilot in 2024.	-	0.5	1.0	Expected to be repeated
2	**$KPI_{p\text{-}M2}$**	More than 5 external experts participated in the pilot to oversee relevant demonstration activities.	-	1.0	1.0	-
3	**$KPI_{p\text{-}M3}$**	The pilot fully considered phases expected in Description of Action for the project.	-	1.0	1.0	-
4	**$KPI_{p\text{-}M5}$**	Pilot allowed to implement 7 tools developed in the project (UP2, UP3, UP4, UP5, UP6, UP8a, UP8b).	-	1.0	1.0	-
5	**$KPI_{p\text{-}M6}$**	Pilot formula allowed for implementation of at least 3 good practices related to wildfire management for each pilot phase expected.	-	1.0	1.0	-
6	**$KPI_{p\text{-}M9}$**	Civil Protection entities were involved in the pilot activities.	-	0.7	1.0	Expected to be repeated
7	**$KPI_{p\text{-}O1}$**	Pilot Owner, Pilot Observer and Pilot Players were indicated in person	-	1.0	1.0	-
8	**$KPI_{p\text{-}O3}$**	Pilot organisation allowed to achieve at least 80% of the pilot objectives specified in relevant Template Operational Readiness.	-	1.0	1.0	-
9	**$KPI_{p\text{-}I1}$**	There were conditions and infrastructure proper for verification of functionalities dedicated to the pilot.	-	1.0	1.0	-
10	**$KPI_{p\text{-}I3}$**	4 UPs were used in an integrated way during the pilot. (UP2 + Dashboard, UP3 + Dashboard, UP6 + Dashboard, UP8 + Dashboard)	-	1.0	1.0	-
11	**$KPI_{p\text{-}I4}$**	UAV solutions are widely accessible. The rest is determined by industry confidential issues.	-	0.7	1.0	Expected to be repeated
12	**$KPI_{p\text{-}I6}$**	UPs tested during the pilot allowed to reduce the deployment of firefighter personnel to the forefront of wildfire (up to 80%).	-	1.0	1.0	-
13	**$KPI_{p\text{-}S3}$**	Pilot Owner and Pilot Players expressed their responsibilities and tasks related to the project in accordance with organisational dimension of the pilot.	-	0.7	1.0	Expected to be repeated
-	-	Sum (Effectiveness Criterium 2):	-	11.6	1.0 (100%)	

4.6.3 Qualitative feedback and pilot outcomes

A social landscape of stakeholders constitutes the audience for the Italia pilot 2, in this sense most of the benefits identified follow a social benefit perspective.

Table 40: Benefits to end-users from Italian Pilot 2

(Group of) end-users	Benefits from SILVANUS
Civil Protection - Puglia Region	Due to user product UP4 information, CP will be able to improve the fire and smoke detection and define faster firefighting tactics
ARIF Regional Agency for Irrigation and Forestry	Due to user product UP4 information, ARIF will be able to improve the fire and smoke detection and define faster firefighting tactics
Citizenship (junior high school students between 11 and 13 years old)	Citizenship will be able to improve behavioural practices to prevent wildfires

As the main stakeholder **Civil Protection** from Puglia Region in Italy realized, SILVANUS technology for supervision and control of the wildfires improves the response impact and effectiveness of the field action. The effect may become more realistic after integration in SILVANUS IFM which will support the Civil Protection units as a Decision Support System and facilitate the communication and coordination with other entities also locally involved in fire response. As the case of Italy, where the response is hierarchically defined, coordination and reduction of response time become critical.

After the Pilot the **ARIF Regional Agency for Irrigation and Forestry**, shared its interest on SILVANUS technologies related with Phase B, namely the fire detection from IoT devices (UP4) and using UAVs (UP5) as effective means for Active Fire Fighting.

In the promotion of UP8 (Citizen engagement mobile application), local schools were involved. More than 50 pupils became aware on how to signal fires to the authorities, providing through the app. the maximum information as possible.

Greece´s Pilot – Impact of wildfires across Sterea Ellada and evaluation of SILVANUS platform for Phase A, B and C

4.6.4 Pilot description

Citizens' engagement activity: Thessaloniki
28th June 2023
Pilot site: Chalkida, Evia Greece
31st October 2023

Evia is located in the eastern part of the geographical district of Sterea Ellada; it is the second largest island in Greece and its total area is 4,167 km2. About 2,500 km2 of Evia is covered by forests. Evia belongs to the Pelagonian zone of non-metamorphic formations.

Figure 15: Tabletop exercise conducted in Chalkida

The Greek pilot focused its tabletop exercises on all three Phases A, B and C.

In this pilot the following UP were tested:

Table 41: User Products in Greece´s Pilot

User Product	Description
UP3	Fire detection based on social sensing
UP4	Fire detection from IoT devices
UP5	Fire detection from UAV/UGV
UP6	Fire Spread Forecast
UP8	Citizen engagement and information sharing application

4.6.5 Pilot key performance indicators and lessons learnt.

As the second part of the pilot was organised after the formal assessment methodology to systemically evaluate the effectiveness of pilot demonstration activities had been developed, and since the two pilot parts were closely linked, the effectiveness assessment was carried out in both formulae (ex post and ex ante). The Pilot Owner, the Pilot Observer and the Task Leader prepared a pilot evaluation template and a survey for evaluation of pilot effectiveness and replicability studies in the SILVANUS project, collected information from their own observations and from pilot attendees, and carried out the assessment.

Operational objectives of the demonstration:
(Taken from D9.2)

- To test and demonstrate the SILVANUS platform as an operational tool in real-life situations.
- To test and demonstrate individual modules of SILVANUS and specifically the following:
  - The social media sensing (UP3) as an early warning fire detection tool and monitoring of the evolution of the fire.
  - The detection from IoT devices (UP4).
  - The use of UAVs/UGVs (UP5) for detecting wildfires and planning of response measures.
  - The use of fire spread forecast (UP6).
  - The biodiversity application (UP7) as a tool for prevention and monitoring of restoration.
  - The use of citizen mobile application (UP8) and training program as a whole.
- To showcase the SILVANUS Decision Support System (DSS) and get relevant feedback from first responders.
- To build the SILVANUS platform in the way that conforms to integrated fire management approach by requiring specific feedback from the end users.
- To support the process of a cultural shift towards tolerance, resilience and risk mitigation.
- To examine the acceptance level of SILVANUS from a community that has been significantly affected by wildfires.
- To identify areas of improvement.
- To enhance training of local stakeholders through SILVANUS activities.

The operational objectives were largely achieved, although there is room for improvement. Some KPIs even exceed what was expected (#5 and #2 in criterium 2) as may be seen in Table 42.

Table 42: Greek Pilot performance

	KPIs	PEMs	[ER] (ex ante)	[MR] (ex post)	KPI value	Improvements in Trial Period 2
1	**KPI_{PA1-2}**	Greek pilot was directly related to the regional demonstration site to be analysed within the project from EU country.	0.7	0.7	1.0	N/A
2	**KPI_{PA5-2}**	Tabletop exercise included workshop on new technologies to support decision making for the most of phases of forest	0.7	0.3	0.43	In the field exercise to be held in October 2024, there will be a distribution of roles among

	KPIs	PEMs	[ER] (ex ante)	[MR] (ex post)	KPI value	Improvements in Trial Period 2
		fire management (preparedness, response, recovery). The debate took place according to scenario with high level of generality, no tasks aimed at developing tactical or strategic actions (no division of roles among the participants and no decision-making activities).				the relevant services involved and decision-making activities will be carried out in all phases of fire management.
3	**KPI_{PA6-1}**	Wildfires from August 2023 in Chalkida were analysed for the purpose of scenario development.	0.7	0.7	1.0	The fires that hit Chalkida in August 2023 were analysed by the competent services, regarding the distribution of responsibilities, the deficiencies, the overlapping of responsibilities. So, the scenario that will be presented in October 2024 will be directly related to the fires of August 2023.
4	**KPI_{DO1}**	1 complementary scenario was analysed. It regarded to wildfire from August 2023.	0.7	0.7	1.0	In the field exercise that will be held in Evia, the scenario will be directly related to the fires that occurred in August 2023
5	**KPI_{DO2}**	According to list of participants, 50 experts were invited.	0.7	1.0	1.0 (1.43)	Authorities responsible for fire management, police, interested parties, forest authorities, rescue teams participated in the tabletop exercise. The exercise to be organized in October 2024 will involve many fire management specialists as well.
-	-	Sum (Effectiveness Criterium 1):	3.5	3.4	0.97 (97%)	
1	**KPI_{p-M1}**	1 complementary scenario was analysed.	0.7	0.7	1.0	In the tabletop Exercise, a fire scenario was presented and the method of treatment by the involved services was analysed, while the technological tools were presented by the providers. In the Field Exercise, these tools will be tested in action for their effectiveness.
2	**KPI_{p-M2}**	According to list of participants – 50 experts were invited.	0.7	1.0	1.0 (1.43)	-
3	**KPI_{p-M6}**	7 participants confirmed in survey that the pilot implements at least 3 good practices related to wildfire management for each pilot phase expected. In accordance with total number of responders '11', the result is not representative.	0.7	0.3	0.43	In the Field Exercise we will try to get answers from more participants.

	KPIs	PEMs	[ER] (ex ante)	[MR] (ex post)	KPI value	Improvements in Trial Period 2
4	**$KPI_{p\text{-}M7}$**	Only 11 participants completed surveys related to pilot effectiveness assessment and replicability studies. Total number of participants was over 50.	0.7	0.3	0.43	In the field exercise will complete surveys more participants.
5	**$KPI_{p\text{-}M8}$**	Only 7 participants reported acquiring new knowledge or information from the demonstration activities. It is not representative value due to total number pilot participants (over 50).	0.7	0.3	0.43	In the Tabletop Exercise, not many answered the questionnaire that was given to them. In the Field Exercise the participants will better understand how the technological tools work, their usefulness and will get a lot of new information.
6	**$KPI_{p\text{-}O1}$**	Pilot Owner was indicated by person. Pilot Observer and Pilot Players were indicated as institutions.	0.7	0.7	1.0	The pilot Owner was PSTE as an institution and the players and observers were also institutions, services that have responsibility for dealing with forest fires.
7	**$KPI_{p\text{-}O5}$**	Pilot stakeholders noticed 4.4 overall rank for satisfaction. The result is not representative due to low number of participants who made the assessment.	0.7	0.7	1.0	In the Field Exercise, more evaluations will be gathered from the participants, who will have a better idea of how the technological tools work and how they can help the competent authorities.
8	**$KPI_{p\text{-}I4}$**	Not all participants declared that products dedicated to the pilot are accessible for local security entities.	0.7	0.5	0.7	In the Field Exercise, the usefulness of the technological tools and the possibility of their use by the local services will be more directly established
9	**$KPI_{p\text{-}S4}$**	Overall rank for satisfaction on the materials was 4.3. The result is not representative due to low number of participants who made the assessment.	0.7	0.7	1.0	In the Field Exercise we will try to get answers from more participants.
10	**$KPI_{p\text{-}S5}$**	Overall rank for satisfaction on organisational activities was 4.3. The result is not representative due to low number of participants who made the assessment.	0.7	0.7	1.0	In the Field Exercise, more evaluations will be gathered regarding the organization, coordination and execution of the exercise, in order to have a representative result.
-	-	Sum (Effectiveness Criterium 2):	3.5	3.4	0.84 (84%)	

4.6.6 Qualitative feedback and pilot outcomes

The benefits identified for the Greek pilot end-users cover a range of the main actors related with firefighting, which differently from others may replicate a scenario of synergies to other EU countries.

Table 43: Benefits to end-users from Greek Pilot

(Group of) end-users	Benefits from SILVANUS
Fire fighters	Fire fighters due to UP4 of Fire and Smoke detection and UP6 of Fire spread forecast, will be able to immediately detect fires and extinguish them at an initial stage.
Civil protection	Civil protection due to UP8 about a Mobile App for Citizen Engagement and Fire Report, will be able to be informed of any fires by passers-by who will update the application, and thus the competent services will be organized for the immediate treatment of the fire but also for the evacuation of areas if necessary.
Police services	Police services due to the UP8 about a Mobile App for Citizen Engagement and Fire Report and UP3 about Fire Detection on social sensing will be able to be informed immediately about fires and to assist the work of the fire service by evacuating areas and providing instructions to citizens.
Voluntary Groups	Voluntary Groups due to the UP3 about Fire Detection on social sensing and UP5 about Fire detection from UAV/UGV devices, will be able to be informed immediately about starting fires and to act in support of the fire service by helping to extinguish fires, to evacuate areas, to inform citizens about escape routes.

Within the Greek stakeholders most impact was identified in:

The incorporation of new technological tools such as IoT and UAV/UGV devices for immediate fire detection and timely extinguishing as mentioned by the **Fire Department**. With a special note to the participation of citizens on fire alert, alerting the fire on its earlier stages, by means of the Mobile App.

On the integration of the prediction algorithms for fire spreading **Civil Protection** will have a more complete response to emergency situations, to proceed with the evacuation of areas if necessary, so that lives are not endangered.

The **Directorate of forests** can improve their maintenance activities using the AI based models.

The use of SILVANUS tools proved within the Greek context to be able to help the responsible authorities, in prevention and responding to fire threats.

4.7 Indonesia´s Pilot

4.7.1 Pilot description

Pilot site: Sebangau National Park – Central Kalimantan Province, Indonesia
From 6th to 11th November 2023

The Indonesian pilot continuously gives information input to report on the economic impact assessment during the restoration project life cycle (Phase C) regarding to agriculture, tourism, construction industry, insurance, and financial services. That information was discussed during demonstration activities and presented during ICOIACT 2023.

The Indonesia´s pilot focused its field exercises on Phases A, B and C.

Figure 16: Travelling Across the Koran River to Reach the Pristine Peat Forest

In this pilot the following UP were tested:

Table 44: User Products in Indonesia´s Pilot

User Product	Description
UP3	Fire detection based on social sensing
UP7	Woode - Biodiversity profile mobile application
UP8	Citizen engagement and information sharing application

4.7.2 Pilot key performance indicators and lessons learnt.

As the pilot was organised after the formal assessment methodology to systemically evaluate the effectiveness of pilot demonstration activities had been elaborated, the effectiveness assessment was conducted in both formulas (ex post and ex ante). Pilot Owner, Pilot Observer and Task Leader prepared pilot evaluation template and a survey for evaluation of pilot effectiveness and replicability studies in SILVANUS project, collected information from own observations and from pilot attendees, and made the assessment.

Operational objectives of the demonstration:
(Taken from D9.2)

- Phase C (Restoration and Adaptation)
  - Demonstrate, test, early user adoption of the biodiversity tagging mobile application (Woode)
  - Data collection of leaf images and its tree species in tropical forest.
  - Demonstrate the technological support to the ecological resilience long term forest monitoring and evaluation of forest restoration using “open forest map” application.
  - Observe current implementation of “manual” biodiversity tagging in real tropical forest.
  - Learn current forest restoration policy and programs in peat forest.
  - Gathering user feedback and further user requirements from forest management stake holder such as Sebangau national park managements, the disaster management office (BPPD), local government, and related parties.
  - Drone image and video data collection over the pilot area.
- Phase A (Prevention and Preparedness)
  - Evaluation of satellite image monitoring tools (integrated in OFM) and SILVANUS dashboard.
  - Present Silvanus wildfire awareness campaign materials to related stake holders.
- Phase B (Detection and Response)
  - Demonstrate the decision support systems in supporting the fire spread simulation.
  - Present the forward command centre and exploring further user requirements.
  - Observe the current technology, tools, and organization of disaster management office (BPBD).
  - Observing the real peat forest and collecting the visual information in order to improve the fire detection application in underground fire incident.

The operational objectives were mostly achieved, with a few aspects to be improve through means of UP rather than the pilot itself. For this reason, it is not foreseen to have a second Trial Period 2 in the Indonesian Pilot.

Table 45: Indonesian Pilot performance

	KPIs	PEMs	[ER] (ex ante)	[MR] (ex post)	KPI value	Improvements in Trial Period 2*
1	**KPI_{PA1-1}**	Rehabilitation area of Sebangau National Park was analysed.	0.7	0.7	1.0	-
2	**KPI_{PA1-2}**	Sebangau National Park (Indonesia; non-EU) was considered as regional demonstration site.	0.7	0.7	1.0	-
3	**KPI_{PA4-1}**	Information about the pilot was shared among forest management authorities, landowners and public authorities with the use of social media.	0.7	0.7	1.0	-
4	**KPI_{PB9-1}**	There was demonstration of User Interface of Silvanus Platform in the pilot site with stakeholder.	1.0	0.7	0.7	The user interface will be further improved
5	**KPI_{PC3}**	Merit-related issues concerning soil rehabilitation strategy were discussed during conference and demonstration.	0.3	0.3	1.0	-
6	**KPI_{DO2}**	Experts (stakeholders) were invited to oversee the pilot demonstration activities.	0.7	0.7	1.0	-
7	**KPI_{ODE3-1}**	Conducting international conference with related theme of SFM and Technology. Conference was held as integral part of the pilot. The international conference gathered more than 70 participants. 2 papers were prepared to be submitted.	0.7	0.7	1.0	-
8	**KPI_{DO3}**	Organisation of the Indonesian large-scale pilot in an agile manner for the systematic evaluation of the project outcomes.	0.7	0.7	1.0	-
9	**KPI_{ODE3-2}**	Demonstration was conducted in the discussion panel with conference attendees (more than 20 participants following the demonstration).	0.7	0.7	1.0	-
-	-	Sum (Effectiveness Criterium 1):	6.2	5.9	0.95 (95%)	
1	**KPI_{p-M2}**	Experts (stakeholders) were invited to oversee the pilot demonstration activities.	1.0	1.0	1.0	-
2	**KPI_{p-M3}**	Indonesian pilot considered Phase C accordingly to Description of Action for the project and will allow for systematic evaluation of the project outcomes.	1.0	1.0	1.0	-
3	**KPI_{p-M4}**	Information about agriculture, tourism, construction industry, insurance and financial services was presented during the conference and discussed when conducting demonstration activities.	1.0	1.0	1.0	-
4	**KPI_{p-M5}**	Several UPs were discussed during the pilot	1.0	0.7	0.7	From the perspective of Decision Support System, several modules will be created
5	**KPI_{p-M6}**	Pilot allowed to implement more than 3 good practices related to wildfire management in accordance to Phase C (the phase expected in Description of Action)	1.0	1.0	1.0	-
6	**KPI_{p-M7}**	Only part of pilot participants was engaged in pilot activities regarding to	1.0	0.7	0.7	The other part of the participants were stakeholders

	KPIs	PEMs	[ER] (ex ante)	[MR] (ex post)	KPI value	Improvements in Trial Period 2*
		pilot organisation, presentation of UPs, and giving direct feedback to technology partners. They filled in questionnaires prepared by T9.6 Leader for the purposes of the pilot effectiveness assessment and replicability studies.				keen to get in touch with the pilot recovery results, so the situation is not replicable.
7	**$KPI_{p\text{-}M8}$**	Only part of pilot participants reported acquiring new knowledge or information from the demonstration activities by filling in questionnaires prepared by T9.6 Leader for the purposes of the pilot effectiveness assessment and replicability studies.	1.0	0.7	0.7	Same as above
8	**$KPI_{p\text{-}M9}$**	The chosen entities considered in wildfire management plans were involved in pilot activities.	0.7	0.7	1.0	-
9	**$KPI_{p\text{-}O1}$**	Pilot Owner, Pilot Observer and Pilot Players were indicated in person before the pilot date.	1.0	1.0	1.0	-
10	**$KPI_{p\text{-}O3}$**	Pilot organisation allowed to achieve at least 80% of the pilot objectives specified in relevant Template Operational Readiness.	1.0	1.0	1.0	-
11	**$KPI_{p\text{-}O5}$**	Pilot Owner (AMIKOM) organised short (15 min. long) session to ensure participants possibility to fill in the questionnaire. Just few of them took this opportunity and relevant results are not representative.	1.0	0.5	0.5	The other part of the participants were stakeholders keen to get in touch with the pilot recovery results, so the situation is not replicable.
12	**$KPI_{p\text{-}I1}$**	AMIKOM ensured that all functionalities of UPs dedicated for a specific pilot had the necessary conditions and infrastructure to be verified during the pilot	1.0	1.0	1.0	-
13	**$KPI_{p\text{-}I2}$**	Pilot Owner (AMIKOM) organised short (15 min. long) session to ensure participants possibility to fill in the questionnaire. Just few of them took this opportunity and relevant results are not representative.	1.0	0.5	0.5	The other part of the participants were stakeholders keen to get in touch with the pilot recovery results, so the situation is not replicable.
14	**$KPI_{p\text{-}S3}$**	Pilot Owner, Pilot Observer and Pilot Players fully expressed their responsibilities and tasks related to the project.	1.0	1.0	1.0	-
15	**$KPI_{p\text{-}S5}$**	Pilot Owner (AMIKOM) organised short (15 min. long) session to ensure participants possibility to fill in the questionnaire. Just few of them took this opportunity and relevant results are not representative.	1.0	0.5	0.5	The other part of the participants were stakeholders keen to get in touch with the pilot recovery results, so the situation is not replicable.
-	-	Sum (Effectiveness Criterium 2):	14.7	12.3	0.84 (84%)	

4.7.3 Qualitative feedback and pilot outcomes

The benefits identified apply to the end-user that were directly involved in the field visit but can easily be expanded to other related ones as for instances Civil protection organizations or Municipalities.

Table 46: Benefits to end-users from Indonesian Pilot

(Group of) end-users	Benefits from SILVANUS
TNS (Forest Authority)	SILVANUS Platform and OFM suitable for the authority to monitor the forest in terms of rehabilitation and restoration. The platform provides real time, time and cost saving monitoring compared to frequent in situ observation.
Fire fighters	Using SILVANUS Platform will define fire occurrence faster and real time. The training for fire fighter using VR also valuable in terms of saving cost and time in doing the training.
Local Government: BPBD (Disaster Management Authority), DLH (Environment Authority)	Fire detection and social media sensing (part of SILVANUS Platform) give a quick information to the authority which is useful in distributing resources when fire occurs. Easy access on the forest information stored in the SILVANUS Platform.

In Indonesia, the main impact aspects are related to information sharing and communication capabilities. The **local community** can access real-time information on fire mitigation processes, and together with NGOs -**WWF** and **BNF**-, they have established responsive communication through the platform.

4.8 Italy´s Pilot 1 – Parco Naturale Regionale di Tepilora

4.8.1 Pilot description

Pilot site: Parco Naturale Regionale di Tepilora, Sardinia - Italy
From 10th November 2023

Brief presentation of the SILVANUS project, as a reminder to local stakeholders, and the presentation of the pilot area. FINCONS presented multiple SILVANUS UP, describing, for each of them the involved partners, the main features, the components, the purpose through examples of actual applications in other sites such as Gargano.

The Tepilora´s pilot focused its tabletop exercises on Phases A and B.

Figure 17: PNRT Director illustrates SILVANUS during one of the working groups.

In this pilot the following UP were tested:

Table 47: User Products in Italy´s Tepilora Pilot

User Product	Description
UP2	Fire Danger Tool
UP3	Fire detection based on social sensing
UP4	Fire detection from IoT devices
UP5	Fire detection from UAV/UGV
UP6	Fire Spread Forecast
UP8	Citizen engagement and information sharing application

4.8.2 Pilot key performance indicators and lessons learnt.

In accordance with the pilot form and formal assessment methodology to systemically evaluate the effectiveness of pilot demonstration activities, the pilot was not preliminarily considered as a venue to be under full evaluation process. Thus, Task Leader prepared pilot evaluation template and made the

assessment on the base of pilot documentation. Pilot Observer reported no objections to the assessment results.

Operational objectives of the demonstration:
(Taken from D9.2)

- collaborate with local stakeholders in order to share current SILVANUS achievements in terms of UPs and technical offering.
- discuss and understand the operational modalities for the implementation of the pilot activities.

The values achieved reflect how the activity addressed a more dialog-oriented action, which may be considered to have worked fine, from that perspective.

Table 48: Italian Pilot 1 performance

	KPIs	PEMs	[ER] (ex ante)	[MR] (ex post)	KPI value	Improvements in Trial Period 2
1	KPI_{PA1-2}	Sardinian event was one of the regional demonstration sites to be analysed within the project from eight (8) EU and three (3) non-EU countries.	-	1.0	1.0	-
2	KPI_{PA4-2}	Project-based citizen engagement activities were discussed with local stakeholders in the formula of round-table exercises. It was also planned for next year pilot activities in the project.	-	0.7	1.0	New awareness raising activities will be organized. A new campaign will start in April 2024 in the 4 municipalities of Torpè, Bitti, Lodè and Posada
3	KPI_{PA4-3}	Pilot Owner invited a wide spectrum of external local stakeholders, including civil protection entities, forestry guards, forests agency and local environmental education enters.	-	1.0	1.0	-
4	KPI_{PA4-4}	Citizen-engagement-toolkit was presented. This allowed to make preparation for relevant assessment during next pilot in 2024.	-	0.3	1.0	New awareness raising activities will be organized. A new campaign will start in April 2024 in the 4 municipalities of Torpè, Bitti, Lodè and Posada. The Citizen-engagement-toolkit will be presented.
5	KPI_{PA4-5}	Pilot participants were consulted for the assumptions of public campaign.	-	0.5	1.0	The awareness raising activities will be organized jointly with the support of local and regional stakeholders
6	KPI_{PA5-2}	Sardinian pilot was example of workshop for first responders in crisis management and disaster resilience.	-	0.7	1.0	A bilateral exchange between SILVANUS and Region of Sardinia: it seems that the Region too. is well equipped with cutting-edge technologies that could also be of interest to project partners
7	KPI_{PA5-4}	Pilot outcomes (results of round-table exercises) may be used to develop training program for fire fighters.	-	0.3	1.0	Another meeting is planned for May 2024 for setting up the in-field exercise and evaluate this kind of outcome too

	KPIs	PEMs	[ER] (ex ante)	[MR] (ex post)	KPI value	Improvements in Trial Period 2
8	**KPI_{PA6-1}**	Historical data analytics for Sardinian forests' area was carried out to make situational background for 2024 pilot activities.	-	0.5	1.0	The analysis is being continuously carried out with the support of project partners in order to guarantee all the useful information for the 2024 pilot
9	**KPI_{PB1-2}**	Pilot outcomes (results of round-table exercises) may be used to develop training program for fire fighters.	-	0.3	1.0	Another meeting is planned for May 2024 for setting up the in-field exercise and evaluate this kind of outcome too
10	**KPI_{PB4-3}**	Pilot outcomes (results of round-table exercises) may be used to make assumptions for geospatial mapping of external weather patterns for the identification of high-risk zones due to 2024 pilot.	-	0.3	1.0	In this regard, a plan will be drafted after the pilot exercise in 2024. It will contain key information about activities for planning prevention and operational intervention measures in case of fire, guidelines for a correct restoration in accordance with the legislation in force.
11	**KPI_{PB5-1}**	Pilot outcomes (results of round-table exercises) facilitate preparation of next year pilot to consider a reduction in the deployment of firefighter personnel to the forefront of wildfire.	-	0.5	1.0	It will be analysed the actual reduction in the deployment of firefighter personnel to the forefront of wildfire, with the support of the key actors in the Region: -Civil Protection Forestry and Environmental Surveillance Corps (CFVA) -FoReSTAS Agency -Regional Agency for the Protection of the Environment for Sardinia (for monitoring and data collection) -Regional Fire Department Sardinia
12	**KPI_{PB9-1}**	Pilot outcomes (results of round-table exercises) involve issues to monitor regarding to field resources in case of 2024 pilot.	-	0.5	1.0	All key actors involved will keep monitoring all issues for a smooth 2024 pilot organization
13	**KPI_{DO1}**	Pilot outcomes (results of round-table exercises) facilitate to formalise a complementary scenario to be implemented in a next year pilot.	-	0.5	1.0	Pilot outcomes will represent a valid support for the implementation of the 2024 pilot activities
14	**KPI_{DO2}**	More than 20 external experts were invited to oversee the pilot demonstration activities.	-	1.0	1.0	-
15	**KPI_{DO3}**	Sardinian pilot ascribed to first cycle of project pilots organised in an agile manner	-	0.7	1.0	The first pilot was organized in an agile manner while the second (2024) will be on the field
16	**KPI_{ODE1-3}**	External pilot attendees are potential representatives to join alliance including	-	0.3	1.0	During the 2024 pilot exercise external attendees will

	KPIs	PEMs	[ER] (ex ante)	[MR] (ex post)	KPI value	Improvements in Trial Period 2
		practitioners, conservationists, technologists, scientists.				participate including practitioners, conservationists, technologists, scientists
17	**KPI_{ODE3-1}**	Pilot outcomes (results of round-table exercises) can be used for preparation of research paper.	-	0.3	1.0	Pilot outcomes (results of roundtable exercises and 2024 pilot exercise) can be used for preparation of research paper.
18	**KPI_{ODE3-2}**	Round-table exercises have form of workshop to demonstrate project outcomes.	-	0.7	1.0	The project outcomes were demonstrated during the round table exercises following actual examples from other pilots. During the 2024 project outcomes will be demonstrated on-field
-	-	Sum (Effectiveness Criterium 1):	-	10.1	1.0 (100%)	
1	**KPI_{p-M1}**	Sardinian pilot allowed to prepare assumptions for at least 1 complementary scenario to reflect upon different causes of wildfires.	-	0.5	1.0	Sardinian pilot allowed to prepare assumption for different scenarios to reflect upon different causes of wildfires.
2	**KPI_{p-M2}**	More than 5 external experts participated in the pilot to oversee relevant demonstration activities.	-	1.0	1.0	-
3	**KPI_{p-M3}**	The pilot fully considered phases expected in Description of Action for the project.	-	1.0	1.0	-
4	**KPI_{p-M5}**	Pilot allowed to present tools that are under development in the project.	-	0.5	1.0	The goal was to collaborate with local stakeholders in order to share current SILVANUS achievements in terms of UPs and technical offering, but also to discuss and understand the operational modalities for the implementation of the pilot activities to be held in 2024
5	**KPI_{p-M6}**	Good practices related to wildfire management for each pilot phase expected were discussed during round-table exercises.	-	1.0	1.0	-
6	**KPI_{p-M9}**	Most significant entities considered in wildfire management plans were involved in pilot activities.	-	0.7	1.0	The synergistic collaboration among the diverse stakeholders represents an ideal alliance for effective fire management. The cohesive efforts of Civil Protection, Forestry Guards, Foresta Agency, Local Environmental Education Centres create a powerful and cohesive network
7	**KPI_{p-O2}**	Workshop for first responders in crisis management and disaster resilience regarding to define training activities	-	1.0	1.0	-

	KPIs	PEMs	[ER] (ex ante)	[MR] (ex post)	KPI value	Improvements in Trial Period 2
		designed to improve safety and preparedness of firefighters in combating wildfire was organised as round table exercise.				
8	**$KPI_{p\text{-}O3}$**	Pilot organisation allowed to achieve at least 80% of the pilot objectives specified in relevant Template Operational Readiness.	-	1.0	1.0	-
9	**$KPI_{p\text{-}O4}$**	Issues considered during round table exercise may be implemented into training activities related to the usage of SILVANUS platform.	-	0.3	1.0	During the 2024 pilot activities it will be necessary to offer some training activities related to the usage of SILVANUS platform.
10	**$KPI_{p\text{-}I3}$**	Pilot output allows to organise next pilot to use at least 2 UPs an integrated way in 2024.	-	0.3	1.0	Different UPs will be used in 2024 exercise
11	**$KPI_{p\text{-}I6}$**	The technology used has potential for 80% reduction in the deployment of firefighter personnel to the forefront of wildfire.	-	0.3	1.0	During the 2024 pilot exercise will be strengthened the exchange of experiences and best practices between local stakeholders and the SILVANUS project since, in some ways, it seems that the Region of Sardinia is well equipped with cutting-edge technologies that could also be of interest to project partners
-	-	Sum (Effectiveness Criterium 2):	-	7.6	1.0 (100%)	

4.8.3 Qualitative feedback and pilot outcomes

The identified benefits were broad, possibly due to the tabletop exercise involving extensive sharing of perspectives and experiences. This could be valuable during Trial period 2 when end-users will need to join efforts under the umbrella of 'coordination'.

Table 49: Benefits to end-users from Italy Tepilora Pilot

(Group of) end-users	Benefits from SILVANUS
Civil protection	Everyone agreed on the need to work on awareness, and in this regard, of particular interest were the UP3 and UP8 that can be easily used during the awareness raising campaign.
Forestry guards	
Forests agency	
Local environmental education centres	

The pilot has given the possibility to discuss with local stakeholders, **Civil protection**, **Forestry guards**, **Forests agency** and **Local Environmental education centres**, to lay the basis for further interaction in anticipation of the pilot activities in Tepilora Park in 2024.

All regional stakeholders expressed their interest in participating in the drafting of a plan for PNRT, containing key information about activities for planning, prevention and operational intervention measures

in case of fire and guidelines for correct restoration in accordance with the legislation in force. CFVA has also underlined the need of including this document in the Regional Fire Protection Plan.

It seems that the Region of Sardinia is well equipped with cutting-edge technologies that could also be of interest to project partners.

The event has also given the opportunity to build regional synergies between PNRT and FORESTAS – stakeholder of SILVANUS but also partner of the ResAlliance and FireRes Projects (H2020) - about fire Fighting and Land Resilience in Sardinia.

4.9 Australia´s Pilot

4.9.1 Pilot description

Pilot site: Brisbane, Australia
From 14th to 16th November 2023

The pilot took place at Queensland Centre for Advanced Technology, which includes a robotics centre and is a 24-hectare site of mixed land, from industrial to forest, creek and pasture.

The Australian pilot focused its field exercises on Phase B.

Figure 18: Pilot UGVs and team in Australia

In this pilot the following UP were tested:

Table 50: User Products in Australia´s Pilot

User Product	Description
UP3	Fire detection based on social sensing
UP4	Fire detection from IoT devices
UP5	Fire detection from UAV/UGV

4.9.2 Pilot key performance indicators and lessons learnt.

As the pilot was organised after the formal assessment methodology to systemically evaluate the effectiveness of pilot demonstration activities had been elaborated, the effectiveness assessment was conducted in both formulas (ex post and ex ante). Pilot Owner, Pilot Observer and Task Leader prepared pilot evaluation template and a survey for evaluation of pilot effectiveness and replicability studies in SILVANUS project, collected information from own observations and from pilot attendees, and made the assessment.

Operational objectives of the demonstration:
(Taken from D9.2)

- Show arm-on-vehicle capabilities for measuring localised ground conditions.
- Demonstrate static and dynamic (on-vehicle) smoke detection in forested environments.
- Demonstrate autonomous UGV exploration and navigation through dense forested environments, with attached smoke detector.

- Demonstrate forest analysis from UGV, sent and received from SAL.
- Demonstrate 3-robot map merging (including different robot types), allowing one officer to control multiple robots using simple point and click end points.
- Demonstrate dynamic obstacles, and the correct alignment of individual maps.

The Australian pilot has reached a considerable high level of accomplishment. From the perspective of improvement little needs to be done, so, this pilot may not participate in Trial Period 2.

	KPIs	PEMs	[ER] (ex ante)	[MR] (ex post)	KPI value	Improvements in Trial Period 2*
1	**KPI_{PA1-1}**	The chosen area of Brisbane forests (600 m x 20 m) was analysed. The area was located next to CSIRO premises.	0.7	0.7	1.0	-
2	**KPI_{PA1-2}**	Brisbane forests (Australia; non-EU) were considered as one of regional demonstration sites.	0.7	0.7	1.0	-
3	**KPI_{PA4-1}**	Information about the pilot was presented to forest management authorities, landowners and public authorities with the use of social media (LinkedIn and Platform X).	0.7	0.7	1.0	-
4	**KPI_{PA4-2}**	Promotion of citizen engagement activities and use of citizen-engagement-toolkit was conducted by presentation of the use of Citizen Engagement Mobile App (User Product 9; UISAV). Local authorities attending to the pilot ascribed into the number of 500 local authorities to be reported	0.7	0.7	1.0	-
5	**KPI_{PA4-4}**	Citizen-engagement-tool-kit (Citizen Engagement Mobile App -User Product 9; UISAV) was assessed simultaneously to effectiveness assessment of the pilot. The general level of satisfaction from functionalities of SILVANUS tools implemented in a pilot was rated on 4.333 (based on 15 surveys).	0.7	0.7	1.0	-
6	**KPI_{PA5-2}**	Trailing collaboration tests were not organised late afternoon of the Day 3 due to logistic determinants related to attendees. The pilot generated content which may be useful to organize tests and workshop in the future.	0.7	0.3	0.43	-
7	**KPI_{PB5-1}**	Use of robots allowed to reduce a total number of firefighters expected to operationally cover the forefront of wildfire due to reconnaissance issues (1 operator for 3 robots).	1.0	1.0	1.0	-
8	**KPI_{PB5-2}**	Technology development allowed to ensure 80% resilience in navigating natural terrain in Brisbane Forest regarding to conditions when a robot navigates.	1.0	1.0	1.0	-
9	**KPI_{PB8-1}**	Data collected by robots allowed to feed 3D visual interfaces related to the robot software.	0.5	0.5	1.0	-
10	**KPI_{PB8-2}**	4 kinds of information collected during robot operation will be transferred for the	1.0	1.0	1.0	-

	KPIs	PEMs	[ER] (ex ante)	[MR] (ex post)	KPI value	Improvements in Trial Period 2*
		purposes of 3D visual interface to be offered to the crisis management personnel (a location, surroundings, a path, a video view).				
11	**KPI_{DO2}**	10 experts (stakeholders) were invited to oversee the pilot demonstration activities. They represented fire service, forest service, land service, and academia.	0.7	0.7	1.0	-
12	**KPI_{DO3}**	The pilot was integral part of first cycle of project pilots. It was dedicated for Phase B, but robot technologies were indicated to be useful also in other phases (Phase A and Phase C).	0.7	0.7	1.0	-
13	**KPI_{ODE3-1}**	1 research paper is being prepared for submission to peer-reviewed journal. The paper will contain results of the pilot effectiveness assessment (the assessment methodology and relevant case study of Australian pilot).	0.5	0.5	1.0	-
14	**KPI_{ODE3-2}**	Trailing collaboration tests were not organized late afternoon of the Day 3 due to logistic determinants related to attendees. The pilot generated content which may be useful to organize tests and workshop in the future.	0.7	0.3	0.43	-
-	-	Sum (Effectiveness Criterium 1):	10.3	9.5	0.92 (92%)	
1	**KPI_{p-M2}**	10 experts (stakeholders) were invited and participated to oversee the pilot demonstration activities.	1.0	1.0	1.0	-
2	**KPI_{p-M3}**	Australian pilot considered Phase B accordingly to Description of Action for the project and allowed for systematic evaluation of the project outcomes.	1.0	1.0	1.0	-
3	**KPI_{p-M5}**	Tools delivered by Catalink, ITTI and CSIRO were demonstrated during the pilot.	1.0	1.0	1.0	-
4	**KPI_{p-M6}**	Pilot allowed to implement 3 good practices related to wildfire management in accordance with Phase B (the phase expected in Description of Action). The good practices concerned the use of robot and fire sensing in accordance with firefighting tactics as well as robot integration to fire detection tools.	1.0	1.0	1.0	-
5	**KPI_{p-M7}**	67,5% of pilot participants were engaged in pilot activities (27 SILVANUS partners from a total number of 40 participants) and 42,5 % of the participants reflect this in the pilot effectiveness assessment and replicability studies by completing relevant survey (17 inputs to the survey).	1.0	0.7	0.7	-
6	**KPI_{p-M8}**	94% of pilot participants (the participants who agreed to consider their output in the evaluation process) reported acquiring	1.0	1.0	1.0	-

	KPIs	PEMs	[ER] (ex ante)	[MR] (ex post)	KPI value	Improvements in Trial Period 2*
		new knowledge or information from the demonstration activities.				
7	**$KPI_{p\text{-}M9}$**	Representatives of fire service and forest service, which are considered in wildfire management plans, were involved in pilot activities.	0.7	0.7	1.0	-
8	**$KPI_{p\text{-}O1}$**	Pilot Owner, Pilot Observer and Pilot Players were indicated in person before the pilot date.	1.0	1.0	1.0	-
9	**$KPI_{p\text{-}O2}$**	Issues related to safety and preparedness of firefighters in combating wildfire were discussed during the pilot activities for first responders in crisis management and disaster resilience (Day 2).	1.0	0.7	0.7	-
10	**$KPI_{p\text{-}O3}$**	Pilot organisation allowed to achieve 100% of the pilot objectives specified in relevant Template Operational Readiness.	0.7	0.7	1.0	-
11	**$KPI_{p\text{-}O5}$**	Pilot stakeholders (who agreed to take part in the evaluation) noticed 4.353 overall rank for satisfaction in terms of the pilot organisation process.	1.0	1.0	1.0	-
12	**$KPI_{p\text{-}I1}$**	CSIRO ensured that all functionalities of UPs dedicated for the Australian pilot had the necessary conditions and infrastructure to be verified during the pilot.	1.0	1.0	1.0	-
13	**$KPI_{p\text{-}I2}$**	Functionalities of SILVANUS tools implemented in Australian pilot noticed high ranks on satisfaction of pilot stakeholders (those who agreed to take part in the evaluation) in relation to use the tools easily (rank value: 3.923) and intuitively (rank value: 4.0).	1.0	0.7	0.7	-
14	**$KPI_{p\text{-}I3}$**	UP4a (Fire Detection from IoT Devices, from Catalink) were integrated to UP6 (Fire Inspection using UGVs, from CSIRO).	1.0	1.0	1.0	-
15	**$KPI_{p\text{-}I4}$**	The technologies could be accessible in the future after their additional development and integration.	0.3	0.3	1.0	-
16	**$KPI_{p\text{-}I5}$**	Pilot allowed to achieve 71% of KPIs related to UP4a (Fire Detection from IoT Devices) and 80% of KPIs related to UP6 (UGVs) dedicated to a pilot (referring to D2.3 – Report on SILVANUS formal assessment methodology).	0.7	1.0	1.0 (1.43)	-
17	**$KPI_{p\text{-}I6}$**	Use of a robot allowed to reduce a total number of firefighters expected to operationally cover the forefront of wildfire due to reconnaissance issues. 1 person may operate 3 robots (at the same time). Robot may go closer to the danger zone than firefighters.	1.0	1.0	1.0	-
18	**$KPI_{p\text{-}I7}$**	Pilot infrastructure noticed 3.929 rank on satisfaction of pilot stakeholders (who agreed to take part in the evaluation) in	1.0	0.7	0.7	-

	KPIs	PEMs	[ER] (ex ante)	[MR] (ex post)	KPI value	Improvements in Trial Period 2*
		relation to proper conditions to meet social requirements of the stakeholders and ensure their effective work during the pilot.				
19	**$KPI_{p\text{-}S1}$**	The mobile operational centre was localized just next to demonstration area (in CSIRO premises) to monitor and manage all activities in the threatened area.	1.0	1.0	1.0	-
20	**$KPI_{p\text{-}S3}$**	Most of responders indicated that Pilot Owner, Pilot Observer and Pilot Players fully express their responsibilities and tasks related to the project.	1.0	1.0	1.0	-
21	**$KPI_{p\text{-}S4}$**	Pilot stakeholders reported 4.438 rank for satisfaction on organisational activities carried out by Pilot Owner to prepare them for the pilot.	1.0	1.0	1.0	-
-	-	Sum (Effectiveness Criterium 2):	19.4	18.5	0.95 (95%)	

4.9.3 Qualitative feedback and pilot outcomes

Table 51: Benefits to end-users from Australian Pilot

(Group of) end-users	Benefits from SILVANUS
Fire fighters	Eventually- UGVs that can semi-autonomously navigate around fire fronts. Currently- demonstrations of what is coming, as preparation
Rural fire management	Better ground-level analytics of forests before/during/after burns.

Within the academic world **Fire Researchers** have demonstrated interest in the pilot providing opportunities for shared projects and facilities.

Fire management professionals have generated ideas and provided feedback on how the UGVs could be practically exploited, for fire combat and prevention situations.

Although the pilot was focused mainly on Phase B, many of the outcomes can be applied to both Phases A and C. As examples one can take for Phase C the visit occurred to the different types of forest which puts in evidence that some indigenous vegetable species may resist better to fire spread than imported ones/invaders or how UGV can realize the prevention work of cleaning fields, even before fire occurs.

4.10 Major outputs from Pilots performance assessment

After finalizing Trial period 1, SILVANUS pilots show a satisfactory fit to what were the plan of execution and stakeholders' engagement. Table 52 summarizes the progress regarding the planned KPIs' target reach and Criteria 1 and 2 of the assessment methodology for pilots. Most pilots accomplished to have a first iteration of the KPIs above 80%.

Table 52: SILVANUS pilots' main indicators

Pilot →	HR	SK	RO	FR	CZ	IT2	EL	ID	IT1	AU	PT	BR
KPIs assigned	21	23	23	33	25	38	15	24	29	35		
KPI's target reached in trial 1	21	23	23	26	19	38	10	17	29	31		
Progress:	100%	100%	100%	79%	76%	100%	67%	71%	100%	89%	0%	0%
Crit1: Project expectations	100%*	100%*	100% ǂ	93%	110%	100% ǂ	97%	95%	100% ǂ	92%	0%	0%
Crit2: Pilot achievements	100%*	100%*	100% ǂ	87%	84%	100% ǂ	84%	84%	100% ǂ	95%	0%	0%

*As the pilot had been organised before the methodology was elaborated, its effectiveness assessment results were obtained in the line of ex post formula only, with positive influence on the assessment scores (1.0; 100%).

ǂ In accordance to the pilot form and formal assessment methodology to systemically evaluate the effectiveness of pilot demonstration activities, the pilot was not preliminarily considered as a venue to be under full evaluation process. Thus, its effectiveness assessment results were obtained in the line of ex post formula only, with positive influence on the assessment scores (1.0; 100%).

High Effectiveness Criterium 1 values indicate that all pilots were conducted in line with organizational assumptions and contributed effectively to project success (KPI_{PR} specified in DoA). High Effectiveness Criterium 2 values indicate that all pilots were conducted in line with organizational assumptions and effectively met expectations defined in T9.6(KPI_p).

The Czech Pilot clearly surpassed what was expected, mostly because of the good preparation work, engagement of stakeholders and availability of tech. partners.

The values among the pilots are not comparable due to the distinct specifics, conditions, and expectations that characterize each pilot. Furthermore, some of these pilots were organized prior to the development of a formal assessment methodology to systematically evaluate the effectiveness of pilot demonstration activities.

The following information allows to compare the extent to which the pilots allowed the achievement of KPIs. In other words, the wider the range of KPIs provided, the better for project's success, defined as the achievement of project KPIs and objectives. The figure compares these results across different pilots. The values are contractual and do not have a unit of measure. In absolute terms it means the Italian Pilot 2 (Puglia) has contributed more to the Project KPIs – discussed in Section 6.

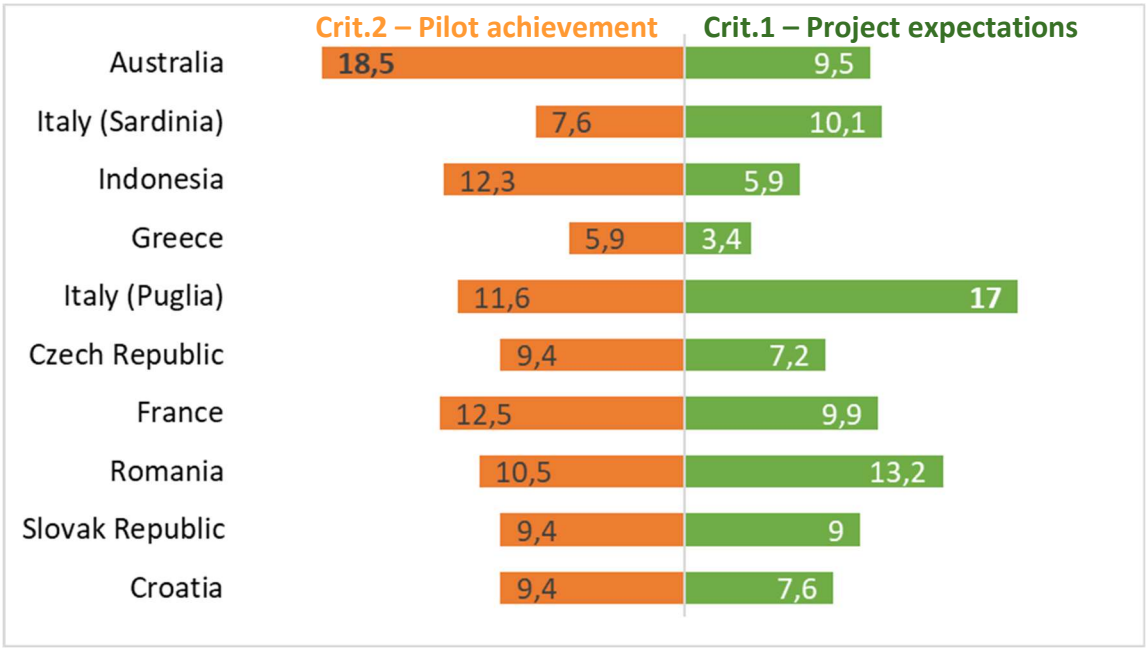

Figure 19: Comparison between particular pilots on contribution to project KPIs

Pilots have committed with a large number of external partners for the second trial period.

The end users from the several pilots became, in a large extent aware of new technologies for each of the three phases of the project. Roughly, more than one third of end-users expect to integrate the new products and tools on their systems with gains of efficiency and costs of the process.

Regarding stakeholders, namely government organizations and public institutions, are betting on SILVANUS proposition related to coordination, social networking with citizens even if related with fire prevention or detection and recovery of the terrain.

All the impacts identified can be worked from the perspective of communication, not only to leverage SILVANUS reputation but mostly to ease the implementation of Trial period 2 measures. These need to be ambitious, yet realistic so that Project KPIs can be accomplished in scope and time.

5 Lessons learnt from piloting activity in trial period 1.

In close relation with Section 4, the current section states the insights the consortium received from Trial Period 1, in what concerns piloting. The decision for separating this section from all the sub-sections of Section 4 was only based on the amount of rich information SGSP has compiled within.

T9.6 Leader collected reports on pilot assessment and replicability studies and, in a systematic manner, is building a Book of Lessons Learnt, which final version will go into deliverable D9.5 (M42). Book of Lessons Learnt is a living document, meaning that relevant content should be evaluated as soon as new lessons learnt stem from pilots organised in the project. Its main goal is to gather the essential information needed to organize effective and replicable pilot programmes that help achieving the project's objectives.

This D9.3 section will be enriched with those insights derived from piloting activities completed, which could be relevant for Trial Period 2 application or for the purpose of replicability. Hence, all lessons already gathered will be presented.

The insights taken, shall be grouped in four sections: merit content, process of a pilot organisation, infrastructure, equipment and tools and staff preparedness to a pilot. These categories were found best fitting to the preparation of a pilot, after interviews and consortium internal discussion.

Merit content encompasses the presentation of technology, organizational practices, and societal involvement to support project goals. The relevant process may be understood as the method through which technological UPs, organizational solutions, and societal involvement solutions are presented, tested, and validated to address project objectives.

The main directions for a pilot organization's infrastructure, equipment, and tools encompass the presentation of technology, including the technologies to be tested, testing infrastructure, spare parts, alternative technological solutions, and service tools. Additionally, it involves the presentation of organizational manners through infrastructure and presentation devices, as well as shaping societal involvement through technical tools and an environment to shape the involvement.

Finally, the main directions for a pilot organization's staff preparedness involve the preparation of technology providers, presenters, moderators, designers, technical support teams, observers, and other participants, as well as the preparation of solution providers, presenters, moderators, technical support teams, observers, and other participants, including citizens, to shape societal involvement.

5.1 Lessons learnt concerning merit content.

Merit content concerns all information and activities to be presented or conducted to achieve pilot goals and objectives.

Technological pilot

Lesson Learnt 1. ***Clear structure of merit content for a technology pilot***

Clear structure of merit content means that every part of the content is reasonably stated and necessary to achieve technology pilot goals. Order of the content elements ensures that every pilot participant is respectively able:

a) to understand background of the technology presented,
b) to see the technology in action,
c) to understand on how the technology is used,
d) to understand on how the technology meets user requirements.

Clear structure of merit content for a technology pilot should be expressed in the pilot agenda (program, schedule, etc.).

Example:

Technology pilot was focused on presentation of ground robots (UGVs) operations supporting wildfire management. The operations regarded to 3D mapping of wildfire response terrain and smoke detection (after technological integration with wireless smoke detector). The pilot agenda consisted in, respectively, short presentation of robots, general introduction to robot technologies and their theoretical background, essential demonstration of robot functionalities, description of demonstrations' output (paying special attention of user functionalities which were preliminarily planned to be delivered), discussion on next steps concerning the technology development and its implementation to wildfire response.

Lesson Learnt 2. ***Flexible structure of merit content for a technology pilot***

Flexible structure of merit content means that some or even all parts of the content are replaceable regarding to order of their presentation in technology pilot agenda. This assumption is correct for the content elements referring to the same part of the elements (a) to understand background of the technology presented, OR b) to see the technology in action, OR c) to understand on how the technology is used, OR d) to understand on how the technology meets user requirements). It is a way to ensure the pilot continuity when some technical problems occur.

Example:

Technology pilot was focused on presentation of multiple technology solutions valuable from the point of view of wildfire detection. There were following solutions: UGV, UAV, onsite long-distance camera-based detectors and onside firefighting patrols. They were presented relatively separable and during the same time. It means that when any technical problems would occur with one of them, it was possible for the pilot participants to move on to see other solutions. User functionalities were verifiable by more than one technology tool.

*Lesson Learnt 3****. Pilot agenda matching crucial technological functionalities.***

To make sure that all project functionalities are considered in a pilot, its agenda should reflect them directly. The agenda needs to be detailed enough to prove that there will be a dedicated time and a dedicated place to verify the functionalities regarding to pilot assumptions and project assumptions.

Example:

Technology pilot was focused on presentation of ground robots (UGVs) operations supporting wildfire management. Pilot assumptions and project assumptions said about several functionalities to be tested: mobile ground humidity sensing, IoT static smoke detection, autonomous exploration with mobile smoke detection, autonomous navigation and forest analytics, two-robot mid-run map sharing, third robot start-of-map sharing, waypoint control of 3 robots simultaneously and return-to-start with progressive obstacle avoidance. They were evaluated one by one, and it was directly reflected in the pilot agenda (each functionality meant a separate item in the agenda).

Lesson Learnt 4. ***Understandable language of a content in technology pilot***

Information presented during a pilot must be understandable for participants accordingly to terminology and cognitive possibilities. The terminology needs to reflect state-of-the-art and be clearly interpreted. Cognitive possibilities determine in what extend a pilot participant is able to understand the merit content. Regarding to technology pilot, special attention should be put on mathematical apparatus, physical

background and cause-consecutive relations between technical functionalities and user requirements. It gains in importance especially when non-technical participants are involved in a pilot.

Example:

Technology pilot was to demonstrate early detection of fire and smoke, followed by the quick and efficient deployment of firefighters, fire trucks, drones, robots, and helicopters until the fire was extinguished, as a trial demonstration in the development of the SILVANUS platform. To make merit content clearer for non-technical partners, every technology was described by relevant technology provider. The provider participated in the pilot all the time ready for additional explanations. In addition, a dashboard visualising the use of particular technologies was presented. This facilitated to explain how particular tools work on matching user expectations.

Lesson Learnt 5. ***Technological pilot division on a set of demonstrations***

Technology pilot is generally a wide-meaning term. Its operationalization may facilitate to design accurate operations to present technologies regarding to project assumptions. However, this requires dividing it into smaller technology presentations (demonstrations). The good practice is to organize demonstrations in a number reflecting a number of functionalities to evaluate and/or a number of technologies to test.

Example:

During the demonstration in the forest, each technology and solution should have a separate stand, a "demonstration site/space". Participants approached to each stand one by one (firstly – stationary smoke sensors, secondly – UAVs in action, thirdly – mobile application functionalities, fourthly – UGVs in action), listened introduction about what will be exactly shown, and then watched (with maintaining safe distances) a demonstration. This helped to avoid the situation that everything is shown at the same time, and it is not clear to people on which they should be focussed on.

Lesson Learnt 6. ***User-oriented background description presented before a technology demonstration.***

Impression on technology usefulness should be shaped at the beginning of its demonstration. It gains in importance when several tools are to test, and it is hard to cognitively understood what seems to be going on during a pilot. Thus, user-oriented background description presented before every technology demonstration is desired. End-user must be sure which user requirement is addressed by a technology and how it will be done.

Example:

Just before testing a particular technology dedicated to wildfire detection and firefighting, moderator mentioned about user-requirement related to this technology. In general, technology allowed to conduct detection and firefighting activities quicker (for example UAV) and/or more safely (for example UGV) than with the use of current solutions.

Lesson Learnt 7. ***Scenario-based technological demonstrations***

Technological demonstrations should be connected in a logical way. The way needs to be reflected by a pilot scenario. A valuable scenario comprises in scenario background, scenario objectives and set of activities to be conducted. The three should correspond to user requirements. The scenario realisation must prove that a use of technology allows to match the requirements. In addition, the scenario may reflect a part of end-user operation (to emphasize how a technology may assist end-user wildfire management activities).

Example:

Technology pilot was to demonstrate early detection of fire and smoke, followed by quick and efficient deployment of firefighters, fire trucks, drones, robots, and helicopters until the fire was extinguished. This set of functionalities corresponded to general way of wildfire response (detection, deployment of first responders and deployment of second responders). It also expressed set of demonstrations (1. early detection of fire and smoke, 2. quick and efficient deployment of firefighters, 3. deployment of fire trucks, 4. deployment of drones, 5. deployment of robots, 6. deployment of helicopters).

Lesson Learnt 8. ***Making order in technology demonstration proceeding***

Technological demonstrations may be complex in their nature because of many aspects to consider. It is characteristic for demonstrations conducted simultaneously (when two or more technologies are tested at the same time). Making order in technology demonstration proceeding may reduce risks which stem from technology complexity and cognitive load for participants. It can be implemented by ordering steps of a demonstration and describing these steps in the order made. This facilitates to monitor a current demonstration stage and a correspondence to a demonstration schedule.

Example:

During demonstrations of UGV supporting wildfire response, moderator informed all participants about the demonstration stage. This regarded current point in demonstration agenda, correspondence to demonstration schedule and next point in the agenda. Consequently, participants knew what is going on and what will be next during the demonstration. It was also easier to manage time during demonstration.

Lesson Learnt 9. ***Potential of technological solutions related to user requirements.***

From the perspective of end-user (firefighter, forest service, etc.), general pilot objective is not to present technological solutions perfectly in terms of their technological potential but rather appropriately to their operational abilities (in terms of firefighting operations, forest service operations, etc.). This is why their potential should be presented with direct (more appropriate) or indirect (less appropriate) relation to user requirements. These requirements are typically specified in Description of Action in the project proposal or during first period of the project. Presentation of the relation is crucial to justify that technological solutions are useful for end-users.

Example:

When demonstrating set of technological tools (UAV, UGV, smoke detectors, cameras, etc)., moderator highlighted several times (especially for end-users) how particular solutions may support firefighters from the hazard identification till the end of firefighting action. Moderator emphasized abilities of the solutions to make situational picture quicker and safer, matching their requirements specified at the beginning of the project.

Lesson Learnt 10. ***Standardised forms of technology presentation***

A form of technology presentation should be specific for the topic and object presented. The most valuable is a direct use of the technology to do things reflecting wildfire response.

Example:

UAV-related demonstration had a form of direct use of a drone to identify hotspots in forest area. Results of the identification were presented on screen to all participants up to date.

Lesson Learnt 11. ***Multiple forms of presenting assumptions of technologies***

Additional explanation of assumptions of technologies presented is valuable when non-technical users take part in a pilot. It should be expressed in multiple forms of presentation (for example a multimedia presentation, a movie, a simulation, an equation) to cover possibly all styles of learning represented by participants.

Example:

During discussion on technology background concerning robots, there were multimedia presentation of technological mechanisms of the robots' use, movies visualising how it works from the perspective of a command centre and discussion on topics reflecting in-depth analysis of these problematic aspects (including robot use in wildfire response).

Lesson Learnt 12. ***Activities ascribed to the scenario reflect end-user needs related to technology tools.***

Proceedings with the use of a pilot scenario and a demonstration scenario should prove to end-users that a technological tool is useful in the context of end-user needs. Thus, activities ascribed to the scenario need to reflect end-user needs. The needs are gathered in Description of Action in the project proposal or collected during the first phase of the project realisation. A pilot moderator should highlight relevant relation when a technology is tested.

Example:

Increase of safety of firefighters in terms of wildfire response was one of end-user needs presented in Description of Action in the project proposal. When demonstrating UGV in extinguishing action, a moderator highlighted that practically a robot may be closer to a hotspot than a firefighter and this increases safety of fire service staff during wildfire response.

Lesson Learnt 13. ***Workshop session to summarise a technology pilot.***

From the perspective of a technology pilot, workshop sessions should be planned at the end of the entire pilot. The aim is to collect and classify all information generated and to make in-depth analysis of the topic.

Example:

Workshop session on 'How to use a robot in bush fires' was planned on the last day of a technology pilot. Participants were after presentation of technological background, robot demonstrations and discussions – ready to summarize new knowledge they had been already gained and confront it to end-user needs.

*Lesson Learnt 14****. Introducing project end-users and local end-users during technology pilot***

A technology pilot should ensure that project end-users and local end-users meet and have a chance to share knowledge and experiences regarding technological solutions and their usefulness for wildfire response. It is also a good possibility to familiarize project end-users with local conditions of wildfire response.

Example:

Pilot owner invited local end-users to take part in all pilot activities. Project end-users also attended to the event. There were 3 days to share knowledge and experiences regarding technological solutions and their usefulness for wildfire response. It generated new information taken to the project after the pilot by project end-users.

Lesson Learnt 15. ***References to technology-related materials***

Pilot attendees should be able to get additional information about the technology presented. Pilot owner and/or technology provider is required to ensure access to additional information materials (papers, books, webpages, software solutions, leaflets, etc.) useful for additional research and developing pilot outcomes.

Example:

When discussing bushfire modelling and simulations, presenter indicated webpage and links to research papers with additional information about the software used for the purposes of modelling and simulations. Presenter also encouraged pilot participants to download a trial version of the software and use it to be familiarised with relevant functionalities as well as to contact the software developers to make improvements.

Lesson Learnt 16. ***A pilot is to prove that relevant technologies work in practice.***

A pilot owner should ensure that all technologies ascribed to this pilot are evaluated and work. Information on which technologies are described to which pilots is available in project documentation (especially in Description of Action). This requires pilot owner to contact to technology providers and cooperate with them. On the other hand, technology providers may report themselves to pilot owner to consider them in a pilot. The second option is more challenging for WP leader to ensure that all pilots together allowed to evaluate all technologies.

Example:

Pilot owner asked technology providers to take part in pilot respecting technology readiness for its evaluation. Based on relevant feedback, pilot scenario was elaborated. Risk that something goes wrong in the technology operation was reduced (no technology provider was surprised by nomination to pilot).

Lesson Learnt 17. ***Highlighting technological progress***

Every user product dedicated to a pilot should be described in a process way to summarize from what status it comes from, what are the current improvement expectations and what is the final status to achieve.

Example:

Discussion on UGV technologies concerned description of a way on how ground robots have been developing for last years. Moderator mentioned about current status of this technology development and perspective directions for next improvements. Based on that, pilot expectations were elaborated.

*Lesson Learnt 18****. Ascribing technologies to wildfire response phases***

As project refers to wildfire management phases (Phase A – preparation and pre-planning activities of wildfire response; Phase B – wildfire response; Phase C – reconstruction and recovery), particular technological functionalities and ways on how to use them should also refer to these phases. In accordance to external participants attendance, the phases should be explained.

Example:

UGV demonstrations were divided to address particular phases of wildfire management (Phase A – preparation and pre-planning activities of wildfire response; Phase B – wildfire response; Phase C – reconstruction and recovery) moderator indicated). Consequently, a pilot participant was sure a background of the technology use.

Lesson Learnt 19. Interoperability of technologies

Common use of different technologies may result in generating a synergy effect. From this perspective their interoperability is highly desirable.

Example:

IoT device was installed on UGV. The two co-constituted a mobile ground platform to detect smoke in forest, to make 3D map, to track its path in hard terrain and to share relevant map with other robots.

Organisational pilot

Lesson Learnt 20. ***Clear structure of merit content for an organisational pilot***

Clear structure of merit content means that every part of the content is reasonably stated and necessary to achieve organisational pilot goals. Order of the content elements ensures that every pilot participant is respectively able:

a) to understand background (including reasons, limitations, conditions and expectations) of the organisational good practice presented,
b) to see the 'step-by-step' way to use of the good practice,
c) to understand on how the technology meets user requirements (in general).

Clear structure of merit content for an organisational pilot should be expressed in a pilot agenda (program, schedule, etc.).

Example:

Organizational pilot was focused on presentation of approach to reduce wildfire risk occurring in wide areas of peatlands. The approach bases on rational water management and ensuring that ground water level is sufficiently high (to make the peat layer wet). The pilot agenda consisted in, respectively, discussion with disaster management representatives who explained essential determinants of wildfire risk management, visitation on peatland under the underground fire (matching all necessary safety restrictions), visitation in forest restored after the approach implementation, participation in research conference with presentations concerning the approach, its practical use and discussion on how to improve the approach by project-related solutions.

Lesson Learnt 21. ***Flexible structure of merit content for an organisational pilot***

Flexible structure of merit content means that some or even all parts of the content are replaceable regarding to order of their presentation in organisational pilot agenda. This assumption is correct for the content elements referring to the same part of the elements (a) to understand background of the organisational good practice presented, OR b) to see the 'step-by-step' way to use of the good practice, OR c) to understand on how the good practice meets user requirements (in general). It is a way to ensure the pilot continuity when some organisational problems occur.

Example:

Organisational pilot was focused on peatland fire management. Particular presentations were relatively separated. They all covered the topic given but it was possible to change their order in case of any organisational problems (to 'buy an additional time' to solve it).

Lesson Learnt 22. ***Pilot agenda matching crucial organisational functionalities.***

To make sure that all project functionalities are faced in a pilot, its agenda should reflect them directly. The agenda needs to be detailed enough to prove that there will be a dedicated time and a dedicated place to verify the functionalities regarding to pilot assumptions and project assumptions. In terms of organisational

pilot specifics, relevant evaluation may take a form of *ex ante* evaluation (with discussion on potential changes in the future) or *ex post* evaluation (based on previous experiences and results).

Example:

Organisational pilot aimed at building a knowledge base useful for orienting the restoration policies and scenarios of forest and landscape regeneration should ensure possibilities to collect information relevant to restoration policies and the scenarios of forest and landscape regeneration. These two issues should be highlighted in agenda and state two essential directions for collecting information.

Lesson Learnt 23. ***Understandable language of a content in organisational pilot***

Information presented during a pilot must be understandable for participants accordingly to terminology and cognitive possibilities. The terminology needs to reflect state-of-the-art and be clearly interpreted. Cognitive possibilities determine in what extend pilot participant is able to understand the merit content. Regarding to organisational pilot, special attention should be put on legal names, social phenomena and cause-consecutive relations between organisational functionalities and user requirements. It gains in importance especially when technical participants are involved in a pilot.

Example:

One of the technology pilot objectives was to present a disaster management framework to give a background on how a security system of a state is organised to handle with wildfire. To ensure a proper level of understanding, representatives of local disaster management centre were asked to describe the system. The description was supported by multimedia presentation and followed by discussion among participants to make sure that everyone speaks the same merit language. Special attention was put on explaining relevant terminology (a disaster, an emergency, a state of emergency, a crisis situation, a wildfire, a bushfire, a forest fire, a peatland).

Lesson Learnt 24. ***Division of an organisational pilot on a set of demonstrations***

Organisational pilot is generally a wide-meaning term. Its operationalisation may facilitate to design accurate operations to present organisational solutions regarding to project assumptions. However, this requires dividing it into smaller presentations (non-technology demonstrations). The good practice is to organise demonstrations in a number reflecting a number of functionalities to evaluate and/or a number of organizational solutions to consider.

Lesson Learnt 25. ***User-oriented background description presented regarding to every organisational solution.***

Impression on organisational solution usefulness should be shaped at the beginning of its presentation. It is especially important when a solution seems to be complex and expensive in implementation. Consequently, user-oriented background description should be presented before every technology demonstration. End-user must be sure which user requirement is addressed by the solutions and how it will be done.

Example:

When considering relatively small pilot, user-oriented background may be described at the beginning of an event, before presentation of organisational solutions (a description – all presentation). In case of larger pilots, the background may be described just before every presentation of organisational solutions (a first description – a first presentation, a second description – a second presentation, etc.).

Lesson Learnt 26. ***Scenario-based organisational demonstrations***

Organisational demonstrations should be connected in a logical way. The way needs to be reflected by a pilot scenario. A valuable scenario comprises in scenario background based on real cases, scenario objectives and a set of activities to be conducted. All of them should correspond to user requirements. The scenario realisation must prove that a use of organisational good practices allows to match the requirements. In addition, the scenario may reflect a part of end-user operation (for instance to emphasize how to organise wildfire management activities).

Example:

When focusing on organisational issues concerning a wildfire, the protection and management of water and energy infrastructures are worth to be highlighted. It is crucial from the perspective of critical infrastructure protection. One of the project pilots is about these issues. Thus, relevant pilot may base on two organisational processes: 1. protection and management of water infrastructures, 2. protection and management of energy infrastructures OR 1. protection of water and energy infrastructures and 2. management of water and energy infrastructures. Every process may be demonstrated separately and ensures possibilities to present and discuss organisational good practices.

Lesson Learnt 27. ***Making order in organisational demonstration proceeding***

If organisational solution is very complex and this generates organisational risks (it is not clear what is the most important and what states the demonstration logics), relevant demonstration should be presented in a step-by-step formula. Steps need to be communicated to pilot participants to make them familiar with a pilot stage and a moment in a pilot schedule.

Example:

During pilot focused on forest reconstruction, there was a need to move a lot between different field locations. Transportation shifts were long because of distances between these fields. Detail agenda was crucial to make aware participants with overall picture of the pilot and highlighted sense and role of particular demonstrations. Thus, it was easier to reflect these aspects in pilot effectiveness assessment and other project documentation.

Lesson Learnt 28. ***Potential of organisational solutions related to user requirements.***

From the perspective of end-user (landowner, public administration body, firefighter, forest service, etc.), a general pilot objective is not to present organisational solutions perfectly in terms of their correspondence to new ideas, approaches and strategies but rather appropriately to their organisational effectiveness (in terms fire protection, disaster management, civil protection, critical infrastructure protection, land management, etc.). This is why their potential should be presented with direct (more appropriate) or indirect (less appropriate) relation to user requirements. These requirements are typically specified in Description of Action in the project proposal or during first period of the project. Presentation of the relation is crucial to justify that organizational solutions are useful for end-users.

Example:

Description of peatland wildfire management solutions was completed by direct information on how these solutions scribe into end-user requirements (especially due to reconstruction and recovery phase of wildfire management).

Lesson Learnt 29. ***Multiple forms of presenting organisational solutions***

To cover possibly all styles of learning represented by pilot participants, multiple forms of information presentations are required. They are suggested such forms as a multimedia presentation, a movie, a simulation, an equation, a graph (with cause-consecutive relationships).

Example:

Presentation of wildfire response system in a country based on a multimedia presentation. The presentation was a sufficient form to include different charts with wild-fire data, maps of wildfire terrain and sets of activities carried out because of a hazard. The presentation was accompanied by a discussion on aspects stemming from practical implementation of organisational solutions.

Lesson Learnt 30. ***Activities ascribed to the scenario reflect end-user needs related to organisational solutions.***

Proceedings with the use of a pilot scenario and a demonstration scenario should prove to end-users that an organisational solution is useful in the context of end-user needs. Thus, activities ascribed to the scenario need to reflect end-user needs. The needs are gathered in Description of Action in the project proposal or collected during the first phase of the project realisation. A pilot moderator should highlight relevant relation when organisational solutions are described and discussed.

Example:

During talks to end-users, economical aspects resounded as significant factors which determine wildland management activities. When presenting manners of fire safety monitoring of peatland, a moderator highlighted that use of underground probes is relatively cheap.

Lesson Learnt 31. ***Workshop session for in-depth analysis of organisational solutions***

Workshop session is said to be an effective way to collect new information and gain knowledge on the topic taken. It may be especially valuable in case of in-depth analysis of organisational solutions. Workshop session allows to involve multiple participants to solve pilot-related and project-related problems.

Example:

A tabletop exercise was conducted first for responders from the pilot country and other important external stakeholders, such as the fire brigade, police, army, coast guard, local authorities, and forest services. Its objective was to establish effective communication and collaboration between first responders based on technologies developed in the project.

Lesson Learnt 32. ***Introducing project end-users and local end-users during organisational pilot***

An organisational pilot should ensure that project end-users and local end-users meet and have a chance to share knowledge and experiences regarding organisational solutions and their usefulness for wildfire management. It is also a good possibility to familiarise project end-users with local conditions of wildfire management.

Example:

The pilot owner invited local end-users to take part in first part of pilot activities. Consequently, local end-users presented national emergency management system and its experiences in wildfire response. Project end-users gained their knowledge about organisational solutions characteristic to a country from TOP10 countries which are the most disaster affected places on the world.

Lesson Learnt 33. ***References to organisational-related materials***

Pilot attendees should be able to get additional information about organisational solutions presented. Pilot owner and/or solution provider is required to ensure access to additional information materials (papers, books, webpages, leaflets, etc.) useful for further research and developing pilot outcomes.

Example:

When discussing forest restoration approaches and procedures, it is desirable to give attendees a possibility to read about them during and after the pilot. It is crucial to better understand the approaches and procedures and gives bigger chances to provoke participants for discussion and expressing their thoughts (also with theoretically positive impact on data collection processes and pilot effectiveness).

Lesson Learnt 34. ***A pilot is to prove that relevant organisational solutions work or worked in practice.***

A pilot owner should ensure that all organisational solutions ascribed to this pilot work or worked. This requires collecting relevant evidence and/or to invite expert who explains and proves relationship between the use of the solutions and its positive effect.

Example:

The pilot was focused on effective management of water for the purposes of fire protection of forests. Pilot owner invited an expert who explained long-term cause-consecutive relation between practical implementation of organisational solution (to ensure that a level of a ground water is enough high) and number of hotspots (and respectively wildfires risk).

Lesson Learnt 35. ***Ascribing organisational solutions to wildfire response phases***

As project refers to wildfire management phases (Phase A – preparation and pre-planning activities of wildfire response; Phase B – wildfire response; Phase C – reconstruction and recovery), particular organisational functionalities and ways on how to implement them should also refer to these phases. In accordance with presence of external participants, the phases should be explained.

Example:

A pilot was dedicated to the last wildfire management phase – reconstruction and recovery of forest assets. It was emphasized in relevant agenda and specifics of demonstration (description of forest management specifics in a country given, organisational chances and limits, idea of national reconstruction and recovery approach, description of results concerning the approach implementation).

Pilot related to societal involvement.

Lesson Learnt 36. ***Clear structure of merit content for a societal involvement pilot***

Clear structure of merit content means that every part of the content is reasonably stated and necessary to achieve societal involvement pilot goals. Order of the content elements ensures that every pilot participant is respectively able:

a) to understand background (including reasons, limitations, conditions and expectations) of the need to involve a society in project-related issues,
b) to see the 'step-by-step' way to effectively involve a society in project-related issues (including preparation of educational materials and effective way to deploy them),
c) to understand on how the involvement may be monitored, expanded and strengthened.

Clear structure of merit content for a societal involvement pilot should be expressed in the pilot agenda (program, schedule, etc.).

Example:

Pilot related to societal involvement was focused on presentation of main project tools and approaches, including society-dedicated tools (for example Citizen Engagement Mobile App). Basing on merit-related assumptions of the tools and approaches, educational materials were prepared (in two language versions – the English one and the local one). They had form of exhibition posters. Then the posters were presented along one of the most known streets in a city which is generally affected (directly and indirectly) by wildfires. Societal impression of the exhibition was strengthened by local authorities who formally opened it with support of media.

Lesson Learnt 37. ***Flexible structure of merit content for a societal involvement pilot***

Flexible structure of merit content means that some or even all parts of the content are replaceable regarding to order of their presentation in societal involvement pilot agenda. This assumption is correct for the content elements referring to the same part of the elements (a) to understand background of the need to involve a society in project-related issues, OR b) to see the 'step-by-step' way to effectively involve a society in project-related issues (including preparation of educational materials and effective way to deploy them), OR c) to understand on how the involvement may be monitored, expanded and strengthened. It is a way to ensure the pilot continuity when some societal problems occur.

Example:

When a pilot related to societal involvement concerns direct participation of external users (for example firefighters, school children, forest service officers), operational risk stemming from their absence or limited number may be reduced by replacing relevant point of pilot agenda to make additional time for invited guests to come. It can be done by changing order of other presentations, workshops, etc.

Lesson Learnt 38. ***Pilot agenda matching functionalities crucial for societal involvement.***

To make sure that all project functionalities are faced in a pilot, its agenda should reflect them directly. The agenda needs to be detailed enough to prove that there will be a dedicated time and a dedicated place to verify the functionalities regarding to pilot assumptions and project assumptions. In terms of specifics characterising pilot related to societal involvement, relevant evaluation should be conducted directly during the pilot.

Example:

The agenda or pilot program should include information about when the functionality will be verified and how (for example during appropriate on-line survey and/or with the use of QR-codes).

Lesson Learnt 39. ***Understandable language of a content in pilot related to societal involvement.***

Information presented during a pilot must be understandable for participants accordingly to terminology and cognitive possibilities. The terminology needs to reflect state-of-the-art and ascribes to common understanding (by the public). Cognitive possibilities determine in what extend a pilot participant is able to understand the merit content. Regarding to a pilot related to societal involvement, special attention should be put on social phenomena (including current social trends), new terminology (neologisms used by the public) and general cause-consecutive relations between societal involvement (means, manners, scope, duration, durability, etc.) and user requirements. It gains in importance especially when narrow-scope experts are involved in a pilot and due to direct engagement of the public.

Example:

During the tabletop exercises, the organiser provided simultaneous translation to the participants. The good idea is to have the interpreters to overcome the language barrier. The organiser/host also informed the participants in what language pilots and discussions would be conducted.

Lesson Learnt 40. ***Limitation in scenario-based demonstrations for pilot related to societal involvement.***

As societal involvement is typically hard to be planned in 100% of confidence, scenario approach can be implemented to pilot related to societal involvement in limited way only. The scenario should consider societal involvement but should not be based on the involvement results.

Example:

When testing Citizen Engagement Mobile App, it is desirable to consider as many app users as possible. However, some of them may be characterised by different app-use abilities and could not be able to check the app functionalities accordingly to relevant procedure. Thus, the testing demonstration should have limited or no impact on other demonstrations in the same pilot. If relation between the testing and other demonstrations is required, the app provider should have pre-defined set of data to ensure the pilot continuity (for example when data from citizens is incoherent or there are lacks in data).

Lesson Learnt 41. ***User-oriented background description presented regarding to every solution related to societal involvement.***

Impression on usefulness of a solutions related to societal involvement should be shaped at the beginning of its presentation. It is especially important when a solution seems to be similar to other ones (for example a mobile application). Consequently, user-oriented background description should be presented before every demonstration. In accordance with societal involvement specifics, a storytelling approach is worth noting. A citizen must be sure on how particular solution may support in daily life and what states it better than existing tools (for example other mobile applications).

Example:

As far as presentation of Citizen Engagement Tool in concerned, a presenter needs to convince a citizen that this tool may be used in daily life (when spending time in a forest), support in emergency situation, is free of charge or cheaper that existing applications and intuitive in use. This may be achieved by presenting the tool simultaneously to describing a real-life story.

Lesson Learnt 42. ***Potential of societal-focused solutions related to user requirements.***

From the perspective of end-user (citizen, public administration body), a general pilot objective is not to present societal-focused solutions perfectly in terms of their correspondence to new ideas and trends but rather appropriately to their personal safety (in terms of personal protection against flames and smoke and other hazards related to a wildfire). This is why their potential should be presented with direct (more appropriate) or indirect (less appropriate) relation to user requirements. These requirements are typically specified in Description of Action in the project proposal or during first period of the project. Presentation of the relation is crucial to justify that organisational solutions are useful for end-users.

Example:

Use of societal-focused solution needs to increase personal safety level of a forest user. It may be done by presenting behavioural patterns and tips proper to survive in wildfire conditions. In addition, these patterns and tips should positively shape a sense of personal safety and consider, for instance, issues related to warning, evacuation and self-protection against fire manifestations (smoke, high temperature).

Lesson Learnt 43. ***Simple forms of presenting solutions related to societal involvement.***
Societal involvement to a pilot requires to use relatively simple forms for presenting information. It is desirable to ensure that most of participants understand a solution demonstrated and is aware on how to use it in practice.

Example:

Citizen Engagement Tool dashboard consists in only several pictograms visualising the app functionalities. The pictograms are clear to recognise and easy to understand what functionalities stay behind them.

Lesson Learnt 44. ***Activities ascribed to the scenario reflect end-user needs related to societal involvement.***
Proceedings with the use of a pilot scenario and a demonstration scenario should prove to end-users that a societal involvement is useful in the context of end-user needs. Thus, activities ascribed to the scenario need to reflect end-user needs. The needs are gathered in Description of Action in the project proposal or collected during the first phase of the project realisation. A pilot moderator should highlight relevant relation when societal involvement is described and discussed.

Example:

End-users specified that societal involvement should support crisis communication and risk communication when a wildfire occurs. They also emphasized that the involvement must not impede wildfire response activities. This is why Citizen Engagement Program is focused on proper behavioural patterns. It is to ensure that a citizen will be able to handle with a wildfire situation on its own with no or strongly limited negative influence on firefighting and other elements of wildfire response domain.

Lesson Learnt 45. ***Workshop session to familiarise with solutions related to societal involvement.***
Workshop session is said to be the most effective way to familiarise with solutions related to societal involvement. Every participant should be able to personally use every solution related to societal involvement (when a such kind of involvement is expected in the project).

Example:

Citizen Engagement App is designed to be used personally by pilot participants (citizens). Software-based workshop sessions should be used to familiarize citizens with this tool.

Lesson Learnt 46. ***References to materials useful for citizens***
Pilot attendees (citizens) should be able to get additional information about solutions related to societal involvement. Pilot owner and/or solution provider is required to ensure access to additional information materials (papers, webpages, leaflets, manuals, etc.) helpful when a participant wants to use the solution on its own also after a pilot.

Example:

Presentation of applications dedicated to citizens should be accompanied by additional information materials. App manuals and webpages seem to be the most valuable to ensure that a citizen can use the app on its own after the pilot.

Lesson Learnt 47. ***Ascribing solutions related to societal involvement to wildfire response phases.***
As project refers to wildfire management phases (Phase A – preparation and pre-planning activities of wildfire response; Phase B – wildfire response; Phase C – reconstruction and recovery), particular solutions related to societal involvement should also refer to these phases. In accordance with presence of external participants, the phases should be explained.

Example:

When conducting Citizen Engagement Program, implementers need to be clear about how particular behavioural patterns work on particular phases of wildfire management.

5.2 Lessons learnt concerning process of a pilot organisation.

Process of a pilot organisation refers to an organisational dimension of a pilot. It means a way in which multiple resources (human resources, infrastructure, equipment, information, etc.) should be connected to effectively conduct a pilot and achieve the project objectives.

Technological pilot

Lesson Learnt 48. ***Efficient agenda of a technology pilot***

From the viewpoint of technology use, a technological pilot must be organised efficiently. It is generally expressed in its agenda. The first look on the agenda generally allows to internally answer a question whether technologies will be presented/tested/evaluated effectively, relatively quick, rationally and economically.

Example:

All items of agenda in UGV pilot reflected the need to shape the pilot background, to make demonstrations and to discuss demonstrations' results. There were no additional points covering time slots with no direct relation to merit content of the pilot.

Lesson Learnt 49. ***Rational time breaks during a technology pilot.***

Time breaks during a technology pilot should reflect both rigors of technology demonstration activities and cognitive potential of pilot participants. It is a good practice to make 2 short breaks and 1 long break when demonstration activities take a one day. Overall demonstration time should not exceed 8 hours.

Example:

Demonstration day in UGV pilot consists in 8 technology field demonstrations (mobile ground humidity sensing, IoT static smoke detection, autonomous exploration with mobile smoke detection, autonomous navigation and forest analytics, two-robot mid-run map sharing, third robot start-of-map sharing, waypoint control of 3 robots simultaneously and return-to-start with progressive obstacle avoidance) and output description. Overall time of these activities was assumed on 8 hours. 3 beaks were planned: 1 tea break + 1 lunch break + 1 tea break.

Lesson Learnt 50. ***Appointment of a person to watch technological pilot agenda.***

To meet time rigours and respect pilot participants, a person to watch technological pilot agenda and time schedule needs to be appointed. This person should be able to foresee duration of unexpected technological issues and to adjust a pilot timetable to the pilot proceeding.

Example:

When demonstrating ground robots, a moderator was a representative of the technology provider and the pilot owner. Moderator knew specifics of the technology presented. Moderator was able to flexible manage pilot timetable to achieve pilot objectives in time assumed regardless of technological problems that occurred.

Lesson Learnt 51. ***Efficient division of a technological pilot modules***

Efficient division of a technological pilot modules makes chances for effective pilot. The good practice is to divide the essential pilot content to three parts: 1. Theoretical introduction; 2. Field tests; 3. Debriefing. Theoretical introduction shapes background for the field tests. The debriefing allows to discuss the tests' results. In addition, the debriefing should base on data collected during field tests. Thanks to this, it could be easier to explain and understand what was happened during a test.

Example:

As far as UGV-related pilot is concerned, it was divided into these three parts (1. Theoretical introduction; 2. Field tests; 3. Debriefing) respectively to three days of the pilot duration. Thus, it was relatively easy to focus on a particular day and expectations to pilot activities. Activities conducted during second day and third day based on outputs from a previous day.

Lesson Learnt 52. ***Interoperability between technology pilot scenarios***

Interoperability between pilot scenarios is very welcome to highlight interoperability and relationships between technologies, tools, functionalities and users' needs. All of them should be coherent.

Example:

When testing SILVANUS dashboard, it was valuable to feed the system by output from field tests. In particular, measurement results from thermal cameras and smoke detectors were noticed and geolocated on the dashboard map. This stated a pilot scenario more realistic and accurate from the viewpoint of end-user.

Lesson Learnt 53. ***Technological scenario continuity despite of interoperability risks***

As far as the interoperability in a technological pilot is concerned, it is a need to be prepared for difficulties in ensuring it (for instance when a technology is not efficient enough or does not work at all). Thus, business continuity standards are welcome to reduce relevant risks.

Example:

SILVANUS dashboard is strongly dependent on output from technology demonstrations. To face a risk related to situation in which some tool does not work properly to achieve representative package of data, pre-collected data is required to ensure the pilot continuity.

Lesson Learnt 54. ***Sharing documents in technological pilot organisation***

Technological pilot organisation typically bases on documentation which consists on (i.e.) Description of Action, Operational Readiness Templates, preliminary effectiveness assessment reports, technology manuals, case studies of technology use, technology operational reports, technology evaluation tests, etc. Some of them should be chosen and shared among pilot participants to make a common picture on what is going to be done during a pilot.

Example:

When organising a technology pilot, pilot owner, technology providers and project partner responsible for pilot effectiveness assessment need to work on the same documentation. In SILVANUS circumstances all project partners (including pilot owner, technology providers and project partner responsible for a pilot effectiveness assessment) have equal access to Description of Action, pilot operational readiness documentation and formal assessment methodology to systemically evaluate the effectiveness of pilot demonstration activities (with annexes). Thanks to this, crucial organisers have the same viewpoint on a pilot.

Lesson Learnt 55. ***Registration list to a technological pilot***

Pilot owner should know who is going to attend to a pilot (name, entity represented, role in the project, role in a pilot). Registration list should be accessible at least 1 month before pilot date to make enough time for security and logistics issues. It is especially important for technology providers who may need to take additional steps to transport technological tools as well as for pilot owner. The second one could design pilot scenario based on technologies physically accessible on the field.

Example:

In case of pilots organised in different continents, there were 2 months for registration. However, demonstration dates were known even earlier. This allowed to make logistical decisions in proper time to buy tickets and book accommodation in reasonable prices. Also, security procedures were fully carried out.

Lesson Learnt 56. ***Preparation for technology pilot conditions***

Technology may be demonstrated in field conditions. It is valuable from a practical point of view, but it is necessary to ensure that each participant is protected from dangerous, harmful and burdensome factors. Personal and other protective equipment should be distributed (e.g. helmets, gloves, goggles, shoes, caps, sunscreen, insects repellent, drinking water, etc.). Protective equipment should be adapted to the expected demonstration conditions. Some reserves should also be collected and kept ready-to-use.

Example:

Technology pilot was organised in harmful weather conditions (intensive sun shining, high temperature) and in area where dangerous animals live (including deadly venomous snakes and spiders). Pilot owner ensured drinking water, caps, sunscreen, and insects repellent. To reduce work risk related to dangerous animals, testing field was marked and checked as well as information leaflets were given out to attendees.

Lesson Learnt 57. ***User requirements identified before a technology pilot.***

The main objective of a technology pilot is to verify technological tools in the light of user requirements. Verification process will be more effective when based on pre-defined user requirements.

Example:

Technology-related user requirements were generally identified in the project proposal. In addition, they were specified during the first months of the project realisation. Project consortium made transition of user requirements into technology objectives and key performance indicators to be checked during a technology pilot accordingly to a pilot effectiveness assessment and user satisfaction survey.

Lesson Learnt 58. ***Technology pilot effectiveness as a derivative of project coordination and communication***

Pilot owner should coordinate the pilot organisation. Task leader needs to support pilot owner in the coordination process respecting relevant task scope as well as technology providers to effectively match end-user requirements. Work package leader is obligated to coordinate entire process of pilot organisation in the project. These relations should be noticed also in communication processes.

Example:

Work package leader and task leader should be present or represented during a technology pilot to make sure that the pilot ascribes effectively to project assumptions and works on project success. It is especially important in case of technological functionalities which should address end-user requirements.

Organisational pilot

Lesson Learnt 59. ***Efficient agenda of an organisational pilot***

From the viewpoint of familiarisation with organisational solutions, an organisational pilot must be organised efficiently. It is generally expressed in its agenda. The first look on the agenda generally allows to internally answer a question whether the solutions will be presented/discussed effectively, relatively quick and rationally.

Example:

When demonstrating organisational solutions related to wildfire reconstruction and recovery, the pilot agenda consisted logically connected semi-demonstrations on different fields. Attendees were able to check some theoretical issues in practice (on peatland underground fire, in bush) which proved that relevant solutions work.

Lesson Learnt 60. ***Rational time breaks during an organizational pilot.***

Time breaks during an organisational pilot should reflect both presentation of organisational solutions and cognitive potential of pilot participants. It is a good practice to make 2 short breaks and 1 long break when demonstration activities take a one day. Overall demonstration time should not exceed 8 hours.

Example:

Demonstration day dedicated to peat forest management practices considered several visitations in multiple places. Meals were served during travel breaks.

Lesson Learnt 61. ***Appointment of a person to watch organisational pilot agenda.***

To meet time rigours and respect pilot participants, a person to watch organisational pilot agenda needs to be appointed. This person should be able to foresee duration of unexpected organisational issues and to adjust a pilot timetable to pilot proceeding.

Example:

When participating in conference (which was integral part of organisational pilot), a moderator was a representative of the pilot owner. Moderator knew pilot agenda and time limitations. Moderator was able to flexible manage the agenda to achieve pilot objectives in time assumed.

Lesson Learnt 62. ***Interoperability between organisational pilot scenarios***

Interoperability between pilot scenarios is very welcome to highlight interoperability and relationships between organizational good practices and users' needs. All of them should be coherent. In addition, interoperability between the scenarios may build layers to seek for synergy effect in wildfire management.

Example:

Analysis of water management techniques in connection to wildfire management procedures allowed to highlight that fire defence lines may be built on the base of drainage ditches. In turns the drainage ditches should be marked respectively for facilitating building defence lines in case of a wildfire.

Lesson Learnt 63. ***Sharing documents in organisational pilot organisation***

Organisation of a pilot, which bases on organisational solutions, typically bases on documentation consisting of (e.g.) Description of Action, Operational Readiness Templates, preliminary effectiveness assessment reports, case studies on use of organisational solutions, research papers, operational reports, etc. Some of them should be chosen and shared among pilot participants to take a common picture on what is going to be done during a pilot.

Example:

When organising a pilot which bases on organisational solutions, pilot owner, solution providers (project partners and/or external experts) and project partner responsible for a pilot effectiveness assessment need to work on the same documentation. In SILVANUS circumstances all project partners (including pilot owner, solution providers and project partner responsible for a pilot effectiveness assessment) have equal access to Description of Action, pilot operational readiness documentation and formal assessment methodology to systemically evaluate the effectiveness of pilot demonstration activities (with annexes). Thanks to this, crucial organisers have the same view on a pilot. However, when expecting support from external experts, there is a need to make documentation excerpts for them to ensure that critical data and information about the project are shared and secured.

Lesson Learnt 64. ***Registration list to an organisational pilot***

Pilot owner should know who is going to attend to a pilot (name, entity represented, role in the project, role in a pilot). Registration list should be accessible at least 1 month before pilot date to make enough time for logistics and security issues.

Example:

In case of pilot organised in Europe, there was 1 month for registration. This allowed to make logistical decisions in proper time to buy tickets and book accommodation in reasonable prices.

Lesson Learnt 65. ***Preparation for organisational pilot conditions***

Organizational pilots typically take place in comfortable inside conditions. When outside activities are planned, pilot participants need to be prepared for it. The protection means should be adjusted to forecasted demonstration conditions. Some reserves need to be collected and ready-to-use as well.

Example:

Pilot was organised in harmful weather conditions (rain, low temperature). Pilot owner ensured hot drinks, additional meal and raincoats. There was a bus for people who wanted to stay warm during overall time of demonstrations.

Lesson Learnt 66. ***User requirements identified before an organisational pilot.***

The main objective of an organisational pilot is to verify organisational solutions in the light of user requirements. Verification process will be more effective when based on pre-defined user requirements.

Example:

Organisationally related user requirements were generally identified in the project proposal. In addition, they were specified during the first months of the project realisation. They are to be checked during an organisational pilot accordingly to a pilot effectiveness assessment.

Lesson Learnt 67. ***Organisational pilot effectiveness as a derivative of project coordination and communication***

Pilot owner should coordinate the pilot organisation. Task leader needs to support pilot owner in the coordination process respecting relevant task scope. Work package leader is obligated to coordinate entire process of pilot organisation in the project. These relations should be noticed also in communication processes.

Example:

Work package leader and task leader should be present or represented during organisational pilot to make sure that the pilot ascribes effectively to project assumptions and works on project success. It is especially important in case of organisational functionalities which should address end-user requirements.

Lesson Learnt 68. **Effective communication, providing information during demonstrations.**

Pilot participants need to be continuously informed about what is happening (what will be demonstrated, who will demonstrate what, safety rules to be reminded, where they are supposed to go), and any possible changes to the agenda. The lack of such information reduces the situational awareness of participants and make difficult effective implementation of the pilot's objectives. This may also cause that participants will be distracted by something unimportant, disperse or miss some element of the agenda.

Example:

During the demonstration, the owner pilot said what was going on, where participants should go, what stage of the exercise was and give clear instructions.

Lesson Learnt 69. **Organisational team**

To ensure efficient coordination of the demonstration, pilot owner organisational team should consist of at least 3 people with assigned areas of competence. One person cannot be responsible for logistical and organisational matters (including contacts with participants) because this may lead to information overload, failure to provide necessary information to participants, and forgetting about important aspects.

Example:

The organisational team of pilot owner consisted of people who were assigned specific tasks and responsibilities, for example: transfers/transport of participants, ongoing assistance to participants (providing minor organisational information), logistics and technical aspects of the demonstration (providing equipment, marking the exercise site, setting up tents, chairs, tables), collecting applications and making reservations, providing catering/food, technical assistance during presentations.

Pilot related to societal involvement.

Lesson Learnt 70. ***Efficient agenda of a pilot related to societal involvement.***

From the viewpoint of shaping societal involvement, a relevant pilot must be organised efficiently. It is generally expressed in its agenda. The first look on the agenda generally allows to internally answer a question whether the solutions will be presented/discussed effectively and relatively quick. It is worth considering organising parallel sessions, parts of the demonstrations dedicated to profiled participants.

Example:

Time of presentation of Citizen Engagement App should be optimal: to make sure that every participant is able to use the app in practice on its own and to shorten the presentation as much as possible. Extra time may be added to answer questions asked by participants.

Lesson Learnt 71. ***Rational time breaks during a pilot related to societal involvement.***

Time breaks during a pilot related to societal involvement should reflect presentation of solutions, cognitive potential of pilot participants and time restrictions for presence of external users in demonstration premises (for example due to security issues). It is a good practice to make 2 short breaks and 1 long break when demonstration activities take a one day. Overall demonstration time should not exceed 8 hours.

Example:

Time breaks during a pilot dedicated to involving society members should allow to get a rest after practical use of solutions (especially when a significant cognitive load to attendees is expected). Good practice is to divide overall presentation on modules. Each module should consist in theoretical part and practical part. Time slots between particular modules are natural breaks to be noticed in pilot agenda.

Lesson Learnt 72. ***Interoperability between scenarios which constitute a pilot related to societal involvement.***

Interoperability between pilot scenarios is very welcome to verify a coherence between ways of societal involvement and users' needs. It is especially important to check whether people behave in a line of wildfire response (for instance citizens will not disturb to firefighters). Because of relatively high level of operational risk, pilot scenario should be resilient from any unexpected outcomes from societal involvement.

Example:

Scenarios should be connected in a process. Each of them needs to be ready to initiate regardless of outcome of previous scenario. Thus, relatively general process division is required. One of the trusted solutions is a disaster management process (prevention, preparing, response, reconstruction and recovery).

Lesson Learnt 73. ***Sharing documents in a pilot related to societal involvement.***

Pilot related to societal involvement typically bases on documentation consisting of (i.a.) Description of Action, Operational Readiness Templates, preliminary effectiveness assessment reports, case studies on use of organizational solutions, research papers, operational reports, statistical reports, surveys, etc. Some of them should be chosen and shared among pilot participants to put all in the same page on what is going to be done during a pilot.

Example:

When organising a pilot which bases on societal involvement, pilot owner, solution providers (project partners and/or external experts) and project partner responsible for a pilot effectiveness assessment need to work on the same documentation. In addition, citizens (which are also the pilot participants) must have a short information about the pilot. Firstly, all project partners (including pilot owner, technology providers and project partner responsible for a pilot effectiveness assessment) have equal access to Description of Action, pilot operational readiness documentation and formal assessment methodology to systemically evaluate the effectiveness of pilot demonstration activities (with annexes). Thanks to this, crucial organizers have the same view on a pilot. However, when expecting support from external experts, there is a need to make documentation excerpts for them to ensure that critical data and information about the project are secured. Secondly, a general view on a pilot may be shared among citizens in a form of a detail agenda and/or a short description of a pilot (including pilot background and objectives).

Lesson Learnt 74. ***Registration list to a pilot related to societal involvement.***

Pilot owner should know who is going to attend to a pilot (name, entity represented, role in the project role in a pilot). Registration list should be accessible at least 1 month before pilot date to make enough time for logistics issues. Additional time may be needed when local security issues determine making access for external participants (citizens).

Example 1:

In case of pilot organised in Europe, there was 1 month for registration. This allowed to make logistical decisions in proper time to buy tickets and book accommodation in reasonable prices.

Example 2:

A pilot which bases on societal involvement may be done in hybrid formula (onside and with the use of Internet communicators). This simplifies the registration process and shortens the registration time for online attendees.

Lesson Learnt 75. ***User requirements identified before a pilot related to societal involvement.***

The main objective of a pilot related to societal involvement is to verify involvement tools in the light of user requirements. Verification process will be more effective when based on pre-defined user requirements.

Example:

User requirements were generally identified in the project proposal. In addition, they were specified during the first months of the project realisation. They are to be checked during an organisational pilot accordingly to pilot effectiveness assessment.

Lesson Learnt 76. ***Effectiveness of a pilot related to societal involvement as a derivative of project coordination and communication.***

Pilot owner should coordinate the pilot organisation. Task leader needs to support pilot owner in the coordination process respecting relevant task scope. Work package leader is obligated to coordinate entire process of pilot organisation in the project. These relations should be noticed also in communication processes.

Example:

Work package leader and task leader should be present or represented during pilot related to societal involvement to make sure that the pilot ascribes effectively to project assumptions and works on project success. It is especially important in case of objectives and key performance indicators concerning societal involvement and proper understanding of the involvement.

5.3 Lessons learnt concerning infrastructure, equipment and tools.

Infrastructure, equipment and tools refer to pilot techno-sphere. It means resources necessary to organise a pilot in a way to effectively conduct it and to achieve the project objectives.

Technological pilot

Lesson Learnt 77. ***Combined facilities for technological pilot purposes***

Pilot owner should ensure different types of facilities to be sure of conditions for effective evaluation of every functionality. In addition, facilities need to respect multiple kinds of technology presentation and protection against severe weather conditions.

Example:

Facilities of the pilot owner included theatre centre (to present technology background, technology foundations and to discuss technology-related issues), robot rooms/labs (to present robots), hill and orchard (to present some basic robot functionalities) and testing field (to make essential demonstrations). All the facilities were located on the terrain owned by pilot owner.

Lesson Learnt 78. ***Access to spare parts in case of technical problems***

Pilot owner and/or technology provider should ensure access to spare parts to be used in case of technical problems.

Example 1:

Demonstrations of UGV were placed in technology provider premises. There were robot rooms and labs useful in case of any technical problems.

Example 2:

When testing multiple technologies in field conditions (top of the hill in terrain of national park), technology providers were equipped in spare parts and own tools ready to use in case of any technical problems.

Lesson Learnt 79. ***Access to alternative robots and devices***

To ensure technology pilot continuity, an access to alternative robots and devices to be used in case of technical problems is necessary.

Example:

Demonstrations of UGV were placed in premises owned by technology provider. There were robot rooms and labs useful in case of any technical problems. Also, alternative robots and devices were ready to use in case of technical problems during a pilot.

Lesson Learnt 80. ***Intuitive technology dashboard***

Technology dashboard functionally integrates most of UPs. It should be intuitive for relevant users (especially for end-users, such as firefighters).

Example:

There is a need to ensure that names of the layers in the dashboard are easy to interpret. The names should reflect functionalities delivered by UPs rather than the names of them nor technologies staying behind them. Process approach needs to be implemented here (‘when I clicked on this button, I will consequently cause this action’).

Lesson Learnt 81. ***Welcome pack for technological pilot attendee.***

Pilot owner should prepare a welcome pack for technological pilot attendee. The welcome pack needs to be equipped in basic things facilitating participation in a pilot with respect of its technological character and personal safety purposes.

Example:

When visiting pilot field, the welcome pack included sunscreen, water bottle, notebook, safety leaflet and mosquito repel. During essential demonstrations, pilot owner ensured additionally cold drinking water, hats and sunscreen. This set of things reflected current weather and environmental challenges for attendees.

Lesson Learnt 82. ***Multiple equipment for technology presentation***

Pilot owner is obligated to ensure equipment for technology presentation regarding to all functionalities required. Thus, pilot owner should ask technology providers about their technical needs and meet these needs during a pilot.

Example:

Demonstration of UGV was carried out with the access to multiple forms of information presentation. There were robot operating on the field, screens on the field, screens in the lab, PowerPoint presentations (on side and online), MS Teams lectures, terrain visit in rain forest / eucalyptus forest, movies and computer simulations. The good practice was that pilot owner was simultaneously a main technology provider.

Lesson Learnt 83. ***Place for technical improvements and repairing.***

Pilot owner needs to designate a place for technical staff or staff able to make any necessary repairing in case of any technical problems. This place should be relatively close to the test field. However, the repairing activities should not disturb the pilot activities.

Example:

Field demonstrations of UGV were carried out close to robot rooms and service desks. One technical supporter assisted demonstrations all the time ready to make any necessary repairing in case of any technical problems. In addition, pilot owner was prepared to change order of demonstrations in case of technical problems as a way to ensure pilot continuity.

Lesson Learnt 84. ***Technology pilot needs to prove that technology tools work.***

Technology pilot should not serve as a kind of potential presentation of technologies only (what they are, how they work, what are their general functionalities, etc.) but rather to prove that the technologies work in direct relation to user requirements and are able to be used by end-users.

Example:

Field demonstrations of UAV, thermal cameras and UGV were focused on direct support of firefighters in identification of hotspots, lengthening radio communication range and putting out a fire. Every technology had appointed specific firefighting-related task. This ensured that entire pilot was strongly determined by end-user requirements and worked on the project success. In addition, end-users who were taking part in the pilot had opportunities to observe the technologies in practice, also from operational (manual) point of view.

Lesson Learnt 85. ***Relatively short distance to a country where a technological pilot is organised.***
Relatively short distance to a country where a technological pilot is organised increases a chance for presence of many internal and external participants during a pilot. It is determined by project budget and other funding opportunities. It is significantly important especially when technology transport issues are taken into consideration (from/to Europe).

Example:

For European projects, the highest chance to collect a big number of participants is determined by organisation of a technological pilot in European country. In addition, the country should be characterised by proper international communication connections (big airports, short distance to main roads).

Lesson Learnt 86. ***Short distance between technological pilot testing field and urban areas***
Short distance between technological pilot testing field and urban area facilitates organisational issues related to a pilot, including risks related to delays, time for a rest after essential demonstration activities, access to spare parts, possibility to involve local external experts and general logistics.

Example:

Good practice is to use premises owned or used by technology provider. Testing field should be situated near communication lines. In the opposite case pilot owner should ensure transportation means for the purposes of pilot participants.

Organisational pilot

Lesson Learnt 87. ***Facilities for organisational pilot purposes***
Pilot owner should ensure facilities located in a place ensuring protection against severe weather conditions and equipped in multiple kinds of methods for information presentation.

Example:

Conference facilities were ensured for the purposes of workshop organisation. The workshop was aimed at establishing effective communication and collaboration between first responders and UPs of SILVANUS. Semi-round table, set of screens, sound system and basic existential support were sufficient to make conditions proper for making presentations and moderating discussion.

Lesson Learnt 88. ***Preparation for technical problems during organisational pilot***
Pilot owner should be ready to manage any technical problems to ensure conditions to present organisational solutions during a pilot. Thus, access to alternative projectors, computers, electricity sources, screens and sound systems is desired.

Example:

Access to alternative projectors, computers, electricity sources, screens and sound systems during international conference connected to one of organisational pilots allowed to ensure organisational continuity. Thanks to this the pilot proceeded accordingly to preliminary schedule.

Lesson Learnt 89. ***Welcome pack for organisational pilot attendee.***
Pilot owner should prepare a welcome pack for organisational pilot attendee. The welcome pack needs to be equipped in basic things facilitating participation in a pilot with respect of its organisational character.

Example:

When visiting Indonesia, the welcome pack included mosquito repel, raincoat, disinfectant, special shoes, hat and socks. All the time pilot owner ensured additionally cold drinking water. This set of things reflected current weather and environmental challenges for attendees.

Lesson Learnt 90. ***Multiple forms of information presentation during organisational pilot***

Pilot owner should ensure access to multiple forms of information presentation (PowerPoint presentations, screens, MS Teams lectures, discussions, movies, computer simulations) to be sure that pilot participants have many different ways to gain their knowledge on organisational solutions related to user requirements in the project.

Example:

Demonstration of project products in terms of exercises on collaboration and communication between wildfire responders was carried out with the access to multiple forms of information collection and presentation. There were screens in the conference room, PowerPoint presentations, lectures, discussions and tabletop exercises.

Lesson Learnt 91. ***Relatively short distance to a country where an organisational pilot is organised.***

Relatively short distance to a country where an organisational pilot is organised increases a chance for presence of many internal and external participants during a pilot. It is determined by project budget and other funding opportunities. If an organisational solution cannot be presented in a good-transportation-connected country, there should be the closes country. In addition, it is desirable for pilot owner to ensure transport capabilities for pilot participants.

Example:

From practical point of view, presentation of solutions concerning wildfire management in rain forests was impossible in European country. This is why relevant demonstration was placed in Indonesia. Pilot owner ensured full support accordingly to transportation (detail transportation agenda, content persons on airports, accompanying staff members during all the pilot time, checking in/out hotels, checking in airports, getting boarding passes, internal communication channel on WhatsApp). Every participant was taken care of pilot owner and knew what/where/when/how to do.

Lesson Learnt 92. **Static exhibition of vehicles and equipment**

It is worth highlighting that pilot participants may organise static exhibition of vehicles and equipment used by the pilot's local partners, end-users and first responders. This enables the exchange of knowledge on the use of equipment and technologies and to obtain interesting recommendations.

Example

Pilot owner organised a visit to the local fire brigade station, so that participants could meet and discuss with local end-user/first responders and familiarise themselves with the vehicles, equipment used for the exercises. An opportunity was also created to learn about the parameters and functionalities of the equipment.

Pilot related to societal involvement.

Lesson Learnt 93. ***Facilities for the purposes of pilot related to societal involvement.***

Pilot owner should ensure facilities located in a place ensuring protection against severe weather conditions and equipped in multiple kinds of methods for information presentation. These facilities should be

adequately roomy to accommodate external participants. If it is technologically possible and practically justified, hybrid formula of a pilot is acceptable.

Example:

When considering societal involvement to the pilot, the pilot owner provided tents and benches as well as Wi-Fi access for mobile devices. They were dedicated for external attendees who required place and Internet connection to be involved in the pilot.

Lesson Learnt 94. ***Preparation for technical problems during pilot related to societal involvement.***

Pilot owner should be ready to manage any technical problems to ensure conditions to effectively involve society representatives in project topics and actions during a pilot. Thus, access to alternative projectors, computers, electricity sources, Internet connectors, screens and sound systems is desired. Just like alternative ways of participants' verification (in access control posts).

Example:

During the pilot, pilot owner provided sufficient number of alternative generators and external screens to ensure societal involvement possibilities in field conditions regardless of technical problems.

Lesson Learnt 95. ***Simple forms of information presentation during pilot related to societal involvement.***

Pilot owner should ensure access to simple forms of information presentation. There could be PowerPoint presentation, screen, MS Teams lecture, discussion, movie, computer simulations etc. The crucial thing is to use 1-3 forms maximum to be sure that pilot participants (especially citizens) gain their knowledge directly regarding to project assumptions.

Example:

Presentation of Citizen Engagement App to external users (citizens) should base mainly on the app and its practical use. Any additional forms of information presentation should only help in understanding how to use the app in practice. Details about its technological assumptions are undesirable in accordance to cognitive load to the users.

Lesson Learnt 96. ***Societal involvement in a country where relevant pilot is organised.***

When societal involvement assumes engaging people from specific social group, it is desirable to organise relevant pilot in country where this group lives. It may be reasonable from the perspective of transportation and legal requirements. This lesson learned does not concern a pilot which is organised on the base of hybrid formula nor online formula.

Example:

Pilot owner invited representatives of local community which live in bush to describe local wildfire conditions and place of a fire in the community culture. This allowed to shorten a line between local expectations and view and the project output (products).

Lesson Learnt 97. ***Good communication connection between place of a pilot related to societal involvement and urban areas.***

Good communication connection between place of a pilot related to societal involvement and urban areas facilitates organisational issues related to a pilot, including risks related to delays, time for a rest after essential demonstration activities, possibility to involve local external experts and general logistics. The connection is also crucial in the context of involvement of citizens. This lesson learned is valid in case of onside pilot activities and is not valid for hybrid/online formula of a pilot.

Example:

Exhibition of posters related to the project (as a kind of a pilot) located on one of the main routes in tourist city affected by wildfires increased chances to familiarize relatively high number of people with wildfire management good practices and the project assumptions.

5.4 Lessons learnt concerning staff preparedness to a pilot.

Staff preparedness refers to social sphere of pilot organisation. It means how staff related to a pilot (pilot owner, project partners, external participants) are ready to conduct a pilot in a way sufficient to ensure project objectives.

Technological pilot

Lesson Learnt 98. ***Sufficient quality of staff during a technological pilot***

Pilot owner, technology providers, work package leader and task leader (or their representatives), at least one pilot observer, external end-users and external experts are very welcome during a technological pilot.

Example:

Technological pilot focused on technology support of firefighters gathered representatives of pilot owner, technology providers, work package leader and task leader, pilot observer, external end-users (firefighters) and external experts (forest service and public administration) during essential demonstrations. Every group has assigned a specific role and collected experiences in association to their expectations and needs related to pilot. During and after essential demonstrations there were possibilities to share thoughts and ideas specific for different perspectives of different users.

Lesson Learnt 99. ***Sufficient quantity of staff during a technological pilot***

Number of staff members involved in a technology pilot activity should be sufficient to ensure proper operation of technological tools, technical support, moderation and collecting information from different perspectives (of different staff members and roles they play during a pilot).

Example:

When a kind of equipment was used, there was an expert ready to answer all the equipment-related questions (including in-depth analysis of the equipment functionalities, construction, limitations, and operational potential).

Lesson Learnt 100. ***A team ready to support in case of technical problems during a technological pilot.***

It is a need to ensure a team ready to support in case of technical problems during a technological pilot. When a pilot owner is simultaneously a technology provider, relevant staff members may be appointed. When a technology provider participates in a pilot as a guest, relevant staff members should be ready for making any maintenance activities in case of necessity.

Example:

The good practice is to send representatives of technology providers to take part in a pilot – representatives who are able to make maintenance activities in case of necessity (at least in a scope necessary to prove that functionalities required in the project assumptions work). The next good practice is to send two representatives – the first one for technology presentation and the second one for technical support.

Lesson Learnt 101. ***Staff dedicated to report a technology pilot.***

Technology pilot should be reported for the purposes of project documentation, dissemination, monitoring and effectiveness assessment. There should be staff dedicated to such reporting activities as making pictures/movies and preparing reports. The good practice is to ascribe documentation-related activities to people involved directly to the project to ensure that the documentation meets project quality requirements. In turns pictures and recordings should be made by a person who knows technologies presented (to ensure that the pictures and movies may be used for technology improvements).

Example:

There was a staff member to document technological pilot activities by making photos and movies. The photos were used to support relevant documentation and project newsletter. The movies were used for dissemination of the project and the pilot owner (technology provider). All of them are ready to serve for technology improvements.

Lesson Learnt 102. ***Local stakeholders prepared for questions from external stakeholders during a technological pilot.***

It is important to prepare local stakeholders on discussions on the pilot-related topics (to be aware that project stakeholders may ask them about the pilot-related issues). Specific questions may concern implementation potential of technologies presented, local determinants of the implementation, local needs and expectations, etc.

Example:

Before presentation of wildfire modelling tools, presenter should bear in mind that project stakeholders may ask questions on the tools implementation potential and possibilities to use referring to project assumptions. Basic knowledge about the project is desirable.

Organisational pilot

Lesson Learnt 103. ***Sufficient quality of staff during an organisational pilot***

Pilot owner, solution providers, work package leader and task leader (or their representatives), at least one pilot observer, external end-users and external experts are very welcome during an organizational pilot.

Example:

Organisational pilot aimed at presentation of good practices on forest restoration and wildfire management based on involvement of multiple participants. There were pilot owners, solution providers, task leaders, pilot observers, external end-users (forest service, disaster management) and external experts (from local authorities and academia). This worked on multiple possibilities to confront different experiences and approaches in a way allowing to achieve project objectives.

Lesson Learnt 104. ***Sufficient quantity of staff during an organisational pilot***

Number of staff members involved in an organisational pilot activity should be sufficient to ensure proper presentation and discussion on organisational solutions, technical support, moderation and collecting information from different perspectives (of different staff members and roles they play during a pilot).

Example:

A big number of online tools facilitate to automatize at least some of organisational issues regarding the pilot. This allows to limit a total number of staff members to be involved in the pilot organisation.

Lesson Learnt 105. ***A team ready to support in case of problems during an organizational pilot.***
It is a need to ensure a team ready to support in case of technical problems during an organisational pilot. Its role is typically limited to watch on correctness of information visualization and sound system operation. The team may be also involved to ensure proper microclimate conditions (for example air conditioning) and access to basic goods (drinks, food, electricity, etc.).

Example:

When organising conference (which was integrated to organisational pilot), there was team dedicated to support in case of any problems (technical ones and organisational ones). The team was appointed from staff members of pilot owner and was in close contact to owner of place where the conference was organised.

Lesson Learnt 106. ***Staff dedicated to report an organisational pilot.***
Organisational pilot should be reported for the purposes of project documentation, dissemination, monitoring and effectiveness assessment. There should be staff dedicated to such reporting activities as making pictures/movies and preparing reports. The good practice is to ascribe documentation-related activities to people involved directly to the project to ensure that the documentation meets project quality requirements.

Example:

There was a staff member to document organisational pilot activities by making photos and movies. The photos were used to support relevant documentation and project newsletter. The movies were used for dissemination of the project and the pilot owner (academia).

Lesson Learnt 107. ***Local stakeholders prepared for questions from external stakeholders during an organisational pilot.***
It is important to prepare local stakeholders on discussions on the pilot-related topics (to be aware that project stakeholders may ask them about the pilot-related issues). Specific questions may concern implementation potential of organisational solutions presented, local determinants of the implementation, local needs and expectations, advantages and disadvantages related to the solutions, solutions correspondence to user requirements specified in the project, etc.

Example:

Before presentation of local good practices on wildfire management, presenter should bear in mind that project stakeholders may ask questions on the god practices implementation potential and possibilities referring to project assumptions. Basic knowledge about the project is desirable.

Pilot related to societal involvement.

Lesson Learnt 108. ***Sufficient quality of staff during a pilot related to societal involvement.***
Pilot owner, solution providers, work package leader and task leader (or their representatives), at least one pilot observer, external end-users and external experts are very welcome during a pilot related to societal involvement. Participation of citizens (or at least their representatives) is mandatory.

Example:

Presence of pilot owner, solution providers, work package leader and task leader, pilot observer allowed to be sure that pilot went as it had been planned. This facilitates to achieve a high level of the pilot

effectiveness (these attendees supported pilot owner in the pilot organisation and proceeding according to the project assumptions).

Lesson Learnt 109. ***Sufficient quantity of staff during a pilot related to societal involvement.***
Number of staff members involved in a pilot activity should be sufficient to ensure proper presentation and discussion on organizational solutions, technical support, moderation and collecting information from different perspectives (of different staff members and roles they play during a pilot). Number of citizens engaged should correspond to Key Performance Indicators in the project.

Example:

Poster promotional campaign based on steady poster exhibition located on the main street in the biggest port city in the country. Form of the exhibition did not require direct access to technical support team.

Lesson Learnt 110. ***A team ready to support in case of problems during a pilot related to societal involvement.***
It is a need to ensure a team ready to support in case of technical problems during a pilot related to societal involvement. Its role is typically limited to watch on correctness of presentation tools and technical conditions during a pilot (for example access to electricity, access to Internet).

Example:

When presenting Citizen Engagement App onside, there should be a person or a team to support participants in case of problems with Internet connection or other technical problems (in terms of mobile settings, etc.).

Lesson Learnt 111. ***Staff dedicated to report a pilot related to societal involvement.***
Pilot related to societal involvement should be reported for the purposes of project documentation, dissemination, monitoring, effectiveness assessment and further societal involvement. There should be staff dedicated to such reporting activities as making pictures/movies and preparing reports. The good practice is to ascribe documentation-related activities to people involved directly to the project to ensure that the documentation meets project quality requirements. In addition, when societal involvement is not onside (for example is online formula), there are generally opportunities to automatize reporting activities (at least some of them – for example counting of users).

Example:

As far as IT solutions are concerned, a person with IT background is crucial to ensure societal involvement continuity and technical support of external users (so called *help desk*).

5.5 Major outputs from lessons learnt from piloting activity in Trial period 1

The lessons learnt from various pilot projects offer valuable insights into the complexities and challenges of implementing innovative solutions in real-world scenarios. Across technological, organizational, and societal pilot initiatives, several recurring themes emerge, underscoring the importance of careful planning, adequate preparation, and robust support mechanisms.

Firstly, the significance of providing suitable facilities and resources cannot be overstated. Whether it's ensuring technical equipment for demonstrations, providing amenities for participants, or offering

adequate communication infrastructure, the availability of these resources lays the groundwork for successful pilot implementation.

Secondly, preparedness for technical challenges is crucial. Pilots often encounter technical issues that can disrupt activities, highlighting the need for contingency plans, access to alternative equipment, and technical support teams capable of addressing problems promptly.

Thirdly, the importance of effective communication and information presentation cannot be overlooked. Whether engaging end-users, stakeholders, or citizens, clear and accessible communication channels, coupled with simple forms of information presentation, are essential for fostering understanding and engagement.

Furthermore, tailoring pilot activities to the local context and engaging relevant stakeholders are critical for ensuring relevance, effectiveness, and sustainability. This includes considering societal dynamics, cultural nuances, and the specific needs of target communities when designing and executing pilot initiatives.

Lastly, having a dedicated and qualified team is vital for the success of any pilot project. From project owners and solution providers to technical support staff and documentation teams, the collective expertise and commitment of these individuals play a significant role in driving the pilot's objectives forward.

In conclusion, the lessons learned from these pilot projects serve as valuable guiding principles for future endeavours pilots and implementations. By applying these insights and best practices, stakeholders can navigate the complexities of pilot implementation more effectively.

6 Project performance assessment

After assessing SILVANUS UPs and their supporting pilots during Trial Period 1, it is time to evaluate the project as a whole, regarding project objectives and how they are being addressed in quantitative terms.

Once again, the level of achievement of a project objective is measured by KPIs, which in this case were defined in the DoA. In the following sub-sections, an image of the state of the outcomes of the project will come before one's eyes.

The following tables present a part extracted from the DoA, formatted in italic. On the right side, one indicates the actual status, by a calculation of the sum of all the values of the KPI in reference, considering all pilots where it is mentioned, in Sections 4._.2 and the set of actions to be taken. The calculation considered is the following, where Measurement result -ex post (MR) and Estimation result-ex ante (ER) can assume the values in Table 22 (0, 0.3,0.5,0.7 and 1):

$$\sum[MR] \text{ out of } \sum[ER]$$

Assuming ER= "-" to be 1.

Project objectives assessment

The tables in this section refer to SILVANUS consortium commitment in going beyond the state-of-the-art in all phases of wildfire's issue. The several project objectives have associated KPI that will help illustrating how the objective was fulfilled.

The values consider only pilots' contributions, but further transversal tasks work (e.g. from Task 3.5 - Citizen engagement programme for preventing wildfires) is expected to add value to the total KPI at the end of the project.

One considers good progress if the respective KPI is above 75%.

Phase A [Prevention and Preparedness] – Objectives

PA1: Environmental and ecological mapping and assessment of forest regions within project demonstrations		
KPI from DoA		Trial Period 1 status
KPI_{PA1-1}	*47,504x104 sq. meters of area analysed and mapped*	5.9 out of 6.8, or 86.76% applied to 8 pilots. The progress indicated is very positive and the inclusion of the Portuguese pilot in Trial Period 2, where large areas' image recognition took place will further increase this ratio.
KPI_{PA1-2}	*At least 15 regional demonstration sites to be analysed within the project from eight (8) EU and three (3) non-EU countries.*	7.3 out of 8.5, or 85.88% applied to 10 pilots. During this period, a total of 10 demonstration sites took place in seven (7) EU countries and two (2) non-EU countries
KPI_{PA1-3}	*> than 4 forest models' adaptations to be studied and reviewed for ecological impact assessment*	No pilot contributed to this KPI, yet.

PA2: Development of a semantic framework to formalise the stakeholder involvement in sustainable forest management		
KPI from DoA		Trial Period 1 status
KPI$_{PA2-1}$	*At least three (3) publications to promote the extension of Agriculture and Forestry Ontology to model wildfire events resulting from common causes*	No pilot contributed to this KPI, yet.
KPI$_{PA2-2}$	*Based on the recently established ontology evaluation metrics from Ontology Summit'13[14]: (a) Satisfy at least 75% of qualitative ontology evaluation metrics; (b) Achieve at least 5% over the baseline for quantitative ontology evaluation indicators.*	No pilot contributed to this KPI, yet.

PA3: Development of fire danger index profile management system based on environmental, ecological and biodiversity models		
KPI from DoA		Trial Period 1 status
KPI$_{PA3-1}$	*Modelling of seasonal weather forecast models for at least three (3) transitional seasons from eight (8) EU and three (3) non-EU regions.*	1.4 out of 1.7, or 82.35% applied to 2 pilots. Although the KPI value is high it was not obtained in the context defined since only two (European) countries contributed to it. In the next trial, one will need to work on this point, having guaranteed that the Portuguese Pilot has already data available, for instances.
KPI$_{PA3-2}$	*Interfaces established with at least four (4) external earth observation data repositories and global climate repositories*	0.7 out of 1, or 70% applied to 1 pilot. This indicator may improve in both value and sources by expansion of UPs and demonstrations of new sites (e.g. Portuguese)
KPI$_{PA3-3}$	*Development of fire danger index to be customised for at least 3 forest model categories based on spatial-temporal distribution of vegetation and biodiversity constraints.*	0.7 out of 1, or 70% applied to 1 pilot. The UP2b has already started data collection to expand the product from the actual in Puglia (Italy 2) to the Sardinia (Italy 1) and Cova da Beira (Portugal) sites

PA4: Implement Culture of risk prevention among project stakeholders and preparedness campaign on fire danger index and preparedness announcements		
KPI from DoA		Trial Period 1 status
KPI$_{PA4-1}$	*Social media engagement for forest management authorities, landowners, public authorities and visitors of eight (8) pilot sites through at least three (3) platforms.*	4.2 out of 5.1, or 82.35% applied to 6 pilots. This KPI is already accomplished.
KPI$_{PA4-2}$	*Promotion of citizen engagement activities and use of citizen-engagement-toolkit through 500 local authorities.*	4.5 out of 5.7, or 78.95% applied to 6 pilots. An updated plan to reach the mentioned KPI is in place, expanding from the actual 4 to all the pilots.

[14] http://ontologforum.org/index.php/OntologySummit2013

KPI_{PA4-3}	*Extend invitations to external stakeholder advisory group from the list of past projects (refer to Table 3)*	3.5 (3.7) out of 3.5, or 100% (105.71%) applied to 4 pilots. This KPI is already accomplished.
KPI_{PA4-4}	*Citizen-engagement-tool-kit assessment by at least 200 engaged users.*	2 out of 3.4, or 58.82% applied to 4 pilots. Same comment as KPI_{PA4-2}
KPI_{PA4-5}	*At least 2000 members consulted through public forum for the evaluation of public campaign*	0.5 out of 1.0, or 50% applied to 1 pilot. The strategy to reach this KPI is being re-evaluated in WP3.

PA5: Define training activities designed to improve safety and preparedness of firefighters in combating wildfire		
KPI from DoA		Trial Period 1 status
KPI_{PA5-1}	*Training programme will emulate at least five (5) different scenarios for the modelling of wildfires*	2 out of 4, or 50% applied to 4 pilots. An expansion in the number of scenarios is being prepared, especially for UP1a and UP1b. So, this KPI should be reached in Trial period 2.
KPI_{PA5-2}	*A minimum of six (6) training sessions and workshops to be organised for first responders in crisis management and disaster resilience*	4 out of 4.8, or 83.33% applied to 6 pilots. Although the value is high, the consortium plans to schedule other similar training sessions (WP3).
KPI_{PA5-3}	*Invitation to at least 20 external experts will be shared with the community for effectiveness evaluation of the training programme.*	1 out of 1, or 100% applied to 1 pilot. This will be applied to other pilots implementing training courses
KPI_{PA5-4}	*A minimum of 50 first responders and fire fighters to be trained in the usage of SILVANUS platform*	1.3 out of 3, or 43.33% applied to 3 pilots. Scale-up is ongoing for all pilots involving firefighters.

PA6: Provide modelling methodologies of wildfire impact on regional areas		
KPI from DoA		Trial Period 1 status
KPI_{PA6-1}	*Historical data analytics for at least three (3) year period to be analysed for the development of scenarios and impact modelling affected by wildfires across EU regions*	2.9 out of 3.7, or 78.38% applied to 4 pilots. The analysis of data is on-going, namely in WP3 and the KPI should be reached at the end of the project
KPI_{PA6-2}	*Predictive algorithms to be evaluated against the worst-case scenarios of past wildfire events from at least six (6) geographic regions across the world*	No pilot contributed to this KPI, yet.

Phase B [Detection and Response] – Objectives

PB1: Define the conditions for Unmanned aerial vehicles use for fire risk assessment and payload capacity for early response		
KPI from DoA		Trial Period 1 status
KPI_{PB1-1}	*> 15% increase in the flight time compared to the current market*	0.3 out of 1, or 30% applied to 1 pilot. Still in improving stage

	standards based on low-cost on-board data analytics integrated within the platform	
KPI$_{PB1-2}$	*At least 5 additional sensor technologies (based on multi-spectral sensing) integrated within the aerial platform in complement with current market standards*	2.4 out of 4, or 60% applied to 4 pilots. On-going.

PB2: Apply and assess onboard computation of high-speed multi-spectral imaging using neural network compression		
KPI from DoA		Trial Period 1 status
KPI$_{PB2-1}$	*> 20% reduction in the power requirement for computing multispectral image and video sequences*	No pilot contributed to this KPI, yet.
KPI$_{PB2-2}$	*Integration of processing at least 5 different streams of data in parallel for fire detection*	No pilot contributed to this KPI, yet.
KPI$_{PB2-3}$	*A reduction of more than 40% in the false alarm rate for fire detection.*	1 out of 2, or 50% applied to 2 pilots. Still in improving stage

PB3: Introduce Multi-modal big data frameworks for processing earth observation datasets		
KPI from DoA		Trial Period 1 status
KPI$_{PB3-1}$	*Extraction of insights on fire danger index measurement based on objective computation of environmental parameters such as aerosol index, corrected reflectance imagery, land surface reflectance, land surface temperature, weather data and presence of sulphur dioxide*	No pilot contributed to this KPI, yet.
KPI$_{PB3-2}$	*Ingest 13 spectral bands at a global scale with a high revisit frequency rendering it a vital data source for land use land cover monitoring, atmospheric correction & cloud/snow separation*	No pilot contributed to this KPI, yet.
KPI$_{PB3-3}$	*Reduced latency of more than 24% for computation through the adoption of graph modelling and temporal data analytics*	No pilot contributed to this KPI, yet.

PB4: Use and evaluate micro-predictive analytics for modelling granular changes fire patterns		
KPI from DoA		Trial Period 1 status
KPI$_{PB4-1}$	*Computation of millisecond prediction fire behaviour model parameters.*	No pilot contributed to this KPI, yet.
KPI$_{PB4-2}$	*Data processing latency reduced more than 15% on 40msecond frequency*	No pilot contributed to this KPI, yet.

KPI$_{PB4-3}$	*Geospatial mapping of external weather patterns for the identification of high-risk zones*	0.3 out of 1, or 30% applied to 1 pilot. Still in improving stage

PB5: Assess the use of robotic ground vehicles to gather situational intelligence of wildfire behaviour		
KPI from DoA		Trial Period 1 status
KPI$_{PB5-1}$	*> 80% reduction in the deployment of firefighter personnel to the forefront of wildfire*	6.3 out of 7.2, or 87.5% applied to 8 pilots. KPI already reached
KPI$_{PB5-2}$	*> 80% resilience in navigating natural terrain*	2.5 out of 3.4, or 73.53% applied to 4 pilots. Should be achieved in Trial Period2, keeping the actual sites' scale-up rate.
KPI$_{PB5-3}$	*A reduction of more than 15% computational complexity in processing information stream.*	No pilot contributed to this KPI, yet.

PB6: Evaluate the application of wireless sensor network mesh to aggregate distributed sensor data (from aerial and ground vehicles)		
KPI from DoA		Trial Period 1 status
KPI$_{PB6-1}$	*Support for high-speed drones beyond 100m/sec*	No pilot contributed to this KPI, yet.
KPI$_{PB6-2}$	*Datalink connectivity up to 75km and GMSK modulation for narrow band transmissions for distances*	No pilot contributed to this KPI, yet.

PB7: Test advanced protective gear for protection of frontline fighters, embedded with communication services		
KPI from DoA		Trial Period 1 status
KPI$_{PB7-1}$	*At least three (3) supplier solutions to be evaluated for the integration of wearable devices*	1.7 out of 2, or 85% applied to 2 pilots. Still on-going with local procurement processes
KPI$_{PB7-2}$	*Feedback from at least five (5) different suppliers to be obtained.*	0.3 out of 0.7, or 42.86% applied to 1 pilot. Still on-going with local procurement processes

PB8: Apply and evaluate intelligent data modelling to estimate impact on environment, effects on human and disruption to critical infrastructure services for response coordination		
KPI from DoA		Trial Period 1 status
KPI$_{PB8-1}$	*Development of 3D visual interface to be exported to at least two (2) rendering platforms*	0.5 out of 0.5, or 100% applied to 1 pilot. Need to reach one other platform in the same or other pilot. **Note:** the value 100% means it was planned for that pilot to use one platform only
KPI$_{PB8-2}$	*Support for at least four (4) forms of interactive annotations within the 3D visual interface to be offered to the crisis management personnel.*	1 out of 1, or 100% applied to 1 pilot. Scale-up to other pilots to take place in Trial Period 2.

PB9: Development of Crisis management tool

KPI from DoA		Trial Period 1 status
KPI$_{PB9-1}$	*Monitoring of field resources deployed within a 5km distance*	6.2 out of 7.4, or 83.78% applied to 8 pilots. To be repeated in the same pilots during Trial period 2, trying to increase the rate value.
KPI$_{PB9-2}$	*At least 10 forms of alert levels for Phase A, Phase B and Phase C criteria as defined in the requirements*	1.4 out of 2, or 70% applied to 2 pilots. To be further technically developed and also applied to other pilots
KPI$_{PB9-3}$	*Legacy system interface with at least four (4) different modalities (such as APIs, file systems, process integration).*	1 out of 1, or 100% applied to 1 pilot. KPI already reached.

Phase C [Recovery] specific objectives

PC1: Development of biodiversity index for monitoring the effectiveness of restoration and adaptation process		
KPI from DoA		Trial Period 1 status
KPI$_{PC1-1}$	*Self-assessment survey of at least 20 pilot sites from the six (6) member states to model the natural habitat of forest environment*	No pilot contributed to this KPI, yet.
KPI$_{PC1-2}$	*Self-assessment survey of at least 20 pilot sites from the six (6) member states to model the natural habitat of forest environment*	No pilot contributed to this KPI, yet.

PC2: Implement continuous report on natural forest inventory during rehabilitation		
KPI from DoA		Trial Period 1 status
KPI$_{PC2-1}$	*Continuous survey recorded on a half-yearly cycle.*	No pilot contributed to this KPI, yet.
KPI$_{PC2-2}$	*Reports on the natural forest inventory published to advisory board members.*	No pilot contributed to this KPI, yet.

PC3: Implement soil rehabilitation strategy through advanced data analytics		
KPI from DoA		Trial Period 1 status
KPI$_{PC3}$	*Report on soil rehabilitation strategy published across six (6) EU member state locations.*	0.3 out of 0.3, or 100% applied to 1 pilot. The consortium is striving to apply this to the European pilots

PC4: Restoration roadmap for natural resources		
KPI from DoA		Trial Period 1 status
KPI$_{PC4}$	*Inventory of natural forest released from eight (8) EU and three (3) non-EU regions.*	No pilot contributed to this KPI, yet.

Demonstration objectives assessment

DO1: Creation of demonstration scenarios and establishment of real-world drills for the evaluation of SILVANUS project outcomes.		
KPI from DoA		Trial Period 1 status
KPI_{DO1}	*Formalisation of at least 6 complementary scenarios to reflect upon different causes of wildfires*	6 out of 7.4, or 81.08% applied to 8 pilots. It is in progress with good perspective of increasing the value

DO2: Engagement of stakeholders at periodic intervals to evaluate the outcomes adopting agile methodologies		
KPI from DoA		Trial Period 1 status
KPI_{DO2}	*At least 20 external experts to be invited to oversee the pilot demonstration activities as outlined in Section 1.3.3 of DoA.*	8.8 out of 9.1, or 96.7% applied to 10 pilot.

DO3: Organisation of at least three large-scale pilots for the systematic evaluation of the project outcomes		
KPI from DoA		Trial Period 1 status
KPI_{DO3}	*Two cycles of Phase A, Phase B and Phase C pilots organised in an agile manner as outlined in Section 1.3.3 of DoA.*	5.2 out of 6.4, or 81.25% applied to 7 pilot. To be evaluated at the end of Trial Period 2. Second cycle will be completed with Trial Period 2 itself.

DO4: Study of economic impacts of burnt area within forest regions		
KPI from DoA		Trial Period 1 status
KPI_{DO4}	*Publication of four (4) reports on the economic impact assessment during the project life cycle.*	No pilot contributed to this KPI, yet. To be evaluated at the end of Trial Period 2. Economic impact can only be evaluated on a technologic matured system, which is still not the case.

7 Expected impacts set by Green Deal

European Commission's Green Deal, from LC-GD-1-1-2020 call, requires, to reach eight targets by 2030, expressed in respective eight expected impacts being addressed by SILVANUS. In D2.3 these Expected impacts were already addressed from the perspective of future UPs contributions. In addition, some pilot actions have been also taken into account, expecting to contribute to the same end. In this section, these pilot actions are listed for each of the eight Expected Impacts. Achievability is assumed to be the same identified in D2.3.

Since SILVANUS will end five years before 2030, the contributions here expressed will be in a qualitative form, fostering results that can be measured at the end of the project and potentially forecasted to 2030.

Expected impact	EI	Phase	Achievability
EI1	0 fatalities from wildfires	A, B, C	Difficult to achieve
Definition Fatalities are defined as those that would not have otherwise occurred if there had not been a wildfire. This includes direct fatal casualties (in the fire), as well as any indirect fatalities as a result of injuries caused by a wildfire incident. Even if the casualty dies at a later date, any fatality whose cause is attributed to a wildfire is included.			
SILVANUS contributions tested during trial period 1. UP1 is addressing this EI concerning firefighters. It created an effective AR/VR training toolkit for firefighters that improves workforce organization, enhances wildfire fighting efficiency, and reduces fatalities eventually to 0. This has proved its way in the Romanian Pilot where several scenarios have been demonstrated. More scenarios are being created for Trial Period 2 and when replicated can recall historic data and evaluate what could have been done in catastrophic contexts, building a set of shareable lessons learnt. UP2 is working this impact on the dimension of first-response teams' preparedness, regarding fire risk mitigation and minimization actions, that were demonstrated in the Gargano region (Italian 2). Similar approach is taken from UP3 on what regards crowd-detection, demonstrated efficiently in several sites. Detection is also the action covered by IoTs and UAV images in UP4, or UP5 minimizing the presence of humans of the fire area, profusely demonstrated in this first trial period, even outside Europe. UP6 may be avoiding the loss of human lives by population movement not facing the fire spread route. Especially in the Slovak and Italian 2 pilots this could be inferred, although improvement is in progress. **EI achievability consideration:** This EI cannot be fully addressed in the context of a project due to its real context relation – (real) fatalities. However, it is working as ***vision***[15] for the development path of SILVANUS UPs and pilot stakeholders' processes (e.g. of Slovak Pilot aiming to a holistic and integrated approach to wildfire management).			

Expected impact	EI	Phase	Achievability
EI2	50% reduction in accidental fire ignitions	A	Not easily achievable
Definition Human caused wildfires as a result of accidental (not intentional) ignition sources are ignitions that were not intentional, and can be altered through prevention efforts (USDA, White, R. & USDA, 2000). In these fire ignitions, all human causes (electrical, network, railroad, campfire, smoking, fire use, candles, cooking/electrical appliances, equipment, railroad, juveniles, farm machinery etc…) are included.			

[15] Something to be attainable in time but not necessarily in the short term.

SILVANUS contributions tested during trial period 1.
In the Romanian tabletop exercise, discussion between present stakeholders led to the conclusion that improved coordination and monitoring shared by committed stakeholders may help approaching this EI. Also, the combination of UP2, UP7 for prevention and UP8 involving conscious citizens for detection, will be a strong tool to tackle this EI.

TUZVO and PLAMEN promoted fire prevention activities for children at elementary schools and citizens of Zvolen town and surrounding villages, Slovakia. The aim was to educate them about the negative consequences of wildfires on the environment, property, and people. These activities addressed the issue of climate change and its impact on environmental conditions, which are expected to lead to an increase in the number and severity of fires in Slovakia. The impact of these efforts can be measured through the results of a survey on fire ignition awareness, expecting to show that the impact was achieved.

EI achievability consideration: This expected impact may not have a wide contribution from SILVANUS, since one requires to address a wide range of situations with different type of agents involved. Nevertheless, already in Trial Period 1 a few conclusions were already reached although for a narrow set of stakeholders as described above. Part of the conclusions may be scalable depending on pairing with other projects or contexts.

Expected impact	EI	Phase	Achievability
EI3	55% reduction in emissions from wildfires	A, B	Likely achievable

Definition
- **carbon dioxide (CO2) emissions.**
- **nitrous oxide (N2O) emissions.**
- **hydrogen emissions.**
- a wide range of organic compound and reactive gasses.
- greenhouse gasses (GHG) emissions**.**

SILVANUS contributions tested during trial period 1.
As early is any wildfire detected and response comes in place, the smaller the damages to the environment.

The volume of GHG emissions can be estimated from the combination of UP7 and UP5 for estimation of biomass burnt. While Phase B focused UPs may help in the reduction of burning time.

In Slovakia (after Slovak Pilot demonstration), early detection of wildfires by drones, which have already completed equipping professional firefighters, has showcased how shortening the time to send rescue services to the scene, select appropriate fire tactics and start the intervention itself, helps this aim.

A refined addressing strategy for this EI will be release by SILVANUS in Trial Period 2

EI achievability consideration: The big contribution of SILVANUS to this EI is strongly based on early and fast response to wildfires. The combination of mentioned UPs on a large scale of cases is key to avoid wildfires and therefore emissions.

Expected impact	EI	Phase	Achievability
EI4	Control of any extreme and potentially harmful wildfire in less than 24 hours	A, B	Achievable

Definition
Control is the process of completely suppressing the combustion in the perimeter of the wildfire. Control occurs by removing one of the three ingredients fire needs to burn: heat, oxygen, or fuel, within 24 hours

Expected impact	EI	Phase	Achievability
since the recording of the initial ignition time. Harmful wildfires are those that can potentially become social, economic, and environmental disasters.			
SILVANUS contributions tested during trial period 1. This EI will be addressed in Trial Period 2 when SILVANUS DSS will be operational. **EI achievability consideration:** SILVANUS Decision Support System brings together the best combinations of tools and strategy to implement them for the input conditions. Although the final decision is human, narrowing down the options is a great contribution for a fast response.			

Expected impact	EI	Phase	Achievability
EI5	50% of Natura 2000 protected areas to be fire resilient	A, C	Achievable
Definition - Officially declared Natura 2020 areas. - fire resilience based on the geographical coverage area. - fire-resistant ecosystems by promoting the resilience of old-growth forests or by adapting young forest under natural evolution to expected climate change impacts, optimizing protection and provision functions in managed areas. - two forms of resilience: (i) Adaptive resilience to wildfire centres on managing both the human and non-human environment in response to changing climate and fire regimes and increasing wildfire risks and exposure of human communities; (ii) Transformative-resilience requiring a profound shift in the human relationship with the environment and the wildfires, that embraces the dynamic and rapidly changing role of fire in social ecological systems [16].			
SILVANUS contributions tested during trial period 1. The integration of SILVANUS detection and response tools in one platform may help deploying the solutions to Natura 2020 areas, increasing their resilience to fire and helping on prevention measures. **Concrete case of Slovak Pilot:** There was specified the need for integrated management of forests during the workshop with stakeholders which was organised as a part of C phase activities demonstration. The need for opening up forested areas for fire trucks deployment was identified and supported also by nature conservancy workers. The need to protect human life and protection of biotopes of national and European significance (also Natura 2000 areas) was placed above the other forest ecosystem services. The alternatives of forest management strategies in Pilot area were provided which aim is to increase the forest resilience. The Pilot demonstration was situated directly in Landscape Protected Area – Biospheric Reserve Polana, which is composed of many Natura 2020 areas**.** The impact can be measured in terms of results from historic data on wildfire incidence before and after the measures. **EI achievability consideration:** SILVANUS is expected to contribute with other strategies to this EI, beside the Slovak Pilot example above. Other Pilots, like Italy 2, include protected areas. Nevertheless, considering Nature 2000 classifies biotopes of specific natural richness, one should understand SILVANUS contributions from the perspective of knowledge transfer, something that will be further leveraged with the Centre for Adaptation Strategies and Development.			

Expected impact	EI	Phase	Achievability
EI6	50% reduction in building losses	A, B	Achievable

[16] McWethy, David B., et al. "Rethinking resilience to wildfire." Nature Sustainability 2.9 (2019): 797-804. https://doi.org/10.1038/s41893-019-0353-8

Expected impact	EI	Phase	Achievability
Definition - A building is a structure with a roof and walls, such as a house or factory. - structural loss means any loss as a result of wildfire ignitions.			
SILVANUS contributions tested during trial period 1. The Mobile app (UP8) developed for the purpose of citizens' engagement in fire notification and providing necessary information for firefighters is another very strong tool to achieve the expected goals related to reduction of fire damages. The impact can be estimated from the average time between fire start and fire detection, comparing the baseline with dissemination of the application. **Case of Slovak Pilot:** Polana region which is a Pilot site is represented by several land use types. These landscape structures provide a mosaic of wildland and urban areas, which are of high interest of EC in relation to wildfire prevention. Including wildfire spread modelling, prognosing to operational practice of firefighters and civil protection authorities supports the decision making of command staff representatives when planning fire stop measures (wetting vegetation around buildings, building firebreaks from which vegetation is removed, cooling roofs and building structures) well in advance. SILVANUS UAV technology was considered to be a cost-effective tool to detect the wildfires, monitor their spread and changes in their behaviour as well as to identify the structures located in the wildfire zone. The impact can be measured, in the short term by a ratio of detection efficiency/cost of equipment, comparing the baseline and SILVANUS proposed UAV technology. In the long term, both OPEX can be compared. **Case of French Pilot:** The early detection of incipient fires combined with the new methods used during the pilot in France, are expected to reduce the spread of fires, burnt areas and building losses. The methods consist in combine smoke or fire detection technics with social network and, during response phase, of unwinding pipes on a steep slope. **EI achievability consideration:** These two strategies will be further combined with those presented in the Portuguese Pilot for Phase A, during Trial Period 2, specifically addressing needs of critical infrastructure among which are industrial buildings. These contributions may tackle a significant part, although not yet estimated, of cases regarding prevention or minimization of building losses.			

Expected impact	EI	Phase	Achievability
EI7	90% of losses from wildfires insured	A, C	Likely achievable
Definition Types of insured losses include home property, garage, tool shed, belongings, vehicles, businesses, etc…, and anything else that can be insured.			
SILVANUS contributions tested during trial period 1. This EI will be addressed in Trial Period 2 when SILVANUS DSS will be operational and economic assessment is performed, helping to classify the costs associated with not ensuring assets that may be consumed on wildfires. **EI achievability consideration:** This expected impact will be addressed with an economic analysis over technically acquired data. So, reliability of data is considered key for this achievement.			

Expected impact	EI	Phase	Achievability
EI8	25% increase in surface area of prescribed treatment at EU level	A	Likely achievable

Expected impact	EI	Phase	Achievability

Definition

Prescribed fire treatments include the planned use of fire to achieve precise and clearly defined objectives.

- introduced in south Europe to control fire regimes by managing fuels, counteracting the disappearance of biomass-consuming practices and reducing the fire risks inherent in highly flammable forests and shrublands.
- the primary objective prescribed burning is to reduce risks to human and natural assets via modifications to fire behaviour, although prescribed burning can be undertaken to promote ecological assets or for cultural purposes[17].

SILVANUS contributions tested during trial period 1.

Concrete case of Slovak Pilot: In Slovakia, prescribed burning is considered a potential fire tactics approach, but it is not currently utilized in practice. Intensive wildfires that burn continuously for 2-3 days are rare, and they can typically be managed by the available resources of professional and volunteer fire units. The training of firefighters, particularly specialized squads within the Ground Firefighting Module, includes the issue of prescribed burning. These specialized squads operate abroad as part of the Civil Protection Mechanism of the EU. This training is an essential factor for the potential implementation of prescribed burning as a fire tactics method.

EI achievability consideration: The conclusions drawn in the Slovak Pilot will be complemented with those presented in the Portuguese Pilot, during Trial Period 2. A more detailed consideration will then be presented.

[17] Penman, Trent D., et al. "Prescribed burning: how can it work to conserve the things we value?" International Journal of Wildland Fire 20.6 (2011): 721-733. https://doi.org/10.1071/WF09131

8 Conclusions and outlook

This report details the efforts made during the initial trial period by each of the SILVANUS Pilots to engage wildfire-related stakeholders at both European and overseas levels, as well as to facilitate the testing and development of SILVANUS's UPs.

The real-world environment of most pilots enabled the perfect scenario for SILVANUS UPs evolvement, as follows.

Table 53: UPs main progress Trial period (achieved) 1 and 2 (to be achieved).

UP	Trial period 01	Trial Period 02
UP1-Augmented Reality and Virtual Reality training toolkit for trainers, from SIMAVI	The technologies required more customizable environments so the simulation might be closer to different biomes and areas. Also, more specific information could be shown in AR such as wind direction and weather information. UP1 was demonstrated in the Romania and France Pilots: • 1 training scenario • 1 virtual environment • More than 10 first responders and firefighters were trained. • Proved the access to UP1's functionalities with common hardware	UP1 will develop: • 3 training scenarios • 3 different virtual environments • More than 17 first responders and firefighters trained. • More than 3 different users able to attend a training scenario (multiplayer support). • Users able of attending at least 3 scenarios in multiplayer mode and support multiple audio interfaces simultaneously. • Users attending the scenario in multiplayer mode able to communicate using audio with delays no more than 3 seconds. • Audio able to reconnect if internet connection is resumed within at least 3 retries within 1 minute. • Multiplayer user actions must be updated in <1 second between users (assuming the internet connection is reliable).
UP2-Fire danger index from CMCC	Improving the model performance and building the data pipeline for forecast of fire danger index from local weather metrics. The feedback given also highlights the importance of increasing resolution of the results. The UP2 tested in Gargano while still under development. Sensitivity/recall results of 87.8% above 85% (KPI)	UP2 still under development to produce further outputs (same of them to be tested in Phase 2): • provide information on fire danger in detailed scale using the data from local weather stations. It should be completed with weather and fuel moisture information gathered under the tree crown closure. • Produce a fire danger probability map. • Include more areas in the fire danger tool if there is data availability (e.g., DSS)
UP3-Fire detection based on social sensing from CERTH	The feedback given is mostly positive in the quick-fire alert extracted from the social media sensing, and in most cases, in combination with other fire alerts, it is possible to mitigate false positives.	For Demo Phase 02, UP3 participated in the Czech pilot, where an initial version of the fire event detection system was tested, along with the integration of UP3 with the SAL platform. In the upcoming Greek, French, and Italian pilots, UP3 will be involved in

UP	Trial period 01	Trial Period 02
	In Demo Phase 01, the UP3 was tested during pilots in France, Australia, and Indonesia, as well as in tabletop exercises in Italy and Greece and conducted an evaluation of three critical components: - X Social Media Crawler - designed to efficiently gather data from X (formerly Twitter), was tested for its speed and accuracy in collecting relevant data in near real-time. - Social Media Analysis Toolkit - was tested to assess its ability to process large volumes of data quickly and consistently. - Silvanus User Interface - was tested across all pilot sites with the use of synthetic fire events to confirm its capability to accurately represent detected fire events on a user-friendly platform, providing clear and responsive visualizations to aid in decision-making.	testing the entire UP3 pipeline components: - Social Media X Crawler - Social Media Analysis Toolkit - Fire Event Detection module - which identifies potential fire events based on the analysed data. - The integration with SAL of the components. Where detected fire events are pushed into the system to be consumed by the Silvanus User Interface and visualized as pins on a map.
UP4a-Fire detection from IoT devices from CTL	Received end-user/stakeholder feedback for the improvement/additional features of the IoT, such as the smoke detection ML model. Added new sensors, improved ML models' performance, designed new case and tested the IoT's detection capabilities/functionality in several SILVANUS pilots. Tested the data ingestion pipeline (NiFi)/SAL for the storing of the IoT collected data, cooperated with ITTI for the development of the IoT layer in the SILVANUS platform and started working on the IoT data population in the KB for their fusion with other data sources and data insight extraction. In Demo Phase 01 the IoT participated in Croatia, France and Australia pilots and Italy and Greece tabletop exercises. The team conducted various experiments testing the IoT's different components: - data transmission with different networks (e.g., mobile networks). - validation of the detection algorithm effectiveness. Also, synergies between UP4a and other UPs were established, such as UP5a and UP12. Details about these activities are included in D4.5.	For the Demo Phase 02 the IoT has participated in Czech pilot. Tests include full data pipeline, data visualisation in the SILVANUS dashboard, measuring detection capabilities, and connectivity tests. For more details see D4.5. The IoT device will participate in the following pilots: Portugal, Croatia, Greece, and in Italy. In Italy, only the ML algorithms detection algorithms will be tested with the use of EMDCs, instead of the IoTs. Furthermore, tests conducted in this period will focus on the further testing of the algorithms and more importantly the communication of the IoT with the FCCs.
UP4b – Fire detection at the edge from ATOS/EVIDEN	The UP4b was tested in Gargano Pilot (Oct. 2023) on the tabletop exercises using synthetic and real images created for demo proposes and was tested in the tabletop exercise of Chalkida - Greece by ATOS/EVIDEN	UP4b will be tested in the field with real images taken by drones in at least 5 pilots.
UP5-Fire detection from Unmanned Air Vehicle/ Unmanned Ground Vehicle from TRT/CSIRO	CSIRO focussed on multi-robot coordination, place recognition and map merging; grass and undergrowth detection; real time forest analytics; and delivering the analytics and image data to the SILVANUS platform.	Continue to test drone capabilities and drone data transfer pipelines to the SILVANUS platform. Further work on (mostly continuing): - area coverage trajectory optimization - area subdivision algorithms

UP	Trial period 01	Trial Period 02

	UP5 was demonstrated in: Croatia, Slovakia, France, Czech's republic, Greece and Italy (Gargano and Tepilora):
	- UAV demonstrated 25 flights, different angles in different terrain with different forest and vegetation coverage.
	
	- UGV participated in six demonstrations:
	  - Multiple robots were used.
	  - 3D maps were generated together with forest analytics.
	  - smoke detection was performed with Catalink's smoke detector onboard.
		- industrialization of optimization modules: input format genericity, work balance optimization, safety margins, etc.
		- work on the mesh in the Sky (future UP12) possibility
		- test the UAV swarm simultaneous deployment of several drones to improve mapping time.
		- deploy UGV for pilots - gather more field experience and feedback.
		For the second Trial Period split this user product in two: UP5a- UGV monitoring and UP5b -UAV monitoring.

UP6-Fire spread forecast from EXUS	3MON (UAV) focussed on data collection from UAV, possibility of usage of drone swarms and building the data transfer pipeline to the SILVANUS platform. In Phase 1 UP6 was demonstrated in the Slovakia, Greece, Italy, Romania and Czech pilots. Where an initial training of the inference was carried out using sample data from one location. Efforts were focused on: - Training data generation. - Identification of most appropriate neural network topology. - Integration of outputs with dashboard and DSS partners. - Gathering end-user feedback from demonstrations.	In Phase 2, a more comprehensive training was carried out, using the same pipelines developed in phase 1: - Training data from multiple pilot locations - increasing the diversity and range of terrain, vegetation and meteorological parameters - train additional models to predict heat per unit area and spot fire locations. The model retrieves live meteorological conditions and hourly forecasts for the next 24-hour period to use in its predictions. The final Fire Spread Forecast model will be demonstrated in Italy (2 pilots), Greece and France.
UP7-Biodiversity profile mobile application from VTG	Received end-user feedback for model design parameters, such as resolution of simulation, area of simulation, time intervals of outputs, etc. Cooperation with dashboard for result integration and visualization. UP7 was demonstrated in Indonesia, France and Czech's republic. The demos allowed to: - the creation of the training set database. - The collection of large amounts of different types of leaves - Through applying augmentation techniques on collected dataset, reach a training set over 10000 images. - The data set to contain over 100 tree species.	In Phase 2 the strategy for UP7 is: - Keep improving and enhancing functionalities of the Woode application. - Include updated geo-location feature to enter user location manually in case of usage in the remote area with internet coverage. - Include the development and integration of the AI generative module to generate video content based on uploaded picture, to demonstrate in the visually appealing way how destructive impacts can fire have on forests. - Include the enhancement and optimisation of the machine learning and social features. - Engage the consortium in identifying functionalities that may be included in the app to facilitate exploring the relationship between forest

UP	Trial period 01	Trial Period 02
		biodiversity and fire resilience or other aspects.
UP8- Citizen's engagement programme and mobile app from MDS/UISAV	The feedback bundles up in site specific issues, and suggestion or more user input availability, and a more diverse DB. In phase 1 a demo of the Citizen Engagement app was showed in the Czech, Slovak, Greek, French and Italian pilots. Several surveys were made, collecting relevant information for the app further development.	For phase 2 the app is available to download for the participants of the pilots. The content and feedback gather in phase 1 is applied in the app. Also, the fire reporting module is available for testing. More surveys will be gathered for this version of the app to make future improvements and continued the development of new features.

As SILVANUS Decision Support System (DSS) is evolving, it is becoming a UP itself. It has been agreed to be named UP9. On the sense and scope of a DSS, INTRA, UTH, TUZVO, AMIKON, AUA and CTL are developing specific modules, listed at the end of Section 3.

All the specific objectives outlined in Section 4 of this report have been addressed by the pilots, either through their own activities with end-users, stakeholders, or public authorities, or through the demonstration of UPs in real-world environments.

The impact on stakeholders was substantial and played a role in disseminating SILVANUS's early results, as well as laying the groundwork for regulatory and standardization activities.

Pilots' contribution to project KPIs is still low and needs to be increased. 34 out of 52 Project KPIs were addressed by the pilots, from those more than two thirds exceed 75% in relative value.

Future steps

UPs have now a complete set of functionalities where to correct, improve or change. Those need to be ready by the start of Trial Period 2.

On the base of experiences collected during Pilots' effectiveness assessment process in 2023, it is strong need to increase feedback from pilot attendees in the form of effectiveness and replicability surveys. This may be achieved by:

a) issuing certificates of attendance for pilot participants who complete the surveys,
b) dedicating a time slot in a pilot agenda to complete the surveys,
c) reminding Pilot Owners about necessity to collect information with the use of pre-defined surveys for the purposes of effectiveness assessment and replicability studies.

Trial Period 2 is scheduled to start early May 2024. The calendar is already being populated among the consortium pilot leaders. The focus will be to really reach the project objectives (Section 5) and Expected impacts (applied to 2025, in Section 6.1). To this end, the consortium should proceed with these actions:

1. Elaborate on which actions should be taken by each of the UP to match entirely the Expected Impacts each one is targeting.
2. Identify which pilots can provide the best conditions to demonstrate the functionalities that will answer to the previous number and agree on the conditions to do so. Rank the pilots for each UP.

3. Map the project objectives against the pilot objectives and identify which pilots can best fulfil a demonstration that will conciliate both interests. For each project objective identify several sites.
4. After planning all the above points, verify if all conditions are met to elaborate on the Economic studies and Standardization.
5. Identify risks and prepare the respective mitigation plans.

Considering UPs readiness, Pilot leaders need to program all activities and logistics not only to meet stakeholders' higher expectations but also to meet with the new UP (explained in Section 3) functionalities.

The cases of Portuguese and Brazilian pilots are of interest since it will be their first demonstration. However, there is work on-going and a plan for action mitigating the previous causes that did unable demonstrations. For instances, in the Portuguese Pilot much work was done already using drone flights equipped with LiDAR and multi-spectral cameras that enabled the development of two AI models for vegetation volume and biomass estimation, around critical infrastructures, besides a very relevant study with scientific publications on terrain recovery making use of grazing techniques.

The activities developed in Phase 1 and to be developed in Phase 2 are summarised in the table 53.

9 References

- SILVANUS Deliverable 2.3: Report on SILVANUS formal assessment methodology, September 2022
- SILVANUS Deliverable 8.2: SILVANUS platform release, 1st version, May 2023
- SILVANUS Deliverable 9.1: Report on organisational readiness of the pilot setup, March 2023
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- McWethy, David B., et al. "Rethinking resilience to wildfire." Nature Sustainability 2.9 (2019): 797-804. https://doi.org/10.1038/s41893-019-0353-8
- Penman, Trent D., et al. "Prescribed burning: how can it work to conserve the things we value?" International Journal of Wildland Fire 20.6 (2011): 721-733. https://doi.org/10.1071/WF09131

ANNEX 1. Questionnaire Template on Pilot Lessons Learnt

Pilot site: Dates in which the pilot took place: to / /2023

The content of this form will be used to complete the information about your completed Pilot in deliverable D9.3. Please use short sentences.

A. Pilot related questions

The following set of questions intend to characterize the demonstration activity results' impact on the end-users (beneficiaries of SILVANUS solutions), on the user product owners and in the project progress.

1. Who were the end-users (or group of end-users) of your pilot and what did the end-users valued more?

E.g.: *Fire fighters – valued the intuitive user interface of User Product…*
Please add more rows as needed.

(Group of) end-users	Functionalities that were valued in the demonstrations

2. How will the identified end-users (or group of end-users) benefit from SILVANUS outcomes and results?

E.g.: *Civil Protection – due to user product X information, will be able to define faster firefighting tactics.*
Please add more rows as needed.

(Group of) end-users	Benefits from SILVANUS

3. From the feedback you provided in your pilot, what can be improved in each demonstrated outcome (model, user product, application…)?

E.g.: *In user product X, the features for the model were correctly ranked…*
Please add more rows as needed.

Outcome	Improvement

4. From all outcomes demonstrated, how many outcomes can be replicated to other contexts? And which ones are site specific?

E.g.: *In user product X cannot be replicable to lake areas due to casing restrictions…*

B. SILVANUS Expected impacts.

The following expected impacts reassemble what was stated in the proposal stage regarding Pilot contributions. Please check the boxes, by double-clicking, for the impacts addressed in your pilot demonstrations:

☐ 0 fatalities from wildfires.

☐ 50% reduction in accidental fire ignitions.

☐ 55% reduction in emissions from wildfires.

☐ Control of any extreme and potentially harmful wildfire in less than 24 hours.

☐ 50% of Natura 2000 protected areas to be fire resilient.

☐ 50% reduction in building losses.

☐ 90% of losses from wildfires insured.

☐ 25% increase in surface area of prescribed fire treatments at EU level.

☐ "Copernicus Emergency Management System (EMS) […] Galileo Emergency Warning Service;"

☐ "The planned Horizon Europe Mission on […] Transformation - with a strong focus on citizens' engagement;"

Briefly justify your choices:

C. Stakeholders present at your pilot demonstration site.

Here we try to assess SILVANUS impact in local community. For each Group of stakeholders, please describe shortly the impact the demonstration may have (had), in your opinion, in stakeholder's activity.

E.g.: *Forest management organizations – 1. Awareness about new cost-efficient methods for ground fire-detection; 2. Fresh information about AI based models for optimizing maintenance activities.*

Please add more rows as needed.

(Group of) Stakeholders	**Impacts**

ANNEX 2 - Pilot evaluation template (conducted on the scope of Task 9.6)

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
No.	KPIs	PEMs	Estimation result (ex ante)	Measurement result (ex post)	Effectiveness indicator*
1	**KPI_{PA1-1}**: 47,504x104 sq. meters of area analysed and mapped				
2	**KPI_{PA1-2}**: At least 15 regional demonstration sites to be analysed within the project from eight (8) EU and three (3) non-EU countries				
3	**KPI_{PA1-3}**: > than 4 forest models' adaptations to be studied and reviewed for ecological impact assessment				
4	**KPI_{PA2-1}**: At least three (3) publications to promote the extension of Agriculture and Forestry Ontology to model wildfire events resulting from common causes				
5	**KPI_{PA2-2}**: Based on the recently established ontology evaluation metrics from Ontology Summit'1316F 17: (a) Satisfy at least 75% of qualitative ontology evaluation metrics; (b) Achieve at least 5% over the baseline for quantitative ontology evaluation indicators				
6	**KPI_{PA3-1}**: Modelling of seasonal weather forecast models for at least three (3) transitional seasons from eight (8) EU and three (3) non-EU regions				
7	**KPI_{PA3-2}**: Interfaces established with at least four (4) external earth observation data				

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
No.	KPIs	PEMs	Estimation result (ex ante)	Measurement result (ex post)	Effectiveness indicator*
	repositories and global climate repositories				
8	**KPI_{PA3-3}**: Development of fire danger index to be customised for at least 3 forest model categories based on spatial-temporal distribution of vegetation and biodiversity constraints				
9	**KPI_{PA4-1}**: Social media engagement for forest management authorities, landowners, public authorities and visitors of eight (8) pilot sites (as outlined in Section 1.3.3) through at least three (3) platforms				
10	**KPI_{PA4-2}**: Promotion of citizen engagement activities and use of citizen-engagement-toolkit through 500 local authorities				
11	**KPI_{PA4-3}**: Extend invitations to external stakeholder advisory group from the list of past projects (refer to Table 3)				
12	**KPI_{PA4-4}**: Citizen-engagement-tool-kit assessment by at least 200 engaged users				
13	**KPI_{PA4-5}**: At least 2000 members consulted through public forum for the evaluation of public campaign				
14	**KPI_{PA5-1}**: Training programme will emulate at least five (5) different scenarios for the modelling of wildfires				
15	**KPI_{PA5-2}**: A minimum of six (6) training sessions and				

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
No.	KPIs	PEMs	Estimation result (ex ante)	Measurement result (ex post)	Effectiveness indicator*
	workshops to be organised for first responders in crisis management and disaster resilience				
16	**KPI_{PA5-3}**: Invitation to at least 20 external experts will be shared with the community for effectiveness evaluation of the training programme				
17	**KPI_{PA5-4}**: A minimum of 50 first responders and fire fighters to be trained in the usage of SILVANUS platform				
18	**KPI_{PA6-1}**: Historical data analytics for at least three (3) year period to be analysed for the development of scenarios and impact modelling affected by wildfires across EU regions				
19	**KPI_{PA6-2}**: Predictive algorithms to be evaluated against the worst-case scenarios of past wildfire events from at least six (6) geographic regions across the world				
20	**KPI_{PB1-1}**: 15% increase in the flight time compared to the current market standards based on low-cost on-board data analytics integrated within the platform				
21	**KPI_{PB1-2}**: At least 5 additional sensor technologies (based on multi-spectral sensing) integrated within the aerial platform in complement with current market standards				

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
No.	KPIs	PEMs	Estimation result (ex ante)	Measurement result (ex post)	Effectiveness indicator*
22	**KPI_{PB2-1}**: 20% reduction in the power requirement for computing multispectral image and video sequences				
23	**KPI_{PB2-2}**: Integration of processing at least 5 different streams of data in parallel for fire detection				
24	**KPI_{PB2-3}**: A reduction of more than 40% in the false alarm rate for fire detection				
25	**KPI_{PB3-1}**: Extraction of insights on fire danger index measurement based on objective computation of environmental parameters such as aerosol index, corrected reflectance imagery, land surface reflectance, land surface temperature, weather data and presence of sulphur dioxide				
26	**KPI_{PB3-2}**: Ingest 13 spectral bands at a global scale with a high revisit frequency rendering it a vital data source for land use land cover monitoring, atmospheric correction and cloud/snow separation				
27	**KPI_{PB3-3}**: Reduced latency of more than 24% for computation through the adoption of graph modelling and temporal data analytics				
28	**KPI_{PB4-1}**: Computation of millisecond prediction fire behaviour model parameters				

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
No.	KPIs	PEMs	Estimation result (ex ante)	Measurement result (ex post)	Effectiveness indicator*
29	**KPI_{PB4-2}**: Data processing latency reduced more than 15% on 40msecond frequency				
30	**KPI_{PB4-3}**: Geospatial mapping of external weather patterns for the identification of high-risk zones				
31	**KPI_{PB5-1}**: 80% reduction in the deployment of firefighter personnel to the forefront of wildfire				
32	**KPI_{PB5-2}**: 80% resilience in navigating natural terrain				
33	**KPI_{PB5-3}**: A reduction of more than 15% computational complexity in processing information stream				
34	**KPI_{PB6-1}**: Support for high-speed drones beyond 100m/sec				
35	**KPI_{PB6-2}**: Datalink connectivity up to 75km and GMSK modulation for narrow band transmissions for distances exceeding 100km				
36	**KPI_{PB7-1}**: At least three (3) supplier solutions to be evaluated for the integration of wearable devices				
37	**KPI_{PB7-2}**: Feedback from at least five (5) different suppliers to be obtained				
38	**KPI_{PB8-1}**: Development of 3D visual interface to be exported to at least two (2) rendering platforms				
39	**KPI_{PB8-2}**: Support for at least four (4) forms of interactive annotations within the 3D visual interface to be offered to				

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
No.	KPIs	PEMs	Estimation result (ex ante)	Measurement result (ex post)	Effectiveness indicator*
	the crisis management personnel				
40	**KPI_{PB9-1}**: Monitoring of field resources deployed within a 5km distance				
41	**KPI_{PB9-2}**: At least 10 forms of alert levels for Phase A, Phase B and Phase C criteria as defined in the requirements				
42	**KPI_{PB9-3}**: Legacy system interface with at least four (4) different modalities (such as APIs, file systems, process integration)				
43	**KPI_{PC1-1}**: Biodiversity index development of six (6) EU member state regions				
44	**KPI_{PC1-2}**: Self-assessment survey of at least 20 pilot sites from the six (6) member states to model the natural habitat of forest environment				
45	**KPI_{PC2-1}**: Continuous survey recorded on a half-yearly cycle				
46	**KPI_{PC2-2}**: Reports on the natural forest inventory published to advisory board members				
47	**KPI_{PC3}**: Report on soil rehabilitation strategy published across six (6) EU member state locations				
48	**KPI_{PC4}**: Inventory of natural forest released from eight (8) EU and three (3) non-EU regions				
49	**KPI_{DO1}**: Formalisation of at least 6 complementary scenarios to reflect upon different causes of wildfires				

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
No.	KPIs	PEMs	Estimation result (ex ante)	Measurement result (ex post)	Effectiveness indicator*
50	**KPI_{DO2}**: At least 20 external experts to be invited to oversee the pilot demonstration activities as outlined in Section 1.3.3.				
51	**KPI_{DO3}**: Two cycles of Phase A, Phase B and Phase C pilots organised in an agile manner as outlined in Section 1.3.3				
52	**KPI_{DO4}**: Publication of four (4) reports on the economic impact assessment during the project life cycle				
53	**KPI_{ODE1-1}**: At least 4 continent representatives to be represented in the SILVANUS global strategic alliance network				
54	**KPI_{ODE1-2}**: A minimum of 35 internationally reputed experts to be members of the global strategic alliance				
55	**KPI_{ODE1-3}**: A minimum of 10 fields of expertise to be represented within the alliance including practitioners, conservationists, technologists, scientists				
56	**KPI_{ODE1-4}**: A minimum of 20 case reports to be analysed by the experts in the network for the identification of causes, response assessment and lessons learnt				
57	**KPI_{ODE2-1}**: 6 industrial showcases in which SILVANUS outcomes will be promoted				
58	**KPI_{ODE2-2}**: 8 project platform features to be				

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
No.	KPIs	PEMs	Estimation result (ex ante)	Measurement result (ex post)	Effectiveness indicator*
	demonstrated across industrial showcases				
59	**KPI_{ODE2-3}**: At least 5 stakeholder community representatives to be invited for the industrial showcase events				
60	**KPI_{ODE2-4}**: Coordinate and organise at least 4 co-located demonstration activities with the CSA project				
61	**KPI_{ODE3-1}**: 12 scientific papers to be published in peer-reviewed journals and conferences				
62	**KPI_{ODE3-2}**: 3 demonstrations at co-located workshops and conferences				
63	**KPI_{ODE3-3}**: At least 3 joint reports published in collaboration with interdisciplinary partnership of SILVANUS consortium				
64	**KPI_{ODE4-1}**: 4 external SMEs to be included in the advisory board				
65	**KPI_{ODE4-2}**: 5% increase in new job creation				
66	**KPI_{ODE4-3}**: An estimate of 10% revenue growth on the exploitation of project assets beyond the project duration				
67	**KPI_{ODE4-4}**: An overall 5% increase in revenue attributing to the scientific knowledge developed within the project				
-	-	Sum (Effectiveness Criterium 1):			
1	**KPI_{p-M1}:** Pilot formalises at least 1 complementary				

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
No.	KPIs	PEMs	Estimation result (ex ante)	Measurement result (ex post)	Effectiveness indicator*
	scenario to reflect upon different causes of wildfires				
2	**$KPI_{p\text{-}M2}$:** At least 5 external experts participating in a pilot to oversee relevant demonstration activities				
3	**$KPI_{p\text{-}M3}$:** Large-scale pilot fully considers phases expected in Description of Action for the project (Phase A, Phase B and/or Phase C) and allows for systematic evaluation of the project outcomes				
4	**$KPI_{p\text{-}M4}$:** Pilot gives information input to report on the economic impact assessment during the project life cycle regarding to agriculture, tourism, construction industry, insurance and financial services				
5	**$KPI_{p\text{-}M5}$:** Pilot allows to implement at least 1 tool developed in the project				
6	**$KPI_{p\text{-}M6}$:** Pilot implements at least 3 good practices related to wildfire management for each pilot phase expected (Phase A, Phase B and/or Phase C)				
7	**$KPI_{p\text{-}M7}$:** At least 50% of pilot participants are engaged in pilot activities and reflect this in the pilot effectiveness assessment and replicability studies by completing relevant surveys				
8	**$KPI_{p\text{-}M8}$:** At least 50% of pilot participants report acquiring new knowledge				

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
No.	KPIs	PEMs	Estimation result (ex ante)	Measurement result (ex post)	Effectiveness indicator*
	or information from the demonstration activities				
9	**$KPI_{p\text{-}M9}$:** All entities considered in wildfire management plans are involved in pilot activities				
10	**$KPI_{p\text{-}O1}$:** Pilot Owner, Pilot Observer and Pilot Players are indicated in person				
11	**$KPI_{p\text{-}O2}$:** Pilot allows to organise simultaneously at least 1 training session or workshop for first responders in crisis management and disaster resilience regarding to define training activities designed to improve safety and preparedness of firefighters in combating wildfire				
12	**$KPI_{p\text{-}O3}$:** Pilot organisation allows to achieve at least 80% of the pilot objectives specified in relevant Template Operational Readiness				
13	**$KPI_{p\text{-}O4}$:** Pilot allows to train at least 10 first responders and fire fighters in the usage of SILVANUS platform				
14	**$KPI_{p\text{-}O5}$:** Pilot stakeholders notice at least 4.0 overall rank for satisfaction in terms of a pilot organisation process (using Likert scale, on the base of questionnaires filled by pilot stakeholders, and concerning division of tasks for pilot stakeholders, rational ascribing pilot tasks to pilot stakeholders,				

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
No.	KPIs	PEMs	Estimation result (ex ante)	Measurement result (ex post)	Effectiveness indicator*
	synergy effect related to collaboration between pilot stakeholders, information flows as well as structure of commanding the pilot)				
15	**$KPI_{p\text{-}I1}$:** All functionalities of UPs dedicated for a specific pilot have the necessary conditions and infrastructure to be verified during the pilot				
16	$KPI_{p\text{-}I2}$: Functionalities of SILVANUS tools implemented in a pilot notice at least 4.0 rank on satisfaction of a pilot stakeholders in relation to use the tools easily and intuitively (using Likert scale on the base of questionnaires filled by pilot stakeholders)				
17	**$KPI_{p\text{-}I3}$:** At least 2 UPs are used in an integrated way during a pilot				
18	**$KPI_{p\text{-}I4}$:** All UPs dedicated to a pilot are accessible for local security entities				
19	**$KPI_{p\text{-}I5}$:** Pilot ascribes to at least 50% of KPIs related to UPs dedicated to a pilot (referring to D2.3 – Report on SILVANUS formal assessment methodology)				
20	**$KPI_{p\text{-}I6}$:** The technology used allows for 80% reduction in the deployment of firefighter personnel to the forefront of wildfire				
21	**$KPI_{p\text{-}I7}$:** Pilot infrastructure notices at least 4.0 rank on satisfaction of a pilot stakeholders in relation to proper conditions to				

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
No.	KPIs	PEMs	Estimation result (ex ante)	Measurement result (ex post)	Effectiveness indicator*
	meet social requirements of the stakeholders and ensure their effective work during a pilot (protection against severe weather conditions as well as harmful and burdensome factors; using Likert scale on the base of questionnaires filled by pilot stakeholders)				
22	**$KPI_{p\text{-}S1}$:** Pilot Players use mobile operational centre to monitor and manage all activities in the threatened area				
23	**$KPI_{p\text{-}S2}$:** Pilot Players use geospatial mapping of external weather patterns for the identification of high-risk zones to fully match operational expectations in wildfire response				
24	**$KPI_{p\text{-}S3}$:** Pilot Owner, Pilot Observer and Pilot Players fully express their responsibilities and tasks related to the project (including activities concerning T9.6 as well)				
25	**$KPI_{p\text{-}S4}$:** Pilot stakeholders notice at least 4.0 rank for satisfaction on materials prepared for them to make familiar with pilot's assumptions, organisation and proceeding (using Likert scale on the base of questionnaires filled by pilot stakeholders)				
26	**$KPI_{p\text{-}S5}$:** Pilot stakeholders notice at least 4.0 rank for satisfaction on organisational activities				

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
No.	KPIs	PEMs	Estimation result (ex ante)	Measurement result (ex post)	Effectiveness indicator*
	carried out by Pilot Owner to prepare them for a pilot (using Likert scale on the base of questionnaires filled by pilot stakeholders)				
27	**$KPI_{p\text{-}S6}$:** Pilot Players test at least 1 advanced protective gear for protection of frontline fighters, embedded with communication services (using Likert scale on the base of questionnaires filled by pilot stakeholders)				
-	-	Sume (Effectiveness Criterium 2):			

* Effectiveness indicator = Estimation result (ex ante) / Measurement result (ex post).

KPI value	The value meaning
0.0	a pilot will/did not have influence on the KPI analysed
0.3	a pilot output will have/had potential to achieve the KPI analysed (it may/might do it, but it has not achieved so far)
0.5	a pilot outcome will/did match indirectly the KPI analysed
0.7	a pilot outcome will/allowed to match the KPI analysed partly
1.0	an outcome will/allowed to match the KPI analysed completely