D6.3 - Privacy by Design and Societal Acceptance Report

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Abstract	The document outlines the Privacy by Design (PbD) framework within SILVANUS and includes a social acceptance analysis, dividing it into two main sections. The PbD segment covers the principles of PbD, the standards adhered to in SILVANUS, the measures implemented to uphold these principles, the methodology employed for PbD, and a detailed examination of privacy concerns on a per user-product basis. Furthermore, it includes a privacy risk assessment for each user product, along with overarching conclusions and recommendations. The social acceptance section briefly discusses feedback from initial pilot rounds regarding SILVANUS acceptance among end users, the methodology used for the social acceptance analysis, and a comprehensive breakdown of results obtained through a dedicated questionnaire, along with corresponding conclusions. Lastly, the annexes contain the PbD and social acceptance questionnaires for reference.

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LIST OF ACRONYMS

ACRONYM	DESCRIPTION
AI	Artificial Intelligence
API	Application Programming Interface
CLM	Community Land Model
COCO	Common Objects in Context format
COSMO	Consortium for Small-scale Modeling (Weather modeling)
DEM	Digital Elevation Model
DPO	Data Protection Officer
DX.Y	Deliverable X. Y (X refers to the WP and Y to the deliverable in the WP)
EU	European Union
ECWMF	European Centre for Medium-Range Weather Forecasts
ERA	ECMWF Re-Analysis
ERA5	ECMWF Re-Analysis v5
FSM	Fire Spread Model
FWI	Fire Weather Index
GDPR	General Data Protection Regulation
GeoJSON	GIS file format
GIS	Geographic Information Systems
IoT	Internet of Things
KBIF	Knowledge Base Information Fusion
LAN	Local Area Network
ML	Machine Learning
NDVI	Normalized difference vegetation index
PbD	Privacy by Design
PET	Privacy Enhancing Technologies
PPI	Personal Identifiable Information
RGB	Red, Green, Blue (refers to colouring)
SAL	Storage Application Layer
SMEs	Small and Medium Enterprises
TIFF	Picture file format
ToC	Table of Contents
UAV(s)	Unmanned Aerial Vehicle(s)
UGV(s)	Unmanned Ground Vehicle(s)
USGS	United States Geological Survey
UN	United Nations
VR	Virtual Reality
WP	Work Package
WPL	Work Package Leader
WRF	Weather Research and Forecast Model

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EXECUTIVE SUMMARY

The SILVANUS ecosystem comprises a comprehensive suite of products and services, designed to bolster readiness, streamline response strategies, and facilitate post-event recovery. It employs advanced technological solutions for data gathering, analytical processing, visualization, and strategic planning, all aimed at fortifying proactive measures, optimizing response coordination, and aiding recovery processes. By integrating well-organized architectures and sophisticated semantic technologies, SILVANUS promotes collaborative efforts among various stakeholders, effectively tackling the intricacies of ecological conservation and fire prevention across multiple terrains.

The SILVANUS platform is designed to respect the 'privacy by design' principles, ensuring that the protection of data privacy is integrated into its technological products and services right from the outset. Despite the extensive use of public rather than private data, the platform adheres to stringent security standards to protect personal data, if any, assessing potential privacy issues and security risks associated with each product or service.

This report explores the 'Privacy by Design' approach, its core principles, and its practical application within the SILVANUS ecosystem. It evaluates the security benchmarks applied to SILVANUS's tech-based products to ensure the protection of personal data, provides a concise overview of the diverse range of user-centric products or services, and importantly, assesses the potential privacy implications inherent in each product. A privacy and security risk analysis for each service is conducted, culminating in an overarching assessment of SILVANUS's performance in terms of data privacy. No serious privacy by design issues were identified; all SILVANUS products are designed according to Privacy by Design principles and to EU's General Data Protection Regulation (GDPR).

Moreover, by adhering to the principles of Privacy by Design, SILVANUS's technical partners enable organizations subject to the NIS2 Directive—those that may handle personal data generated by SILVANUS products—to enhance their compliance with NIS2's security mandates and bolster their overall cybersecurity posture. It is important to note that while the PbD principles primarily focus on privacy protection and the NIS2 Directive emphasizes cybersecurity, both frameworks prioritize security, risk management, and data protection. More specifically, the NIS2 Directive focuses on enhancing the security of critical infrastructures and services, aiming to strengthen their ability to respond to cyber threats and incidents, while improving aspects such as Risk management, Incident reporting, Supply chain security, and Accountability. In short, the SILVANUS platform has been designed to stand out for its commitment to privacy, security, and user-centric development, fostering a proactive approach to forest management and wildfire prevention.

The platform's Social Acceptance is being evaluated through feedback from questionnaires and pilot demonstrations, ensuring that all SILVANUS products meet the needs and expectations of their users.

The input gathered from the societal acceptance survey data offers valuable perspectives on wildfire management, community preparedness, and the potential role of the SILVANUS platform in enhancing protection and resilience in wildfire-prone areas. The findings underscore the importance of proactive education, effective communication, and resource availability in mitigating wildfire risks and fostering community engagement in disaster preparedness response and restoration. One key theme that emerges from the survey responses is the critical need for enhanced awareness and education regarding wildfire risks

and management practices. Moreover, the identification of challenges such as the lack of community-wide fire safety awareness, limited access to fire prevention resources, and environmental factors underscores the complex nature of wildfire risk mitigation. The perceived value of the SILVANUS platform in facilitating communication, providing real-time alerts, and offering resources for fire prevention and preparedness signifies its potential to revolutionize wildfire risk management and response efforts at the community level. The findings suggest that by harnessing technology, fostering collaboration, and prioritizing community engagement, stakeholders can strengthen their capacity to mitigate wildfire risks, protect vulnerable populations, and enhance overall disaster resilience.

1 Introduction

This report emerges from the endeavours undertaken in Task 6.5 (WP6) within the SILVANUS initiative. It unfolds into two principal segments: a) the inception and evolution of the Privacy by Design (PbD) framework within SILVANUS, and b) the community's reception and endorsement of the SILVANUS platform along with its derivative offerings.

Moreover, the document assesses the societal reception of SILVANUS. It outlines the adopted methodology, insights derived from relevant questionnaires, and valuable feedback obtained from the initial pilot demonstrations. Additionally, it summarizes the key findings and conclusions.

Privacy by Design is analysed in section 2, while the societal acceptance part is analysed in section 3. Section 2 defines privacy, describes personal data, identification and privacy rights, the concept of Privacy by Design, the general requirements of the General Data Protection Regulation (GDPR), security standards, tools and mechanisms adopted by SILVANUS. Also, the methodology for assessing the PbD, data processing and personal data life cycle principles are described. Privacy matters per user product developed in SILVANUS are described, a privacy risk assessment and finally overall conclusions for privacy issues.

In section 3 the societal acceptance describes feedback received from the pilots as depicted in the WP9 deliverables, and more importantly, it includes the analysis from a dedicated questionnaire. A discussion on the outcomes is being presented and finally the overall conclusions on the acceptance of SILVANUS.

Conclusively, the questionnaire distributed to the technology providers of SILVANUS for the ‘privacy by design’ evaluation is presented in Annex I, while Annex II presents the questionnaire used to appraise the social acceptance of the platform.

2 Privacy by Design

2.1 Normative aspects and privacy requirements

2.1.1 Defining privacy

Privacy can be defined as "*the claim of individuals, groups, or institutions to determine for themselves when, how, and to what extent information about them is communicated to others*" [1]. The European Union (EU) recognizes privacy as a fundamental right as explicitly stated in article 8 of the EU Charter of Fundamental Rights: *"Everyone has the right to the protection of personal data concerning him or her. Such data must be processed fairly for specified purposes and based on the consent of the person concerned or some other legitimate basis laid down by law [...]".* Privacy safeguards our autonomy, dignity, and personal boundaries, allowing us to make choices about what we share and with whom. In an increasingly interconnected world, protecting privacy becomes crucial, especially in the context of data collection, surveillance, and digital communication.

2.1.2 Personal data, identification, and privacy rights

The definition of personal data according to the Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, (herein after the "GDPR" [2]) is: "Any information relating to an identified or identifiable natural person, an identifiable natural person is one who can be identified, directly or indirectly, in particular by reference to an identifier such as a name, an identification number, location data, an online identifier or to one or more factors specific to the physical, physiological, genetic, mental, economic, cultural or social identity of that natural person" [2].

In view of the above, if the purpose of the processing of personal data does not require the final set of data to refer to an identified or identifiable individual (such as in statistics), but the initial processing does (e.g. before data aggregation), the data controller of the processing organization shall delete or anonymize personal data as soon as identification is no longer needed.

On the other part, without forgetting the legitimate interests of an organisation regarding the data processing it performs, the ultimate goal must be to guarantee the rights and freedoms of the users whose data is processed, and therefore, any adopted measure must focus towards guaranteeing their privacy. This involves designing "user-centric" processes, applications, products and services, anticipating their needs. The user must play an active role in managing his/her data and in controlling what others do with it. This inaction must not imply reduced privacy, referring to one of the Privacy by Design principles (see section 2.1.3) which advocates a default privacy setting that offers the highest level of protection.

The "user-centric" approach is achieved by designing processes, applications, products and services that are focused on guaranteeing the privacy of data subjects [3]. In brief, this could be accomplished by:

- Implementing privacy settings that are "robust" by default and where users are informed of the consequences to their privacy when established parameters are modified.

- Making available complete and suitable information that leads to an informed, free, specific and unambiguous consent that must be explicit in all cases that require it.
- Providing data subjects access to their data and to detailed information on the processing goals and communications carried out.
- Implementing efficient and effective mechanisms that allow data subjects to exercise their rights on data protection.

2.1.3 Privacy by design: definition and principles

Initially developed in the 1990's in Canada, Privacy by Design (PbD) is a framework that focuses on proactively embedding privacy into the design and operation of IT systems, networked infrastructure, and business practices. It is based on adherence to the **seven** foundational principles of Privacy by Design, which include:

1. **Proactive, Not Reactive**, **Preventive**, **Not Remedial**: PbD takes a proactive stance, anticipating and preventing privacy-invasive events before they occur.
2. **Privacy as the Default Setting**: PbD advocates for privacy to be the default state and privacy protections should be automatically enabled, without needing users taking any additional steps to safeguard their privacy.
3. **Privacy Embedded into Design**: Privacy considerations should be an integral part of the design process.
4. **Full Functionality – Positive-Sum**, **Not Zero-Sum**: PbD emphasizes that privacy and functionality need not be mutually exclusive encouraging privacy mechanisms seamlessly integrate with systems' functionality.
5. **End-to-End Security – Full Lifecycle Protection**: PbD ensures that privacy protections extend throughout the entire lifecycle of the system and its date.
6. **Visibility and Transparency – Keep It Open**: Organizations should be transparent about their privacy practices.
7. **Respect for User Privacy:** Organizations should leverage strong privacy defaults while also providing data subjects the ability to grant or revoke consent, empowering them to play an active role in the management of their data.

PbD tools and mechanisms include Privacy Impact Assessments (PIAs), which evaluate the privacy risks associated with new products and services, and Privacy-Enhancing Technologies (PETs), which utilize technologies like encryption and differential privacy to enhance data security and privacy [4]. By adopting this approach, organizations can ensure that their products and services meet the highest standards of privacy and security, providing their users with the confidence that their personal data is protected.

In 2010, the Privacy by Design (PbD) principles were officially endorsed as an essential component of privacy protection by the International Assembly of Privacy Commissioners and Data Protection Authorities. This endorsement marked a significant milestone in the global recognition of PbD as a fundamental approach to privacy protection in the digital age. These principles have since been embraced by public policymakers, legislators, industry groups, and associations as integral to their efforts to update 21st-century information privacy governance systems.

Indeed, the European Union's privacy regulation, the GDPR [2], includes these essential principles of data protection by design and data protection by default. Specifically, Article 25 of the GDPR mandates that *"[…] the controller shall, both at the time of the determination of*

the means for processing and at the time of the processing itself, implement appropriate technical and organisational measures […] for ensuring that, by default, only personal data which are necessary for each specific purpose of the processing are processed". The GDPR thus requires making privacy the default setting, taking a privacy-first approach, building privacy into the design, and using technical and organizational features, such as (PETs to protect EU citizens' privacy and comply with the GDPR, like data minimization, data encryption, anonymization, deletion of data when you no longer need it, etc., deletion of data when you no longer need it, etc.

Privacy enhancing technologies and methods

Privacy-enhancing technologies (PETs) are essential tools that embody fundamental data protection principles that aim to safeguard individuals' privacy by minimizing personal data use, enhancing data security, and empowering users. These technologies align closely with the PbD approach, which, as seen, emphasizes integrating privacy considerations into the design and development of systems, processes, and products from the outset.

PETs can be categorized as soft or hard privacy-enhancing technologies. Soft PETs assume a trust model between the user and the third-party data processing which is therefore based on the notion of consent and compliance. Hard PETs, instead, are based on a trust-less model and therefore aim to minimize data and enforce encryption. Specifically, PETs:

- employ techniques to reduce an information system's possession of personal data without compromising functionality.
- empower users to take control over their personal data. Users can choose to limit the data they share with third-party online service providers.
- negotiate data handling and sharing agreements, supporting users in making informed choices and providing their data according to their preferences.
- provide anonymization and pseudo-anonymization techniques to hide Personal Identifiable Information (PII).
- provide confidentiality through encryption (e.g., homomorphic encryption enabling computation over encrypted data), and privacy-aware data analysis (e.g., differential privacy and federated learning).

2.1.4 Privacy general requirements in the GDPR

Chapter 3 of the GDPR lays out the data privacy rights and principles that all "natural persons" are guaranteed under EU law. Organisations/technological developers are obligated to facilitate these rights. Failure to do so can result in penalties.

The scope of this section is to present the Data Protection "By Design", which is specifically and formally established with article 25 of the GDPR (herein above). The notion "By Design" marks the obligation of data controllers to design systems using the most privacy friendly approach and the state of the art in the fields of personal data protection.

Hereby below are listed the general requirements throughout the text of GDPR relating to "Privacy by Design" (per article):

- Article 12 - Transparency and communication: Organizations/technological developers must explain how they process data in "a concise, transparent, intelligible

and easily accessible form, using clear and plain language". They must also make it easy for people to make requests to them (e.g., a right to erasure requests, etc.) and respond to those requests quickly and adequately.

- Articles 13 & 14 - When collecting personal data: At the moment organizations/technological developers collect personal data from a user, they need to communicate specific information to them. If they don't collect the information directly from the user, they are still required to provide them with similar information.
- Article 15 - Right of access: Data subjects have the right to know certain information about the processing activities of a data controller. This information includes the source of their personal data, the purpose of processing, and the length of time the data will be held, among other items. Most importantly, they have a right to be provided with the personal data of theirs that are processing.
- Article 16 – Accuracy: The accuracy of the data being processed is only tangentially an aspect of data privacy, but people have a right to correct inaccurate or incomplete personal data that are being processed.
- Article 17 - Right to erasure: Also known as the "right to be forgotten" data subjects have the right to request that will be deleted any information about them that organizations/technological developers have. There are five exemptions to this right, including when processing their data is necessary to exercise the right to freedom of expression.
- Article 18 - Right to restrict processing: Data subjects can request that organizations/technological developers temporarily change the way that process their data (such as removing it temporally from a website) if they believe the information is inaccurate, is being used illegally, or is no longer needed by the controller for the purposes claimed. The data subject has the right to object to the processing of their data as well.
- Article 20 - Data portability: Data privacy is the measure of control that people have over who can access their personal information. In line with this principle, the GDPR contains a novel data privacy requirement known as data portability. The organization/technological developer has to store the users' personal data in a format that can be easily shared with others and understood.
- Article 21 - Right to object: Data subjects have the right to object to the processing of their data. This can be overridden by their objection if they demonstrate the legitimate basis for using their data.

2.2 Security Standards, tools, and mechanisms

According to the GDPR [2], a technological producer must meet minimum privacy and security practice requirements. Article 32 of the GDPR provides some leeway regarding what measures should be taken but it leaves the right to "implement appropriate technical and organizational measures to ensure a level of security appropriate to the risk. [5]"

These measures might include:

- Encryption
- Pseudonymization
- Regular testing and evaluation of security measures
- Resiliency measures

- Back-up and restoration measures

The primary step to ensure a level of security is to identify the privacy risks associated with the system and to suggest treatments to address these risks. This process is instrumental in establishing a link between the high-level functional description and actual operational requirements of the system [6].

Another essential step is conducting a privacy impact assessment, which should be supported by robust privacy architectures within organizations. This internal architecture encompasses an organizational structure and governance model that integrates a diverse range of expertise into the process that enhance or support privacy. Additionally, it provides a mechanism for implementing the results of these assessments [7, 8].

An indispensable tool for meeting privacy requirements within organizations is the establishment of a formal framework for defining privacy products.

This framework can be implemented through the following steps:

- Present an initial architecture.
- Identify and prioritize scenarios and quality attributes.
- Identify potential architectural security and privacy enhancements.
- Select and apply privacy and security architectural approaches to the scenario.

2.3 Methodology for Assessing PbD Characteristics in SILVANUS

The SILVANUS consortium aims to ensure Privacy by Design (PbD) compliance in all SILVANUS User Products (UPs), other products (Platform, Database, Machine Learning Models, “Mesh in the Sky” etc.) and targeted services. This Deliverable employs a comprehensive and qualitative methodology to assess and implement PbD characteristics, which includes the following key components:

Stakeholder Mapping

SILVANUS identified all relevant stakeholders, including data subjects, data processors, data recipients, and regulatory bodies. This process is fundamental to understanding the needs and expectations of each group, ensuring that PbD principles are tailored to their requirements.

A Questionnaire for Tech Partners

To properly assess the PbD compliance of all technology partners, a dedicated questionnaire has been created. This questionnaire requires input from all developers involved in the project for each sub-system, user product, product, or service.

The Questionnaire covers both privacy and security topics, including : a) categories of personal data processed, b) personal data collection, c) data storage, d) data use and sharing, e) data removal, f) data security and g) data privacy checklist and h) authorization, i) certification and k) transfer protocols upon request.

Additionally, the principles of data minimization, privacy by default, and end-to-end security were specifically addressed.

The results of the questionnaire are utilized to conduct a risk assessment analysis for each product or service. The process helps identify areas for improvement and develop action plans to address any gaps in PbD compliance.

In total, 28 responses from SILVANUS partners were collected, and their analysis, assessment and conclusions for each product and service is presented in section 2.6. The template of the questionnaire is provided in Appendix I.

Literature review
SILVANUS other deliverables enabled us to identify and reconstruct the platform's architecture (following its 2nd phase of development) and the other related products and targeted services. The perusal of Deliverables D5.3 [9], D8.1 [10], D8.2 [11] and D8.3 [12] was insistent for the implementation of the PbD task.

Working sessions (WP6 meetings, targeted meetings with specific Tech developers)
The WP6 team engaged with all technological partners to understand their data processing practices and to identify areas for improvement in terms of PbD compliance. These specific meetings helped to establish a shared understanding of the PbD principles and to develop strategies for their implementation.

In the chapters below, a short description of the procedure of data processing and personal data life cycle, and an overall description of the SILVANUS platform and types of data, as well as a PbD analysis for all SILVANUS products follows.

2.4 Data processing and personal data life cycle

As the term suggests, the data life cycle encompasses the entire 'life' of data, from its creation and updating to its deletion.

The data life cycle is particularly useful for the SILVANUS project, where data is being used and processed to generate results. The availability of date for a specific period ensures accessibility and usability within the SILVANUS system. Data is generated from different sources and exists in multiple forms to enhance accessibility. The SILVANUS platform, a big data-based application, generates significant amount of data through sensors and other electronic devices and technological products, as described in detail below. The term 'data life cycle' reflects the complete data process within the system.

As previously mentioned, the life cycle of data spans creation, storage, usability and sharing, to archiving and destruction inside the system and its applications. It defines the entire data flow within the SILVANUS platform. Therefore, during project implementation, it is essential to maintain the life cycle of data within a secure system that complies with the privacy and data protection principles outlined in the GDPR [13].

The principles are as follows:

- **Consent**: The individual data subject has consented to it with clear affirmative action. This consent must be freely given, specific, informed and unambiguous.
- **Purpose Limitation**: Personal data must be collected for a specified, explicit and legitimate purpose. It may not be further processed in a way incompatible with the original purpose. Data subjects should be aware of this purpose.
- **Data minimisation**: Only the minimum amount of personal data should be collected to achieve the previously specified purpose. Organisations should not collect vast amounts of personal data and decide how to use it later.
- **Storage limitation**: Personal data should only be kept for a specific amount of time that is proportionate to the purpose for which it was collected.
- **Accuracy**: Collected personal data should be accurate, complete and up to date.

- **Openness, transparency and notice**: Providing data subjects with clear, accessible information about the data controllers' policies, procedures and practices regarding processing personal data.
- **Special categories of data**: More stringent conditions for special categories of data (e.g. genetic data, religious beliefs, political opinions).
- **Data subject's rights**: The individual is very important in data protection law. The GDPR introduces some rights that individuals enjoy, such as:
  - The right to be informed about what is happening with personal data.
  - The right to access this personal data, have it rectified if it is inaccurate and/or have it erased.
  - The right to restrict processing.
  - The right to object to data processing.
  - Rights in relation to automated decision-making and profiling.
  - Partners should take steps to ensure that individuals can contact their organisations for assistance if necessary.
- **Breach notification**: Data controllers and data processors must inform Data Protection Authorities of data breaches under certain circumstances.

Considering the above, it should be noted that all the technological products designed and developed in SILVANUS system (Figure 1), as described below, are in compliance with the GDPR requirements.

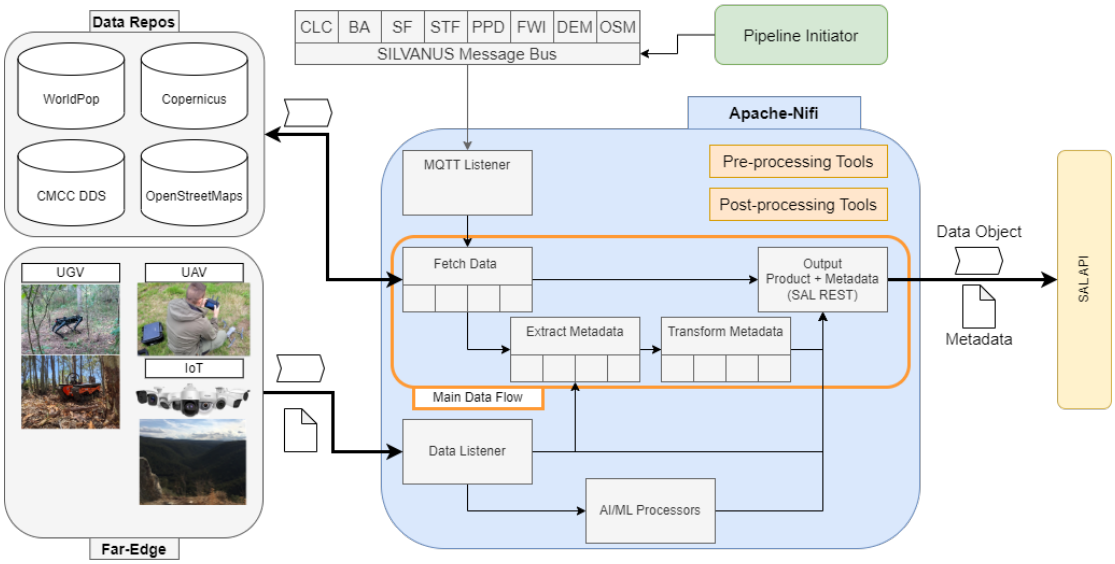


Figure 1. SILVANUS Data Ingestion, Storage and Retrieval – Quick Reference Guide

2.5 Overall description of the SILVANUS platform

High-level description

The SILVANUS platform is a sophisticated system designed to tackle the multifaceted challenges of forest and wildfire risk management across three key phases: Prevention and Preparedness (Phase A), Detection and Response (Phase B), and Restoration and Adaptation (Phase C). In Phases A and C, SILVANUS employs a distributed network of sensors, both static and mobile, to collect data for analysis. This data is processed using both cloud and near-edge

solutions, enabling real-time analysis of wildfire behaviour. Additionally, SILVANUS promotes sustainable forest management and integrated fire management by developing structured knowledge models, biodiversity indices, and citizen engagement programs for diverse communities. Advanced semantic technologies facilitate knowledge-sharing among stakeholders, while Deep Learning algorithms provide timely alerts to authorities by filtering relevant information.

Phase B of the SILVANUS platform focuses on the development of a wildfire response management toolkit that leverages geographical insights to create advanced visualization maps for training and scenario planning, alongside implementing wildfire detection technologies. By integrating cutting-edge technologies such as AI, ML, big data, cloud computing, UAVs, UGVs, and IoT devices, the platform collects data from various sources, including continuous streams (weather/climate), periodic data sources, and sparse data classified by fire ignition events. Advanced data analytics tools, including a semantic information fusion engine, enable the evaluation of wildfire threats and the development of effective risk assessment and mitigation strategies. Mobile command centres equipped with edge-enabled computational units facilitate on-site data processing and visualization, supporting frontline firefighters with dynamic weather pattern modelling for effective information exchange.

Data types of SILVANUS platform

The SILVANUS platform relies on a diverse array of data types to fulfil its operational requirements, which can be broadly categorized into three main groups as mentioned in D8.3 [12]: dynamically changing data, static reference data, and forest data.

Dynamically changing data encompass various sources such as weather and climate data, IoT in-situ data, social media data, UAV data, UGV data, and citizen engagement app data. Weather forecasts from reputable models like ECMWF and COSMO are utilized to generate Fire Weather Indices (FWIs) crucial for assessing fire danger. IoT devices, including cameras and environmental sensors, provide real-time on-ground information. Social media mining, especially Twitter, aids in early fire detection and provide insights on situation awareness. UAVs and UGVs collect aerial and ground-level data respectively, essential for fire detection and modelling. Citizen engagement applications facilitate crowd-sourced data collection, enhancing community involvement in fire prevention efforts.

Static reference data include topographic and elevation maps, Corine Land Cover data, base layers such as road and railway networks, and population density data. These serve as foundational layers for spatial analysis and modelling within the SILVANUS platform. Topographic and elevation maps and data aid in terrain analysis, while Corine Land Cover data offers insights into land use and vegetation cover. Road and railway networks inform evacuation route planning and fire spread modelling, while population density data supports risk assessment and response coordination activities.

Forest data, although changing at a slower pace, are crucial for SILVANUS's operations. These data include forest survey data specific to each pilot site, providing information on tree species and other forest characteristics. Integrating these data into the SILVANUS platform enhances its ability to model fire behaviour accurately and assess wildfire risks effectively.

In summary, the SILVANUS platform (Figure 2) leverages a wide range of data sources to support its operations across different phases. From real-time weather forecasts to crowd-sourced citizen data and static reference maps, these data types enable SILVANUS to enhance

wildfire prevention, detection, and response efforts, ultimately contributing to more effective forest management and ecosystem preservation.

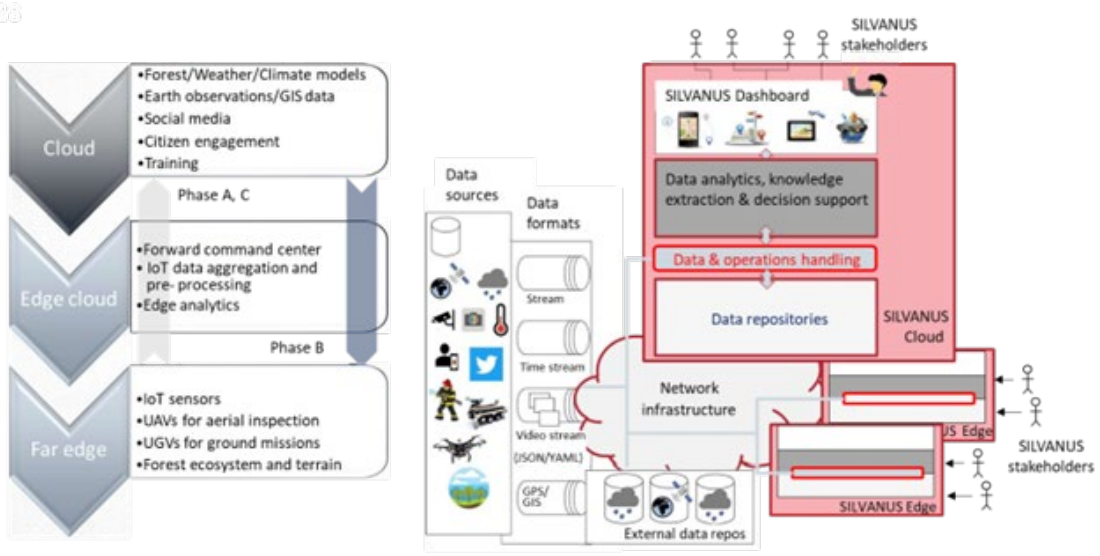


Figure 2. SILVANUS platform and targeted services

2.6 PbD Analysis per User Product (UP), other products and targeted services

The analysis for Privacy by Design is conducted on a per SILVANUS product and targeted service basis to ensure alignment with other deliverables and specifically with SILVANUS Reference Architecture [12]. A PbD analysis, a PbD risk assessment and specific conclusions for each product are provided in this section.

SILVANUS User Products

SILVANUS functionalities are classified and described as User Products (UPs), each of which mainly focuses on the outcome of specific technical work packages/tasks. All SILVANUS UPs (Table 1) implement specific project enablers targeting the three identified Phases A, B and C, and will guide the definition of the SILVANUS platform architecture and development of the required components.

Table 1. UPs to be included in the 2nd SILVANUS platform release (source: Deliverable D8.3 [12])

UP#	Description	Phase	WP/ Task	UP owner
UP1	AR/VR training toolkit for responders	A	T3.4	SIMAVI
UP2	Fire Ignition Models	A	T3.2/T5.1	SIMAVI/CMCC
UP3	Fire detection based on social sensing	B	T4.4	CERTH
UP4	Fire detection from IoT devices	B/A/C	T4.3/T5.1	CTL/ATOS
UP5	UxV Monitoring for Wildfire Behaviour	A/B	T4.5/T4.6	CSIRO/3MON/TRT
UP6	Fire spread forecast	A/B	T5.1/T5.3	EXUS/TUZVO

UP7	Woode Mobile Application	A/B/C	T2.4	VTG
UP8	Citizen engagement and information sharing application	A/B/C	T3.5	HB/MDS/ITTI
UP9	Decision Support System	A/B/C	T5.3	INTRA/UTH/AMIKOM, CTL/AUA
UP10	Forward Command Center	B	WP5	DELL
UP11	SILVANUS UI Dashboard	A/B/C	WP5	ITTI
UP12	Mesh in the sky	A/B/C	WP5	RINI

A comprehensive list of all SILVANUS User Products, including sub-products, as these have been defined in SILVANUS latest reference architecture (deliverable D8.3 [12]) is given below:

- UP1: AR/VR training toolkit for trainers (SIMAVI)
- UP2: Fire Ignition Models
    - UP2a Fire Ignition Models (SIMAVI)
    - UP2b Fire Danger Tool (CMCC)
- UP3: Fire detection based on social sensing (CERTH)
- UP4: Fire detection from IoT devices (CTL/ATOS)
    - UP4a Fire detection from IoT devices (CTL)
    - UP4b Fire detection at the edge (ATOS/THALES)
- UP5: UxV Monitoring for Wildfire Behaviour (CSIRO/ 3MON/TRT)
    - UP5a UGV Monitoring for Risk and Wildfire Behaviour (CSIRO, 3MON)
    - UP5b Wildfire Behaviour inspection based on UAV deployment (TRT)
- UP6: Fire spread forecast (EXUS/ TUZVO)
- UP7: Woode mobile Application (VTG)
- UP8: Citizen's engagement and Information sharing apps (HB/MDS/ ITTI)
    - UP8a Citizen engagement mobile application (MDS)
    - UP8b Citizen situational awareness and information sharing (UISAV)
- UP9: Decision Support System (INTRA/UTH/TUZVO/AMIKOM)
    - UP9a Resource Allocation of Response Teams (DSS-RAR) (INTRA)
    - UP9b Health Impact Assessment (DSS-HIA) (UTH)
    - UP9c Evacuation Route Planning (DSS-ERP) (UTH)
    - UP9d Ecological Resilience Index (DSS-ERI) (AMIKOM)
    - UP9e Continuous monitoring of rehabilitation strategy index (DSS-CMRSI) (AMIKOM)
    - UP9f Biodiversity Index Calculation (DSS-BIC) (AMIKOM)
    - UP9g Soil erosion index (DSS-SEI) (AUA)
    - UP9h Integrated Data Insights (CTL)
    - UP9i Priority Resource Allocation based on Forest Fire Probability (AMIKOM)
    - UP9j Multilingual Forest Fire Alert System (AMIKOM)
    - UP9k Deep Learning Model for Wildfire Severity Prediction using EO4Wildfires (AUA)
    - UP9l: DSS SIBYLA (TUZVO)
- UP10: SILVANUS Forward Command Centre (DELL)
- UP11: SILVANUS UI Dashboard

- UP12: Mesh in the sky

UP1: AR/VR training toolkit for responders

The details for the privacy by design assessment of UP1 are described in Table 2.

Table 2. PbD analysis of the AR/VR toolkit for responders.

Generic description	The training toolkit is an intuitive online/offline training AR/VR platform for wildfire first responders. The toolkit gives them the ability to design and verify various policies in emergency management scenarios, while it also supports the live communication between them. The toolkit may serve as a general disaster/crisis mitigation system in the big data era, based on the cooperation of large-scale, high-resolution, real-time simulations and assimilation of real-time observation data.
Potential Privacy by Design issues	The toolkit uses at least 2 communication channels, one for real-time audio over the Photon cloud infrastructure and a second one for real-time data over webservices. Temporary data are stored on the responder's device, while other actionable data are stored in SILVANUS data repository. The tool will collect and/or process personal data. The kit requires users to connect/register through a personal account. A user consent form is required.
Potential Security issues	The toolkit implements strong access controls and authentication mechanisms to ensure data security across its taxonomy and thus does not raise security issues.
PbD product Risk assessment	The principle of purpose limitation implies that the "temporary data" and "actionable data" must be collected to fulfil specific goals. This means that the toolkit's personal data is only used for general disaster/crisis mitigation purposes. This also relates to informed consent since, under specific circumstances, data subjects must be informed of the purposes for which their data will be processed (see Articles 13 and 14 GDPR). Data must be accurate and reflect reality, which needs to be judged in relation to toolkit's processing purposes. This principle is enforced in the GDPR through data subject's rights, who can ask the controller to erase or rectify the data regarding the data subject (Articles 16 and 17 of the GDPR). The principle of storage limitation establishes that one should not keep personal data for any longer than is reasonable for achieving the purposes for which they were collected in the first place. The period can be longer if the data are being processed for one of the purposes in Article 89 GDPR (public interest, scientific or historical research purposes, and statistical purposes), which may certainly apply expected in this Training Toolkit.

	According to Article 32 GDPR, applicable security measures and capacities include: 1) the pseudonymization and encryption of personal data; 2) the ability to assure the ongoing confidentiality, integrity, availability and resilience of processing systems and services; 3) the ability to restore the availability and access to personal data on time in the event of a physical or technical event and 4) a process for regularly testing, assessing and evaluating the effectiveness of technical and organisational steps for ensuring the security of the processing.
Conclusion	The User Product (as described by the Technological Partner) is designed and developed in compliance with the GDPR requirements. It is recommended that all types of Data, whether "temporary" or "actionable", must be collected to fulfil the purpose of general disaster/crisis mitigation and controlled in the same manner as the access to ordinary data. Temporary data must be erased when not used anymore.

UP2: Fire Ignition Models and Tools

UP2a: Fire Ignition Models

The details for the privacy by design assessment of UP2a are described in Table 3.

Table 3. PbD analysis of the fire ignition models.

Generic description	The product provides an analysis of the historical records of fire occurrences and presents information on fire ignition that affects the forest region. Briefly, the tool implements mathematical models to predict the probability and frequency of forest fire ignition in a given zone and month, using static data (that does not change between different months) and open-source data as input.
Potential Privacy by Design issues	The tool complies with relevant national and EU privacy laws and regulations. The principle of Data Minimization is applied on the Fire Ignition Models.
Potential Security issues	The product implements strong access controls and authentication mechanisms to ensure Data Security. The product prevents unauthorized access, disclosure, or alteration of data within the cloud platform. The product enables secure data transfer and integration with other systems or applications. This "data analytics toolkit, that will enable the collection and aggregation of complex data structures is considered privacy friendly.
PbD product Risk assessment	The tool should ensure that data not required for the system's purposes is not collected or used. The tool does not collect or process personal data as it is a mathematical model based on historic fire ignition data. The tool implements strong access controls.

Conclusion	The User Product is designed and developed in compliance with the GDPR requirements. It is recommended that the data subjects (if any) must be kept to a minimum and should not be more than what is strictly necessary to achieve the purpose of processing. The tool does not present issues or risks associated with Privacy by Design.

UP2b: Fire Danger Tool

The details for the privacy by design assessment of UP2b are described in Table 4.

Table 4. PbD analysis of the fire danger tool.

Generic description	The Fire Danger Tool provides estimation of the fire danger, as a probability, based on data-driven approaches exploiting various data sources (Earth Observation, Weather/Climate High-Resolution Models, Fire History). The tool indicates the fire danger for an area of interest during a certain forecasting period (the next hours, days, months/seasons). Its main goal is to provide information about all conditions that reflect the potential for a fire to ignite and spread over an area, but it can also be used as input for improving early detection (e.g., increased monitoring frequency of the deployed sensors, drone flight missions to monitor areas with high fire risk etc.). It is completely automated and provides an API that facilitates the integration of downstream applications (e.g., visualization tools, GIS, etc.).
Potential Privacy by Design issues	The tool uses the following data types: ▫ Weather data, i.e. 2-meter temperature, 10 m wind u component/wind v component, total precipitation, and relative humidity. This data can come from different sources, with different grades of accuracy and resolution. Global models (e.g., ERA5, ERA5-Land), downscaled models (e.g., ERA5@2km), Limited Area Models (WRF, COSMO CLM), Weather Stations, Satellite Nowcasting, Historical weather data are needed for ML training. Forecasting data will be used for the operational service to predict the fire danger. ▫ Vegetation Data: Leaf Area Index, Vegetation Index from satellite products (Copernicus Sentinel Products). Land Cover: Copernicus Data Topography of the area from SAR satellite data or from static land survey maps. ▫ Historical data about burnt areas: Active Fire Products from Satellite (used for training ML algorithms). All Data are stored in netcdf, satellite format - streaming over http. The tool leverages the Storage Layer API to retrieve data from various sources and utilizes a pre-processing pipeline to standardize the data, run the inference engine, and refine the output data for visualization on maps, with distinct colors representing varying risk level. The tool complies with relevant national and EU privacy laws and regulations. The principle of Data Minimization is applied in the Fire Danger Tool.

Potential Security issues	The product to be developed implements strong access controls and authentication mechanisms to ensure Data Security. The product prevents unauthorized access, disclosure, or alteration of data within the cloud platform. The product enables secure data transfer and integration with other systems or applications. The "data analytics toolkit, that will enable the collection and aggregation of complex data structures is considered privacy friendly.
PbD product Risk assessment	The User Product (as described by the Technological Partner) is related to the estimation of soil erosion, without engaging personal data and or other security sensitive topics, thus a PbD risk assessment is not required for this product.
Conclusion	The User Product (as described by the Technological Partner) does not raise any privacy or security concerns.

UP3: Fire Detection through Social Sensing

The user product Fire detection through Social Sensing consists of two subsystems, the notification system (Table 5) and the crowdsourcing system (Table 6).

Notification system

Table 5. PbD analysis for the notification system of the crowd sourcing tool.

Generic description	A notification system based on X (formerly Twitter) data, which will be sorted into certain languages. If the text is in Indonesian, English, French, Italian or Greek, then the system will classify into fire or not. When the data is classified into fire then the system will detect the location. If there are a few tweets in a certain location in a certain period, the system will decide to notify the relevant stakeholders.
Potential Privacy by Design issues	Key functionalities include refining the X (formerly Twitter) collection process for social media posts, in line with the new X API policies and rate limits, extending the location extraction module, supporting geotagging for English, Italian, Greek, French, and Indonesian languages, detecting fire events through spatiotemporal clustering, enhancing the precision of fire event identification, and improve standalone user interface regarding fire event visualization. Additional functionalities may include fire and smoke detection based on image content, text relevance classification for English, Italian, Greek, French, and Indonesian languages, text categorization, textual concept extraction, event recognition, and use of semantic representation for connection with other visualizations. The product requires users to connect/register through a personal account. A user consent form is required.
Potential Security issues	The product to be developed implements strong access controls and authentication mechanisms to ensure Data Security.
PbD product Risk assessment	The system should respect legal requirements concerning security standards, human-machine protocols, and data protection aspects, particularly in terms of international data exchange. It shall process

	data in a manner that ensures appropriate security of the personal data, including protection against unauthorized, or unlawful processing and accidental loss, destruction or damage, using appropriate technical or organizational measures.
Conclusion	The User Product (as described by the Technological Partner) is designed and developed in compliance with the GDPR requirements. It is recommended that all technical measures, to protect information from being accessed by unauthorized parties once the system is implemented, should be taken promptly to avoid any physical or technical incident, such us to prevent unauthorized access to the system etc.

Crowdsourcing technology

Table 6. PbD analysis for the technology of crowdsourcing as a core element of the tool.

Generic description	UP3 solution utilizes crowdsourcing technology to achieve early wildfire detection, with a specific focus on social media sensing and concept extraction. Three Social Media Crawlers make sure that real-time posts are gathered based on pre-defined keywords. Collected posts (stored in JSON format) are being further analyzed by a sophisticated Social Media Analysis Toolkit, employing advanced algorithms to extract insights from both texts and visuals. To enhance situational awareness, a Fire Event Detection Module actively monitors social media posts, generates real-time fire events, and depicts them as pins on a map.
Potential Privacy by Design issues	The system collects personal and sensitive data in real time. The product complies with relevant national (Greek) and EU privacy laws and regulations. The principle of Data Minimization is applied in the crowdsourcing solution. A user consent form is required.
Potential Security issues	The product implements strong access controls and authentication mechanisms to ensure Data Security. The product prevents unauthorized access, disclosure, or alteration of data within the cloud platform whereas it also enables secure data transfer and integration with other systems or applications and has mechanisms for detecting and responding to security incidents, including intrusion attempts and data breaches. The technology developer implements robust backup and disaster recovery mechanisms to ensure data availability and resilience. The crowdsourcing technology that enables the extraction, filtering and aggregation of relevant context is considered as privacy friendly. The image-based Fire Detection Algorithm is privacy- friendly when it comes to footage that includes frames showing/depicting people's faces (image or video from any source).
PbD product Risk assessment	The legal basis should be defined and documented before deployment of personal and sensitive data. Where special categories of data or criminal offences-related data are processed, the condition for processing these data should be

	identified and documented. The appointment of a DPO under the EU General Data Protection Regulation (GDPR) is mandatory in the case of Crowdsourcing technology since public authorities or bodies will manage it. Security measures such as encryption, anonymization, logs, mechanisms and authentication methods are already integrated into the system to ensure purpose limitation. The system already implements data minimization within data collection by capturing and communicating a reduced personal data set. The storage of face images, body images and voices are needed to fulfil the primary purpose of the system (detection of fire). The system is expected to produce plans and procedures to prevent or mitigate data loss as a result of a disaster (e.g., disaster recovery plan).
Conclusion	The User Product (as described by the Technological Partner) is designed and developed in compliance with the GDPR requirements. It is recommended that the system ensures the establishment of mechanisms for reporting data breaches within due time, assesses the types of personal data to be collected, and documents where the controller would be required to notify the affected individuals if a breach would occur.

UP 4: Fire Detection from IoT Devices

UP4-A: Fire Detection from IoT Devices

The details for the privacy by design assessment of UP4-A are described in Table 7 below.

Table 7. PbD analysis IoT fire detection technologies.

Generic description	IoT devices, placed in areas of interest, monitor and collect data from multiple sensors, such as temperature/humidity sensors. Data is also collected in the form of images from RGB cameras. Pre-processing and lightweight Machine Learning (ML) analysis of these data takes place on the edge, to check for any fire/smoke incidents. Processed data and detected events are transmitted, stored in SAL (Storage Application Layer) and presented on the SILVANUS platform. Further processing is performed by the Integrated Data Insights (UP9i).
Potential Privacy by Design issues	The product complies with relevant national and EU privacy laws and regulations. The principle of Data Minimization is applied in the UP4-A technology. Personal data are not collected or processed.
Potential Security issues	The product enables secure data transfer and integration with other systems or applications and is considered privacy friendly. The image-based Fire Detection Algorithm is privacy- friendly when it comes to footage that includes frames showing/depicting people's faces (image or video from any source).
PbD product Risk assessment	One vital component of the SILVANUS system is IoT devices, which gather data from various sensors and cameras. This technological product adheres to the principle of Data Minimization, which means

	that it should collect the minimum amount of personal data needed for achieving its goal, anonymize and encrypt data when applicable, and provide access to data for authorized personnel only. Therefore, in the case of sensors, quality of voice and images shall be reduced to ensure anonymization in cases where data quality doesn't affect the system's detection capabilities.
Conclusion	The User Product (as described by the Technological Partner) is designed and developed in compliance with the GDPR requirements. It is recommended that the product includes applying techniques for the anonymization of images (automatically during the capture or procedures to do so immediately subsequently) or mechanisms to initiate and stop the capture of data at any time during the operation.

UP4-B: Fire Detection at the Edge

The details for the privacy by design assessment of UP4-B are described in Table 8.

Table 8. PbD analysis of fire detection at Network edge.

Generic description	UAVs capture geotagged photos of the forest, which will be downloaded to a ground station and added to SAL (Storage Application Layer). The photos will be analyzed at the edge with computer vision algorithms to detect fire and smoke, and the results will be re-injected to SAL. The results will include the image with the detected fire and smoke overlaid, the detection boxes and the confidence level of the detection. The information, along with the geolocation of the photos, will be used in the final user dashboard. The detection algorithm has been trained using a synthetic dataset of roughly 30,000 fire and smoke images form forest areas. This dataset is published in the GitHub repository of SILVANUS. Images are already tagged and prepared for training in COCO format. Upon UAV landing, photos are downloaded and ingested in the SAL. Images are retrieved from the SAL using Rabbit MQ, while analysis results are put back to the SAL. The User interface reads images (with or without detected fire events) and their positions from the SAL, and places them on a map, as pins. In the current data flow of this UP no data is being stored, rather is consumed "on the fly" and then discarded. In any case, the SAL infrastructure allows storage of both input and output data.
Potential Privacy by Design issues	The product complies with relevant national and EU privacy laws and regulations. The principle of Data Minimization is applied in the UP4-B technology. The product employs data anonymization or pseudonymization. A user consent form is required.
Potential Security issues	This "data analytics toolkit, that will enable the collection and aggregation of complex data structures, is considered privacy friendly.

	The image-based Fire Detection Algorithm is privacy friendly when it comes to footage that includes frames showing/depicting people's faces (image or video from any source).
PbD product Risk assessment	This product is equipped with technology for collecting images, videos, sounds or other information. It is a "surveillance" system that may capture the personal data of people passing by a specific area (data subjects). According to the provisions of GDPR, UAVs, like all electronic devices and technological products, must respect the principles of privacy by design and privacy by default. Their usage should aim at ensuring that the processing of data is limited only to those necessary to achieve the purposes. This technological product adheres to both, art.5 (1)(c), which pertains to the principle of Data Minimization and art.32 GDPR, which mentions the applicable security measures, such as: the pseudonymization and encryption of personal data.
Conclusion	The User Product (as described by the Technological Partner) is designed and developed in compliance with the GDPR requirements. It is considered that it also anticipates the need for obtaining consent before collecting and processing personal data, thereby legitimizing the process. It is recommended that the system includes applying techniques for the anonymization of images (automatically during the capture or procedures to do so immediately subsequently) or mechanisms to initiate and stop the capture of data at any time during the operation.

UP5: UxV Monitoring for Wildfire Behaviour

UP5-A: UGV Monitoring for Risk and Wildfire Behaviour

The details for the privacy by design assessment of UP5-A are described in Table 9.

Table 9. PbD analysis of the UGV technologies in wildfire monitoring.

Generic description	Autonomous Unmanned Ground Vehicles (UGVs), equipped with Lidars, cameras, IMU devices and communication nodes, are used to identify fire behaviour and risk, based on environment data analysis, smoke and biomass, to estimate fire propagation patterns. The UGV data analysis helps understanding under-canopy conditions (before and after fire), to allow domain experts generate fire spread models. It also allows predicting the probability of fire spreading to a given area.
Potential Privacy by Design issues	Data will be processed in situ (on the robot platforms and control station). Only relevant knowledge will be sent to SILVANUS repository on the cloud. The principle of Data Minimization is applied in the UP5-A technology.

Potential Security issues	The product uses strong access controls and authentication mechanisms to ensure Data Security and is considered privacy friendly.
PbD product Risk assessment	The product should ensure that any data that has been collected is stored securely and is safe from unauthorised access, alteration, or destruction. This also includes measures such as encryption, anonymization and access controls. Data will be retained for the shortest time necessary for its purpose and will be disposed of appropriately. If an individual requests access to the data collected by the UGV, or if requests that such data should be deleted, the Operator will need to respond to the request in compliance with GDPR rules. The Data Controller of the Operator must address the challenge of providing privacy information.
Conclusion	The User Product (as described by the Technological Partner) is designed and developed in compliance with the GDPR requirements. It is recommended that the system includes applying techniques for the anonymization of images (automatically during the capture or procedures to do so immediately subsequently) or mechanisms to initiate and stop the capture of data at any time during the operation.

UP5-B: Wildfire Behaviour inspection based on UAV deployment

The details for the privacy by design assessment of UP5-B are described in Table 10.

Table 10. PbD analysis of the SILVANUS UAV technologies employed in wildfire monitoring.

Generic description	UAVs will be used to collect data over fire danger zones by means of hyperspectral sensors, aiming to detect new fires or monitor on-going ones, while maximizing operational efficiency and parsimony in resource use.
Potential Privacy by Design issues	Data will not be processed in situ. Raw footage will be transmitted for processing by other SILVANUS modules for fire detection or risk monitoring purposes.
Potential Security issues	The principle of Data Minimization is applied in the UP5-B technology. The product uses strong access controls and authentication mechanisms to ensure Data Security and is considered privacy friendly.
PbD product Risk assessment	This sub-product has the same characteristics as the UP5-A (UGV monitoring of wildfires), hence the PbD assessment includes all the above-mentioned risks.
Conclusion **(As described at UP5-A, in addition to the below)**	(As described at UP5-A, in addition to the below) The User Product (as described by the Technological Partner) is designed and developed in compliance with the GDPR requirements. It is recommended that the system ensures that data not needed to fulfil the system's purposes is not collected, processed or used by

	other SILVANUS modules for the detection or risk monitoring purposes.

UP6: Fire Spread Forecast

The details for the privacy by design assessment of UP6 are described in Table 11.

Table 11. The fire spread PbD analysis.

Generic description	The Fire Spread Model (FSM) is a machine learning (ML) tool aiming to predict the development and spread of wildfires over the next 24-hour period. The FSM uses several parameters as inputs including: the terrain (elevation, slope, aspect), meteorological forecasts (temperature, wind speed, wind direction etc.), fuel parameters (fuel type, moisture, canopy characteristics etc.), barriers (firefighter efforts, roads, bodies of water etc.) and the current location of the fire front. Given this information, the tool will generate a series of images depicting the fire-front location at 28 indicative times over the upcoming 24-hour period. The results of the simulation are sent to the User interface for visualization in the command center.
Potential Privacy by Design issues	The following inputs are possible inputs to the model, provided by other SILVANUS UP's or external databases/services: Topography of the area (aspect, elevation, slope), from Copernicus Digital Elevation Maps (DEM). Meteorological data (temperature, wind speed, wind direction, relative humidity, cloud coverage, hourly precipitation). Road networks, acting as fire transmission barrier, from OpenStreetMaps, water bodies data, from Copernicus. The principle of Data Minimization is applied in this technology.
Potential Security issues	The product to be developed prevents unauthorized access, disclosure, or alteration of data within the cloud platform. The Fire Spread Model (FSM) enables secure data transfer and integration with other systems or applications. This "data analytics toolkit", that will enable the collection and aggregation of complex data structures is considered as privacy friendly.
PbD product Risk assessment	The product should ensure encryption of data that will be transferred or stored. Data minimization should be achieved by applying techniques such as feature selection, dimensionality reduction, data compression, or data aggregation, that remove or combine irrelevant, redundant, or noisy data. Data anonymization should also be achieved and combined with other methods of data protection, such as encryption or differential privacy.
Conclusion	The User Product (as described by the Technological Partner) is designed and developed in compliance with the GDPR requirements. It is recommended that the system ensures data minimization (by

	careful evaluation of the trade-off between data efficiency and data quality), data encryption (that will prevent unauthorized access to the data) and data anonymization.

UP7: Woode Mobile Application

The details for the privacy by design assessment of UP7 are described in Table 12.

Table 12. PbD analysis for the Wood-e mobile application

Generic description	A mobile App for fire awareness, biodiversity information collection and analysis. The App enables users to collect relevant images from forests; the images are further processed to detect tree/plant species present in the forest. The Woode app is designed for citizens, eco researchers, fire fighters, civil authorities, and other stakeholders interested in gathering information about forest conditions/state.
Potential Privacy by Design issues	Image content and metadata associated with the user's location will be uploaded as data assets to the SILVANUS platform. The Geo-JSON data representation will be stored and processed in a SILVANUS cloud server. Post analysis data will be published in GeoJSON. All crowdsourced information is consolidated against the geographical location where images are being collected.
Potential Security issues	The product to be developed implements strong access controls and authentication mechanisms to ensure Data Security and prevents unauthorized access, disclosure, or alteration of data within the cloud platform. The product enables secure data transfer and integration with other systems or applications. This “data analytics toolkit, that will enable the collection and aggregation of complex data structures is considered as privacy friendly. The image-based Wood-e mobile application is privacy friendly when it comes to footage that includes frames showing/depicting people's faces (image or video from any source).
PbD product Risk assessment	The Woode mobile app requires users to connect/register through any type of personal account. The product should also ensure lawfulness processing which is carried out on the basis for processing established in Article 6.1 of the GDPR. The principles of fairness and transparency should be respected. The data subject must be informed of the processing operation's existence and its purposes (see Article 60). Therefore, a user consent form is required. Relevant criteria of this product (image content and metadata) concern data avoidance and minimization as well as various transparency issues, such as encryption and anonymization or pseudonymization.

Conclusion	The User Product (as described by the Technological Partner) is designed and developed in compliance with the GDPR requirements. It is recommended that the system ensures that only personal data necessary for the purpose(s) should be processed. The app should be isolated from the platform as much as possible; usage data concerning the app should not be communicated to the platform provider. If the personal data cannot be erased, they should be anonymized or, if this is not possible, anonymized or pseudonymized as soon as possible.

UP8: Citizen engagement and information sharing and mobile applications

UP8-A: Citizen engagement mobile application

The details for the privacy by design assessment of UP8-A are described in Table 13.

Table 13. PbD analysis of the fire reporting module in the citizen engagement application

Generic description	UP8-A provides information and learning opportunities related to risks, fire threats, safe practices, wildfire prevention/management, and after-fire rehabilitation. It is designed for use by the public (people living in wooded regions, forest- and landowners, affected communities, visitors, Civil Protection authorities, local administrators, First responders, Fire fighters. Our application is committed to the principles of Privacy by Design (PbD), ensuring that user privacy is an integral part of the app from the initial design stages through to the final product. This approach means that the developer of the app proactively embeds privacy into it.
Potential Privacy by Design issues	The collection of personal data in the fire report module for the application to function effectively. Data being intercepted or accessed by unauthorized parties could be an issue. A user consent form is required that ensures users are aware of how their data is being used and processed. The system implements data anonymization and minimization mechanisms to protect the privacy of the data and the users.
Potential Security issues	The technological product implements strong access controls and authentication mechanisms to ensure Data security. The fire reporting module enables secure data transfer and integration with other systems or application. Within this product, robust backup and disaster recovery mechanisms have been implemented to ensure data availability and resilience. The tool depends on third-party services that may contain vulnerabilities.
PbD product Risk assessment	The product collects personal and sensitive data. It ensures that data not needed to fulfil the system's purposes are not collected or used. The application implements encryption of data stored on databases.
Conclusion	The User Product (as described by the Technological Partner) is designed and developed in compliance with the GDPR requirements.

	It is recommended that the system ensures that the data subject will be informed of the processing operation's existence and its purposes (see Article 60) by providing its informed consent. Since the product employs end-users tracking technologies, technical mechanisms to protect information from being accessed by unauthorized parties once the system is implemented should be taken. The system should ensure prevention of unauthorized access, disclosure or alteration of data withing the SILVANUS cloud. The data minimization principle should be applied (data should not be more than what is strictly necessary) to achieve the purpose of the processing.

UP8-B: Citizen situational awareness and information sharing

The details for the privacy by design assessment of UP8-B are described in Table 14.

Table 14. PbD analysis of the situational awareness module through the CEP.

Generic description	The citizen engagement mobile app is designed to engage citizens in forest management, especially in the context of wildfires. It provides tools for monitoring, reporting and responding to forest conditions, fostering community involvement and awareness in preserving and protecting forested areas from wildfire threats.
Potential Privacy by Design issues	Exchange of data between mobile devices and the distributed communication infrastructure for collection, processing, aggregation and distributing the data to and from mobile users. Technologies used: MQTT (EMQX and specialized Erlang services), File Server (large binary data transfer over HTTPS), Dockized MapTiler server (vector map data), R-star tree index (GeoJSON data store/query). The principle of Data Minimization is applied in this technology. The system ensures end-to-end encryption of sensitive data.
Potential Security issues	The technological product implements strong access controls and authentication mechanisms to ensure Data security and prevents unauthorized access, disclosure, or alteration of data within the cloud platform. The mobile app enables secure data transfer and integration with other systems or applications. The product employs user tracking technologies. This “data analytics toolkit, that will enable the collection and aggregation of complex data structures” is considered as privacy friendly.
PbD product Risk assessment	The product collects personal and sensitive data. This sub-product has the same characteristics as the UP8-A (Fire reporting module), hence the PbD assessment includes all the above-mentioned risks.

Conclusion (as described at UP8-A, in addition to the below)	The User Product (as described by the Technological Partner) is designed and developed in compliance with the GDPR requirements. It is recommended that the system ensures that the data subject will be informed of the processing operation's existence and its purposes (see Article 60) by providing its informed consent. Since the product employs end-users tracking technologies, technical mechanisms to protect information from being accessed by unauthorized parties once the system is implemented should be taken. The system should ensure prevention of unauthorized access, disclosure or alteration of data withing the SILVANUS cloud. The data minimization principle should be applied (data should not be more than what is strictly necessary) to achieve the purpose of the processing. It is also recommended that the system ensures robust backup and disaster recovery mechanisms with the scope to ensure data availability and resilience. For instance, regular data backups to secure cloud storage or servers, version control systems for code tracking, comprehensive disaster recovery plans, regularly tests for backup processes, secure backup storage with encryption and access controls, and monitoring systems with alerts for proactive maintenance.

UP9: Decision Support System (DSS)

UP9-A: Resource Allocation of Response Teams (DSS-RART)

The details for the privacy by design assessment of UP9-A are described in Table 15.

Table 15. PbD analysis of the resource allocation module.

Generic description	UP9a aims to assist commanders in making optimal decisions regarding resource allocation of response teams, based on fire development and on the actual status of available field teams. The product performs an optimization process, to cover the target area considering available resources, and multiple parameters related to geospatial data, population distribution and terrain characteristics. It emphasizes the importance of minimizing the overall expected impact of wildfire incidents.
Potential Privacy by Design issues	The UP uses fire spread model/forecast data, population density data, fire unit real-time distribution data, fire unit properties and Area properties. Processed data are output in GeoJSON format, for better to visualize the actual/suggested resource allocation on a grid.
Potential Security issues	The DSS-RAR implements strong access controls and authentication mechanisms to ensure Data security, and prevents unauthorized access, disclosure, or alteration of data within the cloud platform. It enables secure data transfer and integration with other systems or applications.

PbD product Risk assessment	The product should ensure that data not required for the system's purposes is not collected or used. As an additional data minimization measure, in the case of sentinels/satellites, images shall be reduced to ensure anonymization in cases where data quality does not affect the system's detection capabilities. The system implements strong access controls with respect to article 32 of GDPR on applicable security measures and capacities.
Conclusion	The User Product is designed and developed in compliance with the GDPR requirements. It is recommended that the data subjects (if any) must be kept to a minimum and should not be more than what is strictly necessary to achieve the purpose of processing.

UP9-B: Health Impact Assessment (DSS-HIA)

The details for the privacy by design assessment of UP9-B are described in Table 16 below.

Table 16. PbD analysis of the health impact assessment module.

Generic description	This module monitors, with the use of portable and stationary solutions, the concentrations of pollutants emitted by the fire and characterizes the air quality in the affected area.
Potential Privacy by Design issues	The product complies with relevant national and EU privacy laws and regulations. The principle of Data Minimization is applied in this mobile app, which ensures end-to-end encryption of sensitive data (not at this stage, it would be necessary to indicate how the solution (if associated to an individual in commercial use) would require consent from the end-user).
Potential Security issues	The product to be developed prevents unauthorized access, disclosure, or alteration of data within the cloud platform. This module enables secure data transfer and integration with other systems or applications. This “data analytics toolkit, that will enable the collection and aggregation of complex data structures” is considered privacy friendly.
PbD product Risk assessment	The product does not collect any personal and sensitive data. It ensures that data not needed to fulfil the system's purposes are not collected or used. The app implements encryption of data stored on databases. The User Product (as described by the Technological Partner) is designed and developed in compliance with the GDPR requirements. It is recommended that the system ensures that the data subject will be informed of the processing operation's existence and its purposes (see Article 60) by providing its informed consent (not at this stage, but only if the app will be used for commercial reasons).

	Since the product employs end-users tracking technologies, technical mechanisms to protect information from being accessed by unauthorized parties once the system is implemented should be taken. The system should ensure prevention of unauthorised access, disclosure or alteration of data withing the SILVANUS cloud. The data minimization principle should be applied (data should not be more than what is strictly necessary) to achieve the purpose of the processing.
Conclusion	The User Product is designed and developed in compliance with the GDPR requirements. It is recommended that the future data subjects must be kept to a minimum and should not be more than what is strictly necessary to achieve the purpose of processing (when the product will be commercially exploitable).

UP9-C: Evacuation route planning (DSS-ERP)

The details for the privacy by design assessment of UP9-C are described in Table 17.

Table 17. PbD analysis of the evacuation route planning component.

Generic description	The evacuation route planning component's main objective is to guarantee the secure displacement of civilians and fire responders from a region affected by a wildfire.
Potential Privacy by Design issues	The system collects personal or sensitive data. The product complies with relevant national and EU privacy laws and regulations. The principle of Data Minimization is applied in this product, which ensures end-to-end encryption of personal and sensitive data.
Potential Security issues	The product to be developed prevents unauthorized access, disclosure, or alteration of data within the cloud platform. This module enables secure data transfer and integration with other systems or applications. The “data analytics toolkit”, that will enable the collection and aggregation of complex data structures” is considered privacy friendly.
PbD product Risk assessment	The product collects personal and sensitive data. It ensures that data not needed to fulfil the system's purposes are not collected or used. The system should ensure prevention of unauthorised access, disclosure or alteration of data withing the SILVANUS cloud. The data minimisation principle should be applied (data should not be more than what is strictly necessary) to achieve the purpose of the processing.
Conclusion	The User Product is designed and developed in compliance with the GDPR requirements. It is recommended that the system ensures

	robust backup and disaster recovery mechanisms with the scope to ensure data availability and resilience.

UP9-D: Ecological Resilience Index (DSS-ERI)

The details for the privacy by design assessment of UP9-D are described in Table 18 .

Table 18. PbD analysis of the ecological resilience index module.

Generic description	The product calculates the ecological resilience for user-specified fire events, based on NDVI data (Normalized Difference Vegetation Index). It allows user-defined location and date filtering for fire event analysis; it handles missing NDVI data for specific timeframes; it also sets resilience calculation thresholds (e.g., good NDVI timeframe, recovery thresholds).
Potential Privacy by Design issues	NDVI data from Sentinel-2B satellite images (TIFF format) are used, along with fire event data (location, date) provided by administrators. Also, user input data for filtering purposes (start date, end date, location).
Potential Security issues	This product enables secure data transfer and integration with other systems or applications. This "data analytics toolkit", that will enable the collection and aggregation of complex data structures" is considered privacy friendly.
PbD product Risk assessment	No personal or sensitive data is collected in this product.
Conclusion	The User Product (as described by the Technological Partner) is designed and developed in compliance with the GDPR requirements.

UP9-E: Continuous Monitoring of Rehabilitation Strategy Index (DSS-CMRSI)

The details for the privacy by design assessment of UP9-E are described in Table 19.

Table 19. PbD analysis of the restoration/rehabilitation monitoring module.

Generic description	UP9-E takes input regarding fire incidents, rehabilitation programs, policy, and soil measurement; it stores data of forest fire related variables. It transforms satellite images into the required index (NDVI, FCD, NBR), stores societal related data in spatio-temporal templates, and overlays spatial temporal data on base maps.
Potential Privacy by Design issues	Earth monitoring TIFF File – source Copernicus and USGS, Modis – source NASA, Era 5 - Copernicus, GDP data (csv/xls), population density (in csv/xls format, sourced from the World bank). Manual Input of policy (text, numeric and document), program (text, numeric and document), fire incident (text/numeric).
Potential Security issues	This product enables secure data transfer and integration with other systems or applications.

	This "data analytics toolkit, that will enable the collection and aggregation of complex data structures" is considered privacy friendly.
PbD product Risk assessment	No personal or sensitive data is collected by this product.
Conclusion	The User Product (as described by the Technological Partner) is designed and developed in compliance with the GDPR requirements.

UP9-F: Biodiversity Index Calculation (DSS-BIC)

The details for the privacy by design assessment of UP9-F are described in Table 20.

Table 20. PbD analysis of the biodiversity index tool.

Generic description	UP9-F receives input from landcover data images, transforms satellite images into the required index (Shannon Index, Evenness), overlays the spatial temporal data on the base map. It provides time series analysis of the biodiversity prior to/during fire events and after forest rehabilitation. It calculates landscape biodiversity.
Potential Privacy by Design issues	The product to be developed requires users to connect/register through a personal account. The Index complies with relevant national and EU privacy laws and regulations.
Potential Security issues	This product enables secure data transfer and integration with other systems or applications. This "data analytics toolkit", that will enable the collection and aggregation of "complex data structures" is considered privacy friendly.
PbD product Risk assessment	The product collects personal data when users register. It ensures that data not needed to fulfil the system's purposes are not collected or used. The Index implements encryption of data stored on databases. The User Product (as described by the Technological Partner) is designed and developed in compliance with the GDPR requirements. It is recommended that the system ensures that the data subject will be informed of the processing operation's existence and its purposes (see Article 60) by providing its informed consent. Since the product employs end-users tracking technologies, technical mechanisms to protect information from being accessed by unauthorized parties once the system is implemented should be taken. The system should ensure prevention of unauthorised access, disclosure or alteration of data within the SILVANUS cloud.

	The data minimisation principle should be applied (data should not be more than what is strictly necessary) to achieve the purpose of the processing.
Conclusion	The User Product is designed and developed in compliance with the GDPR requirements. It is recommended that the data subjects (if any) must be kept to a minimum and should not be more than what is strictly necessary to achieve the purpose of processing.

UP9-G: Soil Erosion Index (DSS-SEI)

The details for the privacy by design assessment of UP9-G are described in Table 21.

Table 21. PbD analysis of the Soil Erosion index module.

Generic description	This UP uses a conceptual (empirical)-based model, namely the Modified Universal Soil Loss Equation (MUSLE), to calculate soil erosion in each pilot forest area. It receives input for fire incidents, resilience and rehabilitation programs, policies, and soil measurements, stores data related to soil erosion variables, transforms topographic data into required variables, such as slope and flow path length, stores environmental spatiotemporal data, overlays spatial-temporal data on a base map, and provides a time series analysis of forest soil erosion pre- and post-fire incident, and after-forest rehabilitation. Secondary functionalities may include converting raw data into desired variable values. The stakeholders and users of UP9F are environmental researchers, forest managers, and policy makers. The input data types, and hardware sources/actuators include Digital Elevation Models (DEM) in geotiff format, monthly average precipitation in csv or raster format, and vegetation type using Copernicus satellite images. Data transport technologies involve receiving data through a data form from the UI and providing data in csv format. Data repositories include internal database repositories and object storage. The data flow process includes the user selecting the area of interest, providing precipitation data and vegetation type (if simulation is needed) or leaving default values, the system running the analysis on specific values and landscape, and outputting a csv with the soil erosion index. Data analytics methods used involve value extraction through a mathematical model combining different parameters and empty data infiltration using techniques like linear regression and linear interpolation.
Potential Privacy by Design issues	No potential Privacy issues are raised in this product.
Potential Security issues	No potential Security issues are raised in this product.

PbD product Risk assessment	The User Product (as described by the Technological Partner) is related to the estimation of soil erosion based on the collection of soil data, without engaging personal data and or other security sensitive topics, thus a PbD risk assessment is not required for this product.
Conclusion	The User Product (as described by the Technological Partner) does not raise any privacy or security concerns.

UP9-H: Integrated Data Insights (DSS-IDI)

The details for the privacy by design assessment of UP9-H are described in Table 22.

Table 22. PbD analysis of the Integrated Data Insights module.

Generic description	The main functionality of the Knowledge Base revolves around Integrated Data Insights (IDI). The IDI aims to enhance situational awareness and systematically analyze outcomes from various project components. It integrates human expertise into automated frameworks, enabling entities like government agencies, fire and emergency services, environmental agencies, and health departments to make informed decisions. The Knowledge Base unifies project components, specifically UP3, UP4a and UP9b using a shared vocabulary and a comprehensive, scalable semantic framework for information fusion. This creates a unified Resource Description Framework (RDF)-based semantic Knowledge Base, acting as a foundation for decision support and integrating diverse data sources for enhanced insight and decision-making.
Potential Privacy by Design issues	Data used: Sensor Data; Air Quality; Fire/Smoke Detection; social media - posts; Geolocation
Potential Security issues	This product enables secure data transfer and integration with other systems or applications. The “data analytics toolkit, that will enable the collection and aggregation of complex data structures” is considered privacy friendly.
PbD product Risk assessment	No personal or sensitive data is collected in this product.
Conclusion	The User Product (as described by the Technological Partner) is designed and developed in compliance with the GDPR requirements and does not raise any privacy or security issues.

UP9-I: Priority Resource Allocation based on Forest Fire Probability

The details for the privacy by design assessment of UP9-I are described in Table 23.

Table 23. PbD analysis for the Priority Resource Allocation.

Generic description	Data Fusion is an application to predict wildfire in some areas, based on static and dynamic variables. Data fusion uses Fuzzy logic to calculate the fire probability in some areas, while Monte Carlo is used

	to calculate the area and Bayes theorem is used to calculate the priority level of resource allocation. Provides 14 variable characteristics of the forests both human related and physical-environmental; Provides the danger levels of fire in regards of their characteristics; Provides the priority level of resources allocation in line with area characteristics and danger levels. The product is based on public data such as: Satellite maps, ASTER GDEM, Era 5, OpenstreetMaps, Sentinel, World Bank data, Local, and Local government data.
Potential Privacy by Design issues	The product to be developed requires users to connect/register through a personal account.
Potential Security issues	The product to be developed implements strong access control and authentication mechanisms, to ensure Data Security. Any incident of unauthorized access, disclosure, or data alteration is clearly indicated in the cloud platform. The product enables secure data transfer and integration with other systems or applications. This data analytics toolkit that enables the collection and aggregation of complex data structures is considered as privacy friendly.
PbD product Risk assessment	The product collects personal data when users register. It ensures that data not needed to fulfil the system's purposes are not collected or used. As an additional data minimization measure, in the case of sentinels/satellites, images shall be reduced to ensure anonymization in cases where data quality does not affect the system's detection capabilities. The app implements encryption of data stored on databases. The app also implements strong access controls with respect to article 32 of GDPR on applicable security measures and capacities.
Conclusion	The User Product (as described by the Technological Partner) is designed and developed in compliance with the GDPR requirements. It is recommended that the data subjects (if any) must be kept to a minimum and should not be more than what is strictly necessary to achieve the purpose of processing. It is also recommended that the system ensures that the data subject will be informed of the processing operation's existence and its purposes (see Article 60) by providing its informed consent.

UP9-J: Multilingual Forest Fire Alert System (DSS-MFAS)

The details for the privacy by design assessment of UP9-J are described in Table 24.

Table 24. PbD analysis for the Multilingual Forest Fire Alert System

Generic description	This UP provides early warning social media sensing, data fusion and push to the related user in specific language preference and location

	of user responsibility. The detection provides notification decision of fire incidents using multilingual textual framework which is available in multilingual based on each country's language. The UP provides a link to alert recipients to access more detailed data of fire probability on respected spatial distribution on map.
Potential Privacy by Design issues	Data crawling from X account might be potential in having security issues. However, the Technological producer did not put the detailed account information. The data collection refers only to the information crawled from the X post.
Potential Security issues	There is a possibility that the information from the X post will be included in the information from the X post being included in hoax data. Sometimes the X post is also full of false information. This UP handles those problems with the double confirmation of the X information with other data, such as human and environmental factors. Moreover, the UP also follows the key cloak access system.
PbD product Risk assessment	No personal or sensitive data is collected by this system. The product to be developed implements strong access control and authentication mechanisms, to ensure Data Security.
Conclusion	The User Product (as described by the Technological Partner) is designed and developed in compliance with the GDPR requirements.

UP9-K: Deep Learning Model for Wildfire Severity Prediction using EO4Wildfires (AUA)

The details for the privacy by design assessment of UP9-K are described in Table 25.

Table 25. PbD analysis for the Deep Learning Model.

Generic description	A segmentation model that uses Computer Vision to assess the severity of potential future wildfires inside a specific area. It has been developed, leveraging imagery from Sentinel 1 and Sentinel 2, alongside time-series meteorological data sourced from NASA Power. The training dataset, "EO4WildLife," has been curated by AUA within the framework of SILVANUS and is accessible via https://zenodo.org/records/7762564. The finalized architecture is equipped to generate a scalar metric indicating the potential severity of wildfires, in addition to a Boolean mask delineating the affected regions. The trained model can be provided for integration as an API service. Note that no user data or inference data will be retained after the service's invocation.
Potential Privacy by Design issues	It uses the following types of data: • Sentinel 1 VV, VH, (VV-VH)/(VV+VH) • Sentinel 2 mosaic, bands (02, 03, 04, 05, 08, 11) • NASA Power (9 metrics for 30 past days)

Potential Security issues	This product enables secure data transfer and integration with other systems or applications. The "data analytics toolkit", that will enable the collection and aggregation of complex data structures" is considered privacy friendly.
PbD product Risk assessment	The model should ensure that data not required for the system's purposes is not collected or used. As an additional data minimization measure, in the case of sentinels/satellites, images shall be reduced to ensure anonymization in cases where data quality does not affect the system's detection capabilities. The tool implements strong access controls with respect to article 32 of GDPR on applicable security measures and capacities.
Conclusion	The User Product (as described by the Technological Partner) is designed and developed in compliance with the GDPR requirements. It is recommended that the data subjects (if any) must be kept to a minimum and should not be more than what is strictly necessary to achieve the purpose of processing.

UP9-L: DSS SIBYLA

The details for the privacy by design assessment of UP9-L are described in Table 26.

Table 26. PbD analysis for the Priority Resource Allocation.

Generic description	DSS SIBYLA is a Tree growth simulator, a versatile tool for modeling forest development across a spectrum of stand structures and ecological conditions. It can model various forest stand structures, from even-aged homogeneous stands to complex selection forests. It can simulate diverse natural conditions based on climate, air, and soil characteristics, providing a broad operational scope for forest managers to implement thinning and felling regimes. It can address key ecological factors like biodiversity, biomass, and nutrient cycles, along with oxygen production and carbon sequestration, including economic dimensions such as the structure of wood assortments, forest revenues, and management costs. It serves as a comprehensive platform for forest managers to predict and plan forest growth, considering both ecological and economic factors.
Potential Privacy by Design issues	The program is freeware, if it is to be used for non-commercial activities, i.e. mainly for education, and research, but also for personal usage if someone is interested in learning about the functions and the possibilities of the growth simulator. The only restriction on its usage is the registration code, which is obtained free of charge when the program is downloaded from the internet. The code is valid for a period of half a year. Afterwards, it is required to download a new half-year code from the internet. Together with the code, the user is bound to download the new version of the program SIBYLA. Every download is free of charge.

	If SIBYLA is to be used for making plans, elaborations, analysis, scenarios, prognosis, advisory and judicial reports ordered by a third person (a physical or a legal entity) or for making profit of an individual or organization, the consent of the authors must be obtained in the form of the paid license. Permission is not required for scientific tasks financed from grants, funds, presents, or sponsors. Link to download: https://sibyla.tuzvo.sk/software.html
Potential Security issues	The product collects personal data by registration in some cases. A potential risk of personal data elaboration may exist, but the cloud platform of SILVANUS implements strong mechanisms to prevent such issues. Among the potential risks could be assigned unauthorized access, disclosure, or alteration of data in the system.
PbD product Risk assessment	The tool is a freely available software for research purposes. Nevertheless, the tool is being protected by the SILVANUS platform encryption and relevant purposes and are consistent with relevant national and EU laws. As an independent tool it respects privacy by design with the necessary consents.
Conclusion	The User Product is developed in compliance with GDPR requirements. The product collects personal data by registration. This is provided in accordance with General Data Protection Regulation (GDPR - EU law 2016/679) on data protection and privacy for all individuals within the European Union (EU) and the European Economic Area (EEA). The potential user must give his/her consent which allows SIBYLA development team to store this information only for statistical purposes for a period of 10 years. The user is informed and provides his/her consent. The product is developed and secured to prevent unauthorized access, disclosure, even alteration of data stored in the system.

UP10: SILVANUS Forward Command Center

The details for the privacy by design assessment of UP10 are described in Table 27.

Table 27. PbD analysis for the forward command center.

Generic description	The fire commander will have the capability to oversee firefighting operations using Forward Command Centers (FCCs). These FCCs will connect to both the Edge Micro Data Center (EMDC) and the SILVANUS cloud, enhancing the management of such incidents. The EMDC hosts components of the SILVANUS system. It consists of specialized IT servers configured to operate at the edge, outside the primary cloud data center, to support the Fire Commander's tactical needs (e.g., DSS Apps). Due to the limited storage capacity of these devices, EMDCs will store general data as

	well as specific information for each pilot, with only essential data subsets being cached at the edge. The EMDC service will retrieve data from its local object store by searching and querying the local metadata index. If the data object is not found locally, the Local Storage Abstraction Layer will consult the cloud metadata index. Once the required data is located, it will be downloaded to the local object store, ensuring that the most recent versions of certain data objects are always available locally. The data analytics approach incorporates a mathematical model that leverages fuzzy logic to handle uncertainty and imprecision, alongside the Monte Carlo method for problem-solving through random sampling, and the Bayesian method for statistical inference. For data visualization and decision support systems (DSS), graphical representations are utilized to provide a clear and intuitive understanding of data, complemented by descriptive analytics to summarize and interpret the information. This multifaceted methodology ensures a robust analytical framework, enhancing the decision-making process with a comprehensive view of the data landscape

Potential Privacy by Design issues	The SILVANUS Forward Command Center (Dashboard) would integrate a diverse set of geospatial and environmental data, including topographical and terrain data from Satellite maps and ASTER GDEM, climate and atmospheric data from Era 5, detailed street, and infrastructure data from OpenStreetMap, and socio-economic data from sources like Sentinel, Worldbank, and Local government records. Each data source presents unique Privacy by Design challenges. For instance, Satellite maps and ASTER GDEM may raise concerns about the resolution of images and the potential for identifying individuals or sensitive locations. OpenStreetMap emphasizes the importance of not mapping private information to respect individual privacy. Sentinel data, being part of a larger system, has protocols to de-identify personal information, ensuring privacy is maintained. Worldbank has a robust policy on personal data privacy, reflecting its commitment to responsible data handling. Lastly, data from Local governments must be managed with care to protect citizens' privacy, especially in smart city applications where data security and privacy are paramount. In designing the dashboard, it is crucial to ensure that data integration respects these privacy considerations, employing strategies like data anonymization, secure data storage, and clear data governance policies to mitigate potential privacy risks. FCC delegates data access permissions to the data owners by utilizing the 'access' field in the metadata. This field enables FCC, through integration with Key cloak, to manage privacy and security on the platform. In simple terms, users can only access or ingest data into the system if they have the appropriate role, which is granted by the data owners. Currently, part of this process is manual. However, we anticipate having it fully automated in the coming integration cycle for all services.
Potential Security issues	This product enables secure data transfer and integration with other systems or applications. This "data analytics toolkit", that will enable the collection and aggregation of "complex data structures" is considered privacy friendly. All communication between the FCC and other parties is TLS-enabled and supports AAA over Key cloak.
PbD product Risk assessment	The product collects personal data. It ensures that data not needed to fulfil the system's purposes are not collected or used. The Dashboard implements encryption of data stored on databases. Since the product employs end-users tracking technologies, technical mechanisms to protect information from being accessed by unauthorized parties once the system is implemented should be taken.

	The system should ensure prevention of unauthorised access, disclosure or alteration of data withing the SILVANUS cloud. The data minimisation principle should be applied (data should not be more than what is strictly necessary) to achieve the purpose of the processing.
Conclusion	The User Product (as described by the Technological Partner) is designed and developed in compliance with the GDPR requirements. It is recommended that the data subjects (if any) must be kept to a minimum and should not be more than what is strictly necessary to achieve the purpose of processing. It is also recommended that the system ensures that the data subject will be informed of the processing operation's existence and its purposes (see Article 60) by providing its informed consent.

UP 11 SILVANUS User Interface Dashboard

The details for the privacy by design assessment of SILVANUS GUI are described in Table 28.

Table 28. PbD analysis for the SILVANUS Dashboard GUI.

Generic description	The Dashboard is a sophisticated and interactive tool designed to present a wealth of data in a visually engaging manner. Through the utilization of charts, tables, maps, and other graphical elements, this panel offers users a comprehensive overview of various datasets. Its primary function is to streamline access to critical information, ensuring users can swiftly retrieve and interpret essential data. One of the standout features of the Dashboard is its ability to incorporate map layers that correspond to diverse data sources, typically supplied by other User Profiles. This integration enhances the depth and breadth of information available, enabling users to gain insights from multiple perspectives. Moreover, the Dashboard facilitates seamless communication between citizens and firefighters by seamlessly integrating with mobile applications. This connectivity fosters real-time interaction and collaboration, enhancing emergency response capabilities. Targeting firefighters, analysts, and public administration entities, the Dashboard serves as a pivotal tool in the decision-making process. By presenting data in a clear and intuitive manner, users can assess the relevance of information swiftly and effectively. Ultimately, the Dashboard empowers users to make informed decisions based on a comprehensive understanding of the data at hand, thereby enhancing operational efficiency and response effectiveness.
Potential Privacy by Design issues	No potential Privacy issues are raised in this product.
Potential Security issues	No potential Security issues are raised in this product.

PbD product Risk assessment	As a purely visualization mechanism, the UP may imply privacy issues only if critical information or sensitive is exposed to unauthorized users. Taking that into account, this product will be available to authorized personnel only, like fire commanders, this risk is considered minimal.
Conclusion	No PbD issues are raised for this product

UP 12 - Mesh in the Sky

The details for the privacy by design assessment of Mesh in the Sky infrastructure are described in Table 29.

Table 29. PbD analysis for Mesh in the Sky.

Generic description	A cutting-edge solution that specializes in providing wireless communication infrastructure through Mesh network radios. This innovative technology enables seamless communication between first responders and connected citizens, fostering efficient and effective information exchange during critical situations. Targeting a diverse user base including first responders, civil protection authorities, citizens, and foresters, the UP plays a crucial role in facilitating real-time communication and collaboration. By deploying wireless mesh nodes as hardware devices, the UP establishes a robust transport layer for data communication, ensuring reliable connectivity in various scenarios. With support for IP/TCP standard protocols, the UP ensures compatibility and interoperability with existing network infrastructures, enhancing connectivity and communication capabilities. In addition, in-situ devices deployed in the field are seamlessly integrated into the IP/TCP network, enabling seamless data communication and information sharing. Furthermore, the UP incorporates MQTT protocol support, enabling the establishment of communication channels between forward command centers and field devices. This protocol enhances the efficiency of data transmission and facilitates real-time decision-making processes, ultimately improving response times and coordination during emergencies.
Potential Privacy by Design issues	The product to be developed requires users to connect/register through a personal account. It also complies with relevant national and EU privacy laws and regulations.
Potential Security issues	This product enables secure data transfer and integration with other systems or applications. This “data analytics toolkit, that will enable the collection and aggregation of complex data structures” is considered privacy friendly.

PbD product Risk assessment	Mesh networking technology is ideal, among other things, for IoT applications, where multiple devices need to communicate with each other, such as drones, for instance. Although this user product itself may not directly collect, process or transmit personal data, there is potentially a risk through the interconnected devices it links, which may gather personal data via cameras or sensors.
Conclusion	The User Product (as described by the technological partner) is designed and developed in compliance with GDPR requirements, as it ensures data encryption (that will prevent unauthorized access to the data). It is recommended that the system ensures robust back up and disaster recovery mechanisms with the scope to ensure data availability and resilience.

SILVANUS Other Products and targeted services

1. SILVANUS platform

Evacuation and Health modules

The details for the privacy by design assessment of 1-A are described in Table 30.

Table 30. PbD analysis for evacuation and health modules.

Generic description	The product targets to provide solutions towards the collection of pollution data as they are generated by wildfires and support an alerting mechanism that informs the affected persons (i.e., local commanders, first responders, citizens in nearby areas). Additionally, the UP aims at delivering the safest evacuation paths to be adopted by citizens that should evacuate the affected areas. It is worth mentioning that the proposed and implemented modules do not correlate the collected data with any person as the discussed data are those being monitored by sensors and deal with values of CO/CO2, NOx, O3, etc. We consider two parts of the monitoring component, i.e., a static part where Libelium sensors are placed in statis locations (e.g., on firefighting vehicles or in the surrounding areas) and a mobile part where sensors connected with a Raspberry Pi in a box are carried by first responders. Hence, we have the opportunity to collect the desired data and send them to the back-end system where an additional level of processing takes place. The module related to the delivery of evacuation paths gets information for the movement of fire, thus, smoke and pollution materials, calculates their speed and direction to result in the safest evacuation routes.
Potential Privacy by Design issues	The product complies with relevant national and EU privacy laws and regulations. The principle of Data Minimization is applied in this technological product. The system does not collect any personal or other sensitive data but only data related to the results (pollution) of wildfires.

	No potential Privacy issues are raised in this product.
Potential Security issues	The product to be developed prevents unauthorized access, disclosure, or alteration of data within the cloud platform. This module enables secure data transfer and integration with other systems or applications. The analysis of the collected data and the provision of any alert takes place in the SILVANUS Cloud back end where the highest security level is applied. The "data analytics toolkit, that will enable the collection and aggregation of complex data structures" is considered privacy friendly.
PbD product Risk assessment	The product relies on the data collected by environmental sensors applying predictive models upon them to detect the movement of pollution and the outcomes of wildfires. The system does not collect and record any personal data, however, the technological producer adopts with all the security measures taken by the SILVANUS platform to avoid unauthorized access.
Conclusion	No PbD issues are raised for this product.

Platform security solutions

The details for the privacy by design assessment of 1-B are described in Table 31.

Table 31. PbD analysis for Platform security solutions.

Generic description	Ensuring security solutions for SILVANUS architecture and devices.
Potential Privacy by Design issues	Previously collected personal and sensitive data will be used and stored in the SILVANUS platform. The platform's security and encryption mechanisms support to avoid the processing of personal data.
Potential Security issues	The product to be developed is designed to ensure end-to-end encryption of sensitive data already collected. It will implement strong access controls and authentication mechanisms to ensure Data Security. The product prevents unauthorized access, disclosure, or alteration of data within the cloud platform, and it enables secure data transfer and integration with other systems or applications (data flows within SILVANUS apps and services). It is anticipated that all security measures will be implemented.
PbD product Risk assessment	The product has no privacy by design risks itself.
Conclusion	The Product (as described by the Technological Partner) is developed in compliance with GDPR requirements. It is developed and secured to prevent unauthorized access, disclosure, even alteration of data stored in the system. The data

	encryption that will prevent unauthorized access to the data must be implemented.

2. SILVANUS Machine learning model/s (IST-ID)

The details for the privacy by design assessment of machine learning models 3 are described in Table 32.

Table 32. PbD analysis for the Machine Learning Models

Generic description	Two (2) Machine Learning Models are developed. The first one is trained with high-resolution LiDAR data (provided by third-party EDP LABELEC) and low-resolution satellite data, to predict vegetation volume per pixel; once validated the model will be improved by publicly available satellite data. The trained model, the process of model development and associated results will be published as part of an open-access scientific article and the code will be publicly available. The second ML model will be used to manage vegetation growth using cattle. Based on information from the technological partner, the machine learning model, is a potential product that could be integrated in SILVANUS platform. It can be used by researchers and agencies to map fractional covers as a factor influencing landscape fire hazard and to support landscape management (i.e. identify areas requiring management).
Potential Privacy by Design issues	The products comply with relevant national and EU privacy laws and regulations.
Potential Security issues	No potential security issues are raised in these machine learning models.
PbD product Risk assessment	The data sharing of the machine learning models is not expected to be an issue, since the data required to run both models will be publicly available and the models themselves will be published as part of a scientific publication. So, the models will not violate any EU privacy laws and regulations, as the data required for them to operate, will be publicly available.
Conclusion	No PbD issues are raised for this product.

2.7 Privacy Impact Assessment (PIA)

SILVANUS technological partners conducted Privacy Impact Assessments (PIAs) to evaluate the privacy risks associated with the products and services that they develop. The results of the PIAs are used to develop action plans for addressing any privacy risks and to ensure that the project's products and services meet the requirements of the GDPR and other relevant privacy laws.

SILVANUS continuously monitors and evaluates its PbD compliance, using feedback from stakeholders, regulatory bodies, and industry best practices. The Consortium regularly

updates its PbD strategy and action plans to ensure that its products and services remain compliant with the latest standards and regulations.

2.8 PbD conclusions and recommendations

Assessing a platform ecosystem's user products (UPs) and services, such as SILVANUS', against Privacy by Design (PbD) principles reveals a strong commitment to data privacy and security compliance with the General Data Protection Regulation (GDPR). Each UP should be carefully designed to comply with privacy principles and ensure the protection of personal data.

Compliance with national and EU laws and regulations is of paramount importance to protect the privacy of individuals and to uphold ethical standards. The careful consideration and implementation of PbD measures by the project partners, especially in high-risk technological products, demonstrates a proactive attitude towards data protection.

Thorough adherence to privacy principles, legal requirements and the application of best practices in data handling underline the partners' commitment to upholding privacy standards. Addressing privacy and data protection challenges early in the project lifecycle can mitigate potential risks and prevent data breaches. It is crucial to remain vigilant about the long-term implications of privacy and data security decisions.

In light of these considerations, a proactive approach to identifying and resolving privacy concerns is essential to maintain the project's ethical standing and ensure stakeholder trust. Ongoing monitoring, regular assessments and a culture of privacy awareness will strengthen the SILVANUS project's commitment to privacy by design and contribute to its overall success in advancing forest management and wildfire prevention while protecting individual privacy rights.

From all the above-mentioned, it emerges that the privacy-by-design issues have been examined, as the partners have taken all appropriate and anticipated measures, especially in cases of technological products where there is a significant risk.

It should be noted that from the description of the technological products and their specific characteristics, combined with the information provided by the partners, it is evident that they have adhered to all principles, requirements and applicable laws concerning PbD and data, which are sensitive and could potentially cause issues.

Moreover, ensuring compliance with Directive (EU) 2022/2555, also known as the NIS 2 Directive, is crucial for the SILVANUS project to align with the high common level of cybersecurity measures mandated across the European Union. By adhering to the NIS 2 Directive's requirements, the project can enhance its cybersecurity capabilities and resilience, thereby safeguarding critical infrastructure and digital services against cyber threats. This alignment with EU cybersecurity regulations not only demonstrates a commitment to data protection and security but also strengthens the project's overall cybersecurity posture. Integrating the principles of the NIS 2 Directive into the privacy by design framework of the SILVANUS project will ensure a comprehensive approach to addressing both privacy and cybersecurity concerns, fostering trust among stakeholders and enhancing the project's credibility in the realm of wildfire management.

Conclusively, the SILVANUS project is a good example in privacy, security and user-centric development. By prioritizing data protection and privacy, the project is paving the way for

innovative solutions in integrated multifunctional forest management and wildfire prevention, response and recovery, while maintaining the highest ethical standards.

3 Societal impact assessment

3.1 Introduction

Amidst the continuous and rapid climate change, according to the IPCC [14] the situation is only expected to deteriorate further, as wildfires become increasingly severe and more extreme. Indeed, throughout the EU, 2023 was one of the continent's worst years in terms of burnt areas' size. Only in Greece the wildfire in Dadia burned according to estimates from EFFIS [15] more than 94,000 hectares of forests and Natura 2000 protected area of Dadia-Lefkimi-Soufli Forest National Park.

The EU, aspiring to reduce the impact of climate change, set up the new EU Strategy on Adaptation to Climate Change [16]. This strategy outlines a comprehensive framework, aiming to respond effectively to the evolving situation, thus establishing a safer and healthier environment for all EU populations.

From that perspective, the protection of forests and consequently the reduction of wildfires are among the key factors, along with other measures, that can provide a holistic approach to this acute problem. Moreover, under the prism of the Green Deal, EU set out the vision and provided funding to a number of projects that could contribute to a series of targets that have to be fulfilled by 2030 [17].

SILVANUS, being a pioneer project, under the Horizon 2020 Green Deal umbrella, in addressing the problem of wildfires, aims to contribute actively to the achievement of those targets, becoming a catalyst towards a better and safer EU environment.

Forests must be protected not only to be part of our world, but also because they offer many ecosystem services related to the world's biodiversity, landscape, society and economy. SILVANUS aims to build an innovative technological platform that will provide real-time information, decisions and training to first responders from the prevention and preparedness to response and suppression and finally support restoration and rehabilitation. Briefly speaking, SILVANUS will promote the protection of forests for a better climate and safer societies.

Clearly, SILVANUS contributes to the following UN Sustainable Development Agenda and Goals 2030 [18] by protecting forests and wildland, in general, from wildfires:

- Goal 6: Ensure availability and sustainable management of water and sanitation for all.
- Goal 12: Ensure sustainable consumption and production patterns.
- Goal 13: Take urgent action to combat climate change and its impacts.
- Goal 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, halt and reverse land degradation and halt biodiversity loss.

In addition to the above goals, SILVANUS will be used mainly by emergency responders and other scientists with the ultimate aim of contributing to a safer and healthier environment for Europe. SILVANUS also addresses the following goals which are more society centric:

- Goal 3: Ensure healthy lives and promote well-being for all at all ages.
- Goal 5: Achieve gender equality and empower all women and girls.
- Goal 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.
- Goal 10: reduce inequality within and among countries.
- Goal 11: Make cities and human settlements inclusive, safe, resilient and sustainable.
- Goal 16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.

SILVANUS is developed by a consortium of 49 partners from academia, research, industry, SMEs, and emergency responders from the public or the private sector. The SILVANUS platform is being built to fit in all cultures and countries providing at the end an international product and sub-products that will work in all environments, terrains, and governance schemes with easy adjustments, if necessary. Thus, its acceptance from society, either from a firefighter in the field or an elder person unaware of the wildfire problems, is crucial for its exploitation.

3.2 Methodology

For the purpose of surveying and analysing SILVANUS' level of acceptance in the society the following inputs were considered:

- The participatory process described in D2.1 [19] and more specifically input related to the society and the acceptance of systems such as SILVANUS.
- A review and main conclusions drawn from the first round of the pilot implementation period as described in deliverables D9.2 [20] and D9.3 [21] and related lessons learned.
- Considerations mentioned by the United Nations and relevant Sustainability Goals [18].
- EU priorities on society and especially their protection from wildfires.
- Answers to a questionnaire that was developed specifically for this purpose with the EU Survey tool (https://ec.europa.eu/eusurvey/runner/SILVANUS_SocialImpactQ).

Results from previous deliverables and especially from the implementations of the pilots are mentioned in the next chapter (Ch. 3.3).

The questionnaire that was developed and is included in Annex II of this document was designed to be answered by all the different types of interested parties/stakeholders engaged by SILVANUS, being professional or volunteering emergency responders, scientists, civil protection officers, local administration, critical infrastructure operators, or the general public. The questionnaire was designed in a way that could be answered easily by any type of adult person with closed questions and spaces for open comments. The questionnaire is also developed upon an inherit dichotomy of stakeholders, namely those directly related to

responding to wildfires (e.g. firefighters, civil protection personnel, etc.) and others that are not part of the first-line response mechanisms (e.g. local community members, researchers, etc.).

This differentiation has been applied at the start of the questionnaire, as responders (including volunteers) are trained to prevent and respond, while others may not simply be aware of the phenomenon. Moreover, this is easier for the questionees as they can select and indicate their expertise much more easily. In this way, no type of stakeholders is excluded by the questionnaire.

The questionnaire has been open since September 2023, being disseminated either after specific pilots or through social media, internet, specific contacts, personal contacts of the SILVANUS partners and university lessons.

The questions are presented and analysed in section 3.4. The overall conclusions are presented in section 3.5.

A detailed presentation of the questionnaire and the relevant analysis of the responses submitted are included in section 3.4 below, while section 3.5 offers some generalized observations and overall conclusions.

Lastly, at this point, it must be highlighted that the questionnaire was designed in accordance with the principles of ethics and privacy by design. Preserving the anonymity or responders has been the cornerstone of this approach, while consensual participation upon acknowledging the relevant information sheet was mandatory before participants were allowed to proceed answering the questions.

3.3 Feedback gathered from pilot implementation.

The SILVANUS platform and its products were designed through a participatory process involving internal project partners and external experts in the fields of forests, wildfires, and civil protection. The process included detailed questionnaires for stakeholders to complete.

The functional requirements of the SILVANUS platform were derived from the initial activities of the participatory process. These requirements were clustered into four categories: “MUST”, “SHOULD”, “COULD”, and “WONT”, for all three phases of wildfires (A, B, C). The requirements upon which SILVANUS was built were validated by a group of experts and stakeholders, including two foresters, three firefighters and fire engineering experts, and two civil protection experts. The study identified both commonalities and differences. The identified “MUST” and “SHOULD” requirements have served as the foundation for SILVANUS. These requirements were used as the basis for the initial version of the platform, which was demonstrated in the first round of pilots (source: deliverable D2.1 [19]).

During the first round of pilot activities, the participatory process continued. This enabled the consortium to make improvements leading to the second version of the platform. The needs expressed by local stakeholders, including representatives from the local communities, were encompassed. This allowed for a broader perspective of society and their opinion of SILVANUS. The social acceptance questionnaire is also a participatory process, as the respondent takes part, remotely, in a type of focus group.

From the first round of pilots, in which SILVANUS was demonstrated to the various local and national stakeholders as a system comprising various tools related to wildfire risk management, it became clear that the SILVANUS platform was a system of interest.

The outcome of the pilot implementation was positive for SILVANUS, especially for its direct users, e.g. emergency responders, civil protection officers, foresters and other scientists. The unique advantage of SILVANUS lies in its ability to address all phases of wildfire risk management, not just response.

The successful demonstration of available data sources and technologies and their benefits for wildfire management was well received. Stakeholders in the pilot area agree that there is potential for future use of the SILVANUS technology.

Some of the benefits of SILVANUS with a positive outcome for society as presented in Deliverable D9.2 [20] are presented below:

- Provision of internet and other 5G and GSM networks in the area.
- Alerts for citizens and tourists through crowdsourcing applications.
- Social media are also interested in the benefits for situational awareness.
- Citizen engagement application for awareness, education, training and support to authorities. In addition, the application is proving to be an effective means of reaching and engaging young people, overcoming the limitations of traditional methods.
- The importance of community wildfire education and training cannot be overstated, as it plays a significant role in increasing awareness, preparedness, response and recovery efforts. The programme, together with the mobile application, was found to be extremely interesting and useful.
- The use of virtual and augmented reality applications for firefighting training, especially for complex scenarios.

- The use of UAVs and UGVs in the field for monitoring, preparation, operational support and even post-burn mapping.
- The use of IoT devices for smoke and fire detection.
- The forward command centers with their mobility can be set up almost anywhere using Mesh in the Sky technologies.
- Health devices have been appreciated by end users, not only because they provide important air quality monitoring data, but also because they are easy to use, portable and easy to install on vehicles.
- Evacuation algorithms are among the most important for firefighters and administrators.
- The fire spread prediction tool has become a critical tool for firefighters and civil protection agencies. Its ability to provide rapid results, in minutes or even seconds, is of immense value to the overall response mechanism.
- The biodiversity application has a dual benefit: a) it can be used by foresters to monitor burned areas and assess the level of regeneration taking place, and b) it provides a unique and engaging opportunity for young people to connect with nature and forests. The application also highlights the importance of restoration and prevention efforts in maintaining biodiversity.
- The Decision Support System (DSS), which can provide valuable feedback during the response phase on the use of resources, potential positions and recommendations for tactics, all in a real-time framework. Of course, its use in scenarios for preparation and training is also of great importance.
- The fact that all the different tools can exist under the same platform, without having other systems and without the user having to transfer data from one system to another.

Despite the benefits of SILVANUS' innovative technologies, the pilots identified a number of challenges to end-users' full acceptance of such technologies. The challenges identified during the pilots are briefly presented below [20]

- The use of cutting-edge technologies in the field can still be a problem for technology providers.
- Firefighters and end-users in general may have difficulties in using the new systems, although this is not a permanent and difficult problem and can be solved with proper training of users.
- Integration of the different technologies can be an issue, especially in the field.
- Advanced mapping technologies and real-time risk analysis is among the necessities of first responders.
- Interoperability is a crucial aspect of the success of SILVANUS. Not only in terms of internal processes, so that the system can take into account the various inputs and provide outputs quickly and in a timely manner that are useful for operations, but also in terms of alignment with existing systems.
- Interoperability is also crucial at a cross-border level, which is very important for Europe.
- False alerts for social media technologies and verification of incoming information can be a challenge.
- IoT devices can pose difficulties ranging from installation, the number of devices required, setting up a network of sensors, and finally ensuring hardware security.

- The performance and accuracy of fire detection algorithms is critical to end users.
- The use of robots and drones to monitor and analyse environmental parameters presents operational challenges.
- Integrating virtual reality solutions into existing firefighting workflows can be challenging.

Overall, all the people involved in the pilots seemed to have a positive outcome towards SILVANUS and its technologies [21]. Through the pilot implementation and depending on the user products that were demonstrated the following technologies were the most referred in terms of added values to the end users such as firefighters and civil protection:

- Fire Detection through social media.
- Fire detection from IoT devices.
- The use of UAVs and UGVs for their multiple functionalities.
- The use of fire spread algorithm.
- The use of the citizen mobile application.
- Some of them also appreciated the AR/VR toolkit for the training of firefighters off sight and more frequently.

The overall characteristics of SILVANUS were valued positively from every type of participating stakeholder considering the challenges mentioned previously. Other types of stakeholders, such as foresters, appreciated the biodiversity application and the GIS and monitoring capabilities of SILVANUS during Phase A and Phase C. Citizen engagement was also raised as significant by various types of stakeholders.

3.4 SILVANUS social assessment analysis

The examination of results from the social acceptance questionnaire of SILVANUS reveals compelling insights garnered from a diverse pool of 877 responses from 23 countries both within and outside the EU, up to the 13th of November 2024 (Figure 3). Predominantly, responses originated from Indonesia (37%) and Greece (31%), with contributions from various other countries like Slovakia, Portugal, Cyprus, Czechia, Italy, Australia, Argentina, Spain, Sweden, Afghanistan, Ghana, New Zealand, Georgia, and France. Notably, approximately 8% of respondents opted not to disclose their nationality.

Regarding gender distribution, 66% of respondents identified as male, while 32% identified as female. The majority of responses stemmed from individuals within the 18-24 age bracket, comprising 54% of the total. Nonetheless, insights from other age brackets such as 35-44 years (15%) and 45-54 years (13%) also enriched the dataset (Figure 4).

Further delving into the analysis, Section 3.4.1 looks into the findings concerning the first category of respondents encompassing emergency responders, professionals, and volunteer firefighters. In turn, Section 3.4.2 elucidates the results pertaining to the second category, including local communities, operators of critical infrastructures, and the general public. Noteworthy is the distribution of 207 responses within the first category and 670 responses within the second category, facilitated by the collaborative efforts of SILVANUS' academic partners.

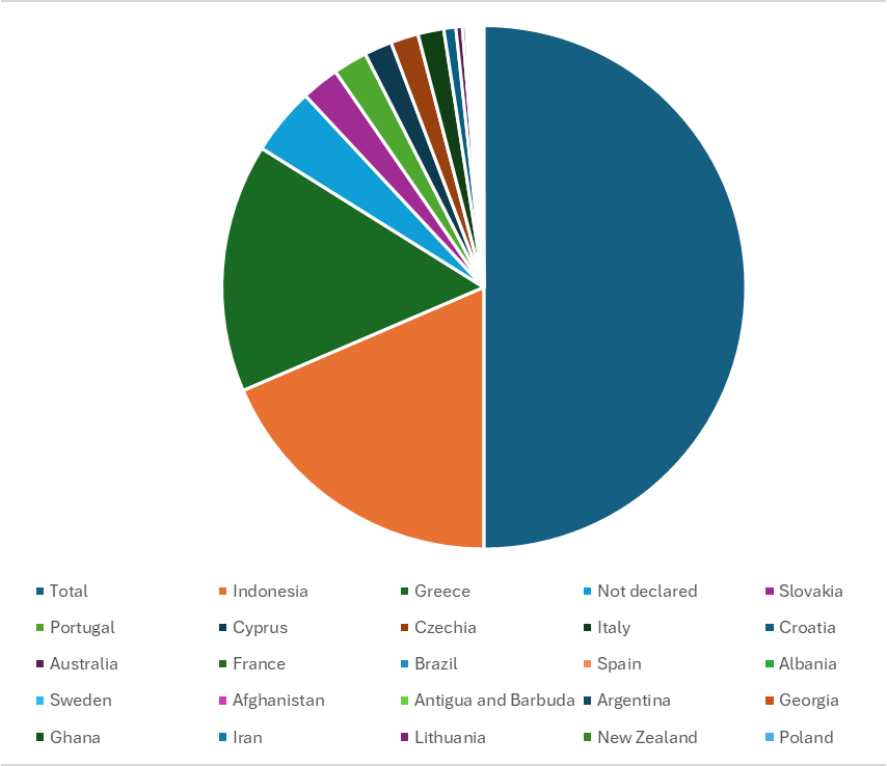


Figure 3. Countries from which answers were received to the social acceptance questionnaire.

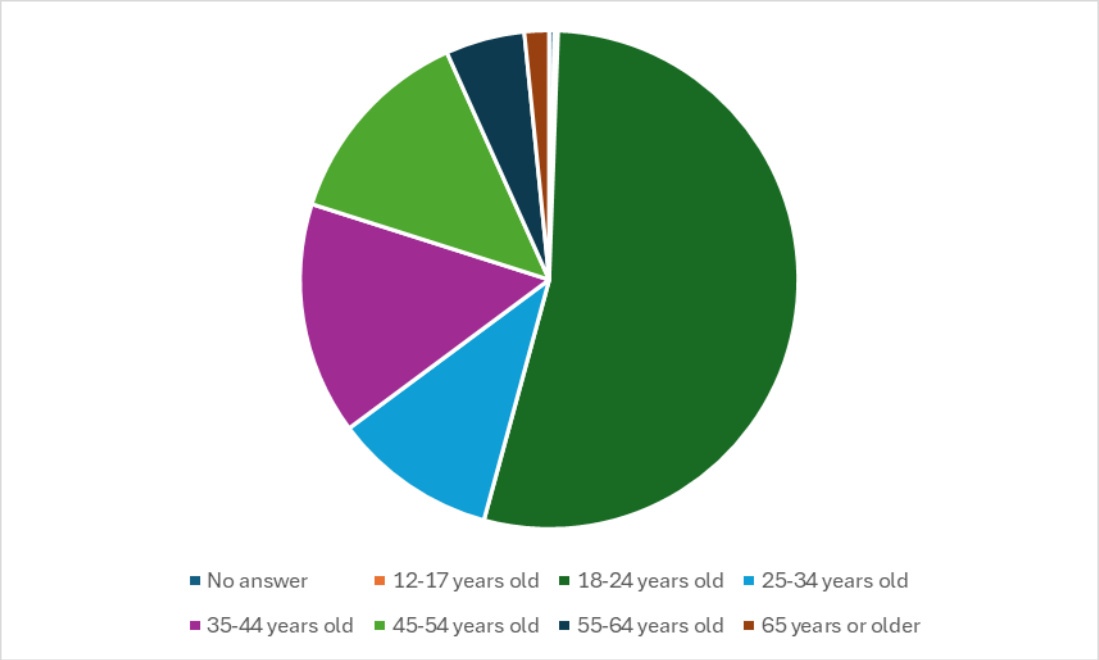


Figure 4. Age class of the respondents to the SILVANUS social acceptance questionnaire

3.4.1 Analysis and results of the responders' category

A comprehensive review of the responder data indicates that a total of 207 responses were received from both first and second responders. The majority of the responses (179 out of 207, 86%) are from European countries. The distribution across countries shows a more balanced representation compared to the overall response numbers. Greece leads with 37% of responses, followed by Czechia (14%), Slovakia (13%), Indonesia (12%), Italy, France, Afghanistan, Antigua and Barbuda, Brazil, Croatia, Cyprus, Italy, New Zealand and Portugal. Approximately 9% of respondents opted not to disclose their nationality or country of origin, as depicted in Figure 5.

Gender-wise, the majority of respondents, constituting 74%, identified as male, underlining a gender imbalance in the dataset. However, the age distribution presents a positive trend, with representation across various age groups displaying a nearly uniform distribution. This diversity is evident across most age categories, ensuring a well-rounded demographic composition (Figure 6).

The enriched dataset, from emergency responders and other local authorities, offers valuable insights into wildfire management perceptions and experiences across different regions. The significant participation from countries like Greece, Indonesia, Slovakia, Czechia, Italy, Cyprus, France, New Zealand, Croatia, and Afghanistan highlights the global relevance and interest in wildfire management strategies. The diversity in gender representation and age demographics further enriches the dataset, providing a holistic understanding of perspectives and experiences within the responder community.

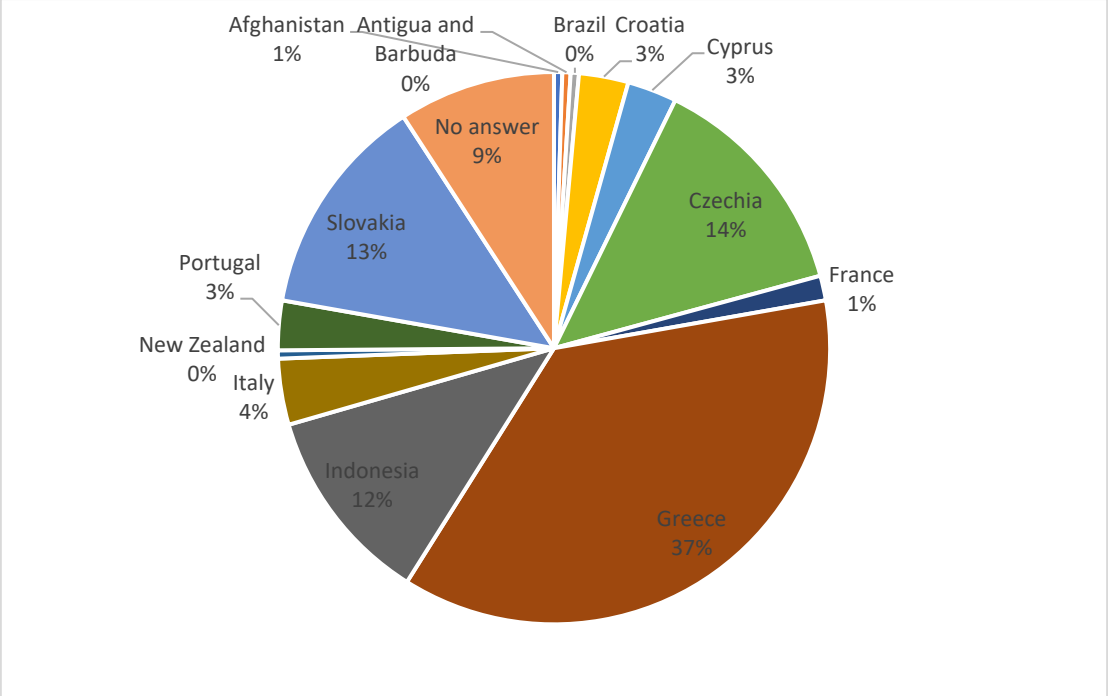


Figure 5. Percentage of countries responded in the questionnaire as emergency responders or local authorities.

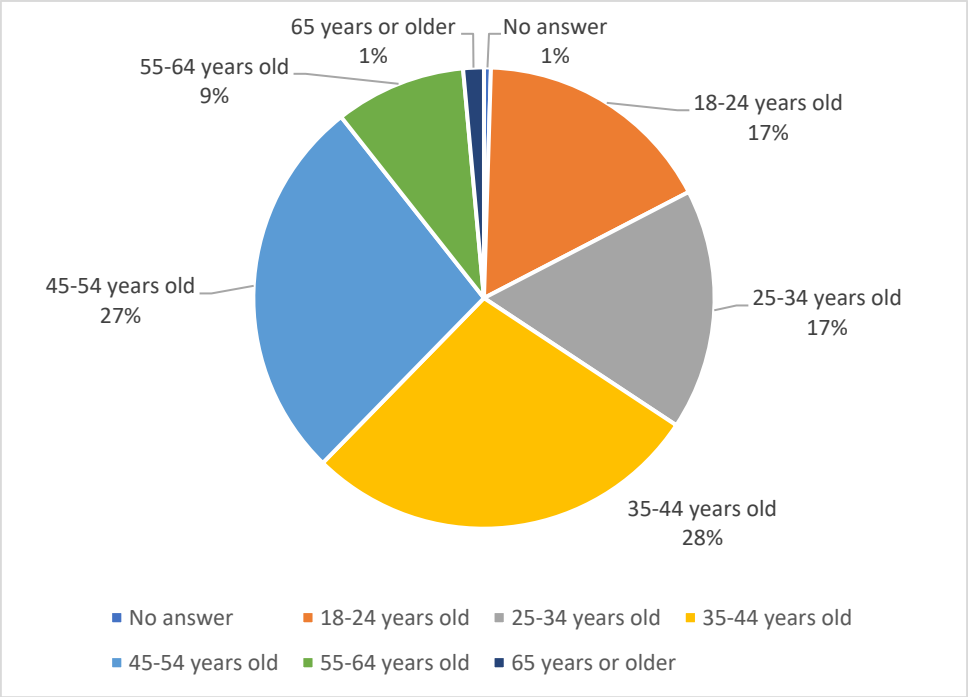


Figure 6. Age distribution of the respondents for the emergency responders and local authorities category.

According to the feedback provided by emergency responders, the primary challenges encountered in managing and responding to wildfires encompass limited resources and equipment, communication and coordination between emergency organizations, lack of timely and sufficient actionable data, unpredictable weather conditions and communication

with residents who refuse to evacuate.(Table 33). Notably, challenges like the absence of permanent personnel or changes in fire behavior were not prominently highlighted by the responders. It is apparent that the mentioned challenges hold similar levels of importance, with none significantly outweighing the others in terms of necessity. This balanced distribution underscores the multifaceted nature of obstacles faced by emergency responders in their efforts to effectively combat wildfires. By acknowledging and addressing these key challenges in a comprehensive manner, stakeholders can work towards enhancing wildfire management strategies and bolstering response mechanisms for improved outcomes in wildfire incidents.

Table 33. Key challenges mentioned for wildfires mentioned by emergency responders and local authorities.

Key challenge	Number	Percentage
Communication & coordination between emergency organizations	110	53.14%
Communication with residents who refuse to evacuate	38	18.36%
Unpredictable weather conditions	87	42.03%
Lack of timely and sufficient actionable data	93	44.93%
Limited resources and equipment	129	62.32%
Other (no permanent personnel, no intensive labour, fire behaviour change-climate change)	6	2.9%

Emergency responders unequivocally prioritize the protection of human life as the foremost concern during wildfires, followed by efforts to protect property and infrastructures. Subsequently, the containment of the fire spread precedes over protecting the environment, including designated areas such as NATURA 2000 sites (Figure 7). This hierarchical order of priorities reflects the fundamental duty of responders to ensure the safety and well-being of individuals at risk, while also addressing the critical need to mitigate the destructive impact of wildfires on both human settlements and natural surroundings. By aligning their actions with these prioritized objectives, emergency responders strive to minimize casualties, preserve essential infrastructure, and curtail the detrimental effects of wildfires on communities and ecosystems, thereby demonstrating a strategic and pragmatic approach to wildfire management and response efforts.

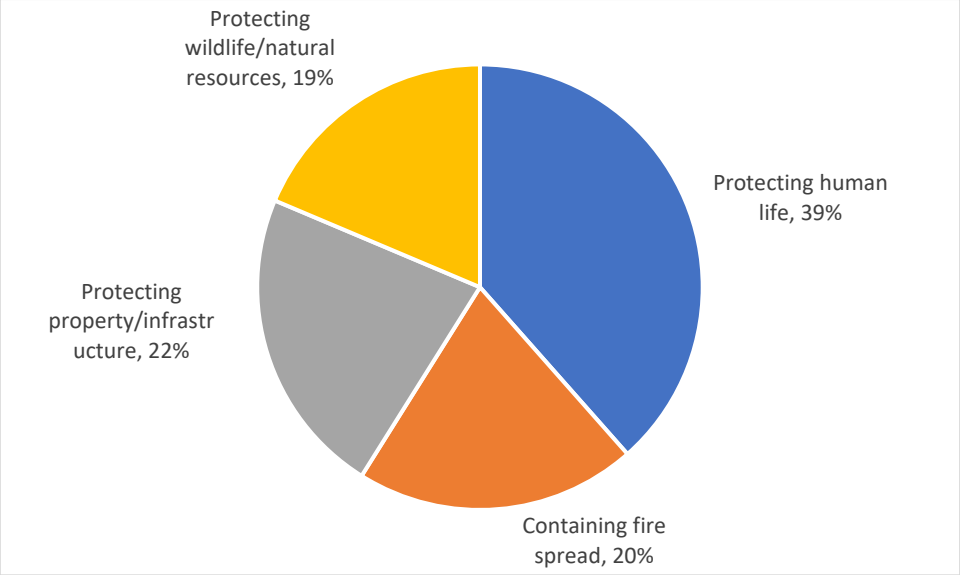


Figure 7. Priorities of responders related to a wildfire incident.

A significant portion of responders, nearly 64%, have not utilized online resources or platforms akin to SILVANUS in the past to access wildfire-related information. However, 34% of responders have engaged with such resources previously. Notably, among those who indicated using such resources, 41% found the material to be highly beneficial, with an overwhelming 93% rating the content as ranging from neutral to extremely helpful.

In response to the question regarding how platforms like SILVANUS could support their work in the field, responders expressed keen interest in features such as assisting in coordination and communication during the response (Score=2.42) and providing real-time monitoring and early warnings (Score=2.22). Conversely, there was relatively less enthusiasm for support in post-fire restoration and rehabilitation efforts (Score=1.34), although this aspect still garnered significant consideration (Figure 8). This may arise from the diverse nature of the respondents to the questionnaire, including firefighters (33.82%), civil protection personnel (8.7%), police officers (3.86%), military personnel 4.35%), volunteers (25.12%), search and rescue personnel (2.9%), emergency medical responders (2.42%) and other categories, such as foresters or other similar disciplines (13.53%), which reflect a high percentage that deals with response.

Furthermore, responders articulated additional areas of interest through free-text responses, including the provision of public notifications and evacuation guidelines, enhancing communication coverage and internet access in remote regions, supporting coordination, fire danger estimation, and real-time weather conditions. They also highlighted the importance of integrating science with practical applications, real-time imagery, utilizing drones for coordination, and establishing a database for region-specific activities to simulate various wildfire scenarios for preparedness and training purposes. These insights underscore the diverse needs and expectations of responders regarding the functionalities and capabilities of platforms like SILVANUS in enhancing wildfire management and response strategies.

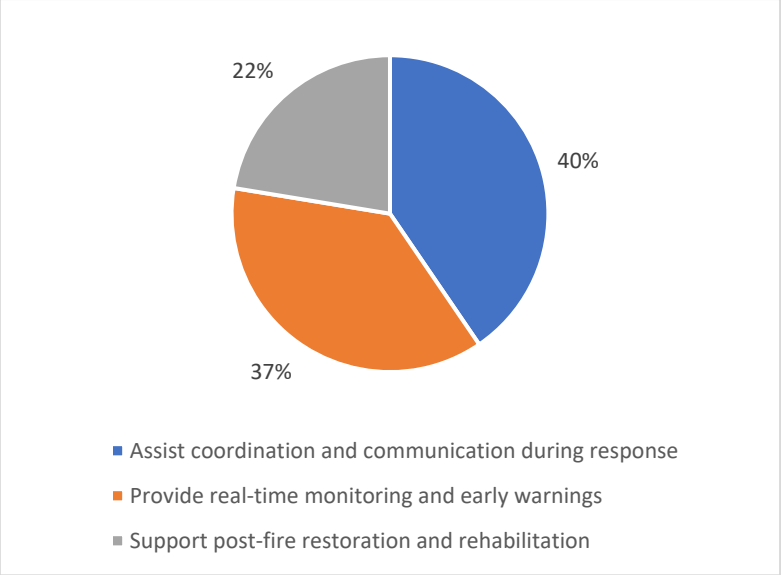


Figure 8. Score of the three options given by responders on how SILVANUS could help them in their daily work.

In response to the question regarding how responders contact inhabitants in wildfire-prone areas, a majority (14.98%) indicated utilizing emergency alerts as their primary communication method (Figure 9). A noteworthy example of this approach is the utilization of the EU emergency call number 112 in Greece, which effectively disseminates alerts concerning wildfires, evacuation guidelines, and post-event notifications. Additionally, other communication channels like social media and door-to-door visits are also employed, with some responders opting to leverage all available means of communication (34.78%) to ensure comprehensive outreach to at-risk populations.

The strategic use of emergency alerts, such as the EU emergency call number 112 in Greece, highlights the importance of efficient and timely communication in alerting inhabitants about wildfire threats and guiding them through necessary evacuation procedures. By incorporating multiple communication channels, including social media and direct visits to households, responders can enhance their reach and effectiveness in disseminating critical information to communities facing wildfire risks. This multi-faceted approach underscores the proactive measures taken by responders to engage with and safeguard inhabitants in wildfire-prone areas, thereby fostering a culture of preparedness and responsiveness in mitigating the impact of wildfires on vulnerable populations.

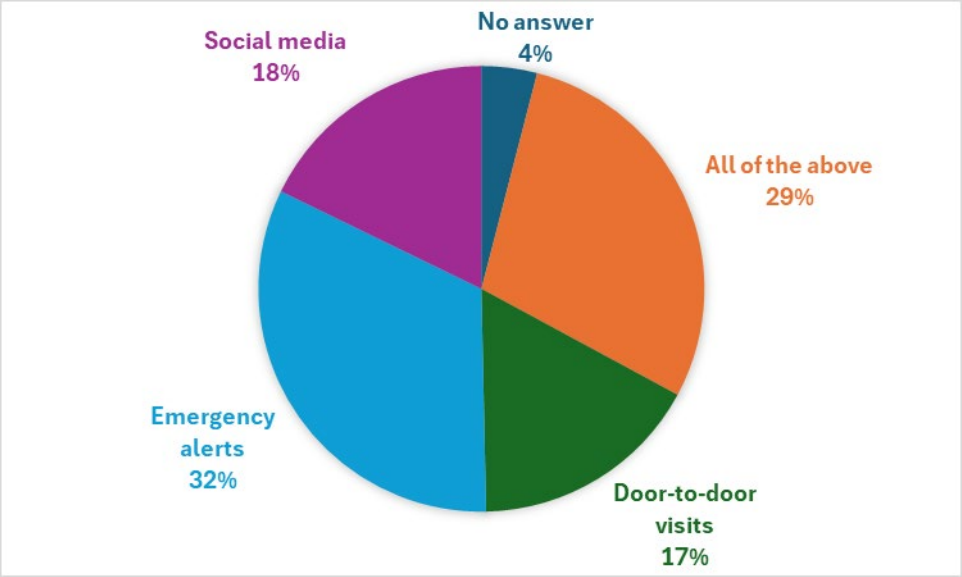


Figure 9. Use of means to contact inhabitants in wildfire prone areas in case of a wildfire.

In determining which areas to evacuate during a wildfire incident, responders prioritize locations of special significance, such as camps hosting children, facilities accommodating elderly individuals, and cultural sites, placing the utmost importance on safeguarding vulnerable populations and preserving cultural heritage. Subsequently, areas in closest proximity to the advancing wildfire are prioritized for evacuation, followed by regions with the highest population density and the most severe wildfire risk profiles. Areas with the highest property value are accorded the least priority for evacuation, reflecting a strategic approach that emphasizes the preservation of life and the protection of communities in the face of wildfire threats (Table 34). This hierarchical prioritization framework ensures that resources and efforts are allocated effectively to maximize the safety and well-being of individuals in high-risk areas, underscoring the responder's commitment to mitigating the impact of wildfires on human life and critical infrastructure.

Table 34. Priorities for evacuation as answered by the responders.

How do you prioritize which areas to evacuate during a wildfire?	Score
Places of special interest (children camps, elderly care facilities, cultural sites)	4.21
Areas closest to wildfire	3.48
Areas with the highest population density	3.02
Areas with the highest wildfire risk profile	2.95
Areas of high property value	1.31

In response to inquiries regarding countries' procurement focus on specific tools or equipment for wildfire management. There is a notable emphasis on acquiring a diverse range of equipment, encompassing air tankers, helicopters, fire trucks, hoses, and hand tools to bolster firefighting capabilities comprehensively (29%). Fire trucks and hoses are the most essential firefighting resources for 24% of the sample (second in the row). However, a substantial percentage (≈18%) of respondent's express uncertainty regarding any specific emphasis on equipment procurement, indicating a potential lack of clarity or awareness in this aspect (Table 35).

The broader spectrum of equipment procurement, spanning from aerial assets like airplanes and helicopters to ground-based tools, reflects a comprehensive approach towards equipping responders with the necessary resources to address diverse wildfire scenarios. The presence of respondents unsure about equipment procurement priorities underscores a potential need for enhanced communication and transparency regarding resource allocation and acquisition strategies in wildfire management. By fostering a clear understanding of equipment procurement priorities and aligning them with operational needs, countries can optimize their preparedness and response capabilities in mitigating the impact of wildfires on communities and natural landscapes.

Table 35. Focus on equipment.

Does your country/region/state emphasize more on procuring specific equipment to fight wildfires?	No of answers	Percentage
No answer	15	7,25%
Air tankers and helicopters	35	16.91%
All of the above	60	28.99%
Fire trucks and hoses	50	24.15%
Hand tools (e.g. shovels, axes etc.)	9	4.35%
Not aware of	38	18.36%

Respondents overwhelmingly express a preference for leveraging all available options through data analytics in predicting or preventing wildfires, with 55% advocating for a comprehensive approach (Table 36). This collective stance underscores the recognition that a multifaceted and integrated strategy is essential in effectively addressing the complexities of wildfire prediction and prevention. By embracing a holistic approach that harnesses the power of data analytics across various facets of wildfire management, responders can enhance their predictive capabilities and implement proactive measures to mitigate wildfire risks.

The strong emphasis on utilizing data analytics in a comprehensive manner highlights the interconnected nature of wildfire management and the interdependencies between different strategies. It underscores the understanding that isolated actions may not suffice in tackling the multifaceted challenges posed by wildfires. By integrating data analytics into all aspects of wildfire prediction and prevention, responders can harness the full potential of technology and information to enhance preparedness, early warning systems, and mitigation efforts. This collective acknowledgment reinforces the importance of adopting a unified and collaborative approach towards wildfire management, where data-driven insights play a pivotal role in shaping effective strategies for wildfire prediction and prevention.

Table 36. Data analytics role in preventing and predicting wildfires.

What can data analytics do in predicting or preventing wildfires?	No of answers	Percentage
Help identify high-risk areas and support prevention	33	15.94%
Develop more effective strategies for wildfire management	15	7.25%
Provide more accurate and timely information on location/spread of wildfires	26	12.56%
None of the above	1	0.48%
Not aware of	3	1.45%

No answer	15	7.25%
All of the above	114	55.07%

In response to the question regarding the utility of the SILVANUS Integrated Technological & Informational Platform, the majority of answers emphasize the significance of all available options, including connecting affected individuals with emergency resources and support, providing real-time updates on wildfire location and spread, and sending evacuation alerts and crucial information to the affected communities (Table 37). This collective perspective underscores the multifaceted potential of the SILVANUS platform in enhancing wildfire management strategies through its diverse functionalities.

By facilitating the connection between affected individuals and essential emergency resources, SILVANUS can streamline support mechanisms and ensure timely assistance to those in need during wildfire incidents. The provision of real-time updates on wildfire location and spread enables responders to make informed decisions and deploy resources effectively to combat the fire. Additionally, sending evacuation alerts and vital information to the affected communities enhances communication and promotes swift and organized evacuation procedures, ultimately enhancing the overall response to wildfire events.

The alignment of respondents on the comprehensive utility of the SILVANUS platform underscores its pivotal role in augmenting wildfire management efforts through a combination of social sensing, mobile applications, and integrated information systems. By leveraging the diverse capabilities of the platform, responders can enhance coordination, communication, and response mechanisms to better address the dynamic challenges posed by wildfires and prioritize the safety and well-being of affected communities.

Table 37. Usefulness of SILVANUS platform based on emergency responders' opinion.

SILVANUS Integrated Technological & Informational Platform (e.g., social sensing, mobile apps) can be useful in:	**No of answers**	**Percentage**
Providing real-time updates on the location/spread of wildfires	57	27.54%
Sending evacuation alerts and other important information to the affected communities	15	7.25%
Connecting affected individuals with emergency resources and support	8	3.86%
None of the above	2	0.97%
No answer	13	6.28%
All of the above	112	54.11%

Emergency responders highlight the significance of wildfire mapping and visualization tools as the primary functionality (48%), emphasizing the importance of visualizing wildfire data for informed decision-making. Incident reporting and tracking systems (30%) follow closely, aiding in the documentation and monitoring of wildfire events. Additionally, resource allocation and logistics management tools (14%) play a crucial role in optimizing resource deployment during wildfire responses. It is essential to note that these functionalities should

not operate in isolation but should be integrated with related sub-products to maximize their effectiveness within the SILVANUS platform.

In addressing critical challenges faced in the field, responders identify the lack of reliable communications as the most pressing issue (38%), underscoring the vital role of effective communication channels in wildfire response efforts. Interoperability between emergency response agencies (36%) is also highlighted as a significant challenge, emphasizing the importance of seamless coordination among various entities during wildfire incidents. Furthermore, difficulty in disseminating timely and accurate information to the public (18%) is recognized as a key obstacle, showcasing the need for efficient communication strategies to ensure public safety and awareness during wildfires (Figure 10).

By acknowledging these challenges and leveraging advanced technological tools within the SILVANUS platform, responders can address communication gaps, enhance coordination between agencies, and improve information dissemination processes, ultimately strengthening their wildfire management capabilities and fostering more effective responses to wildfire incidents.

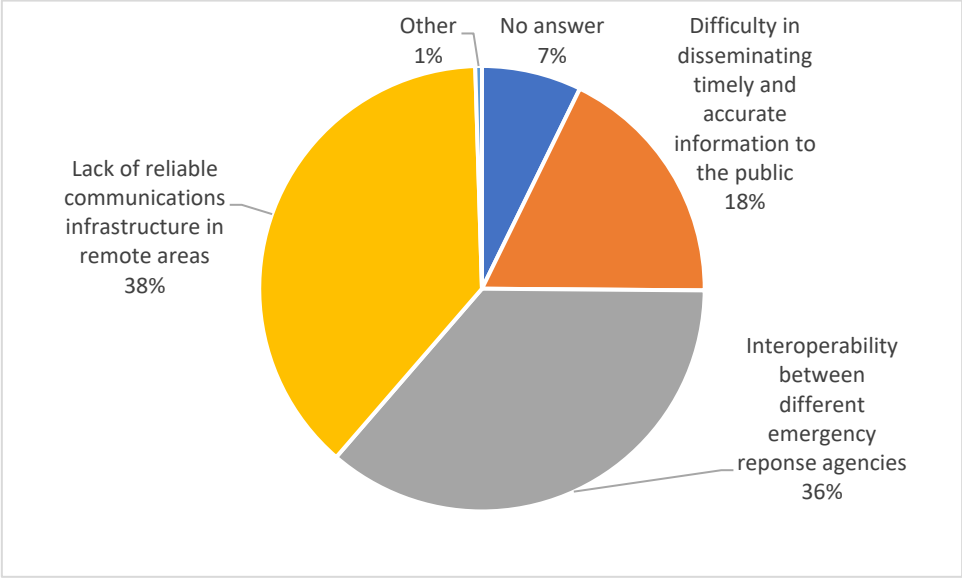


Figure 10. Primary communications challenges during a wildfire incident for emergency responders.

Emergency responders identify various potential barriers and challenges in the adoption and implementation of the SILVANUS Integrated Technological and Information Platform for wildfire prevention, response, and restoration efforts. Interestingly, limited funding emerges as a top concern, scoring 30.4%. This underscores the critical role of adequate financial resources in enabling the adoption and sustained implementation of advanced technological solutions like SILVANUS. In addition to funding constraints, responders also highlight other key challenges, including responders' difficulty in accepting new technologies, limited access to state-of-the-art technology in remote areas, interoperability issues, data privacy and security concerns (Table 38).

The adoption of comprehensive systems such as SILVANUS necessitates not only financial investment but also the resolution of interoperability challenges to ensure seamless

integration with existing systems. Data privacy and security considerations are paramount in the implementation of technology-driven solutions, emphasizing the need for robust safeguards to protect sensitive information. Moreover, overcoming resistance to change and fostering a culture of innovation are crucial in facilitating the acceptance and effective utilization of new technologies among responders.

By proactively addressing these anticipated barriers and challenges, stakeholders can pave the way for a smoother integration of the SILVANUS platform into wildfire management practices. By prioritizing funding, resolving interoperability issues, bolstering data security measures, and fostering a culture of technological acceptance, responders can maximize the potential of SILVANUS to enhance wildfire prevention, response, and restoration efforts effectively.

Table 38. Potential barriers or challenges in the adoption and implementation of SILVANUS platform

What potential barriers or challenges do you anticipate in the adoption and implementation of SILVANUS Integrated Technological and Information Platform in wildfire prevention, response and restoration efforts?	No of answers	Percentage
Limited funding for acquiring and maintaining the necessary technology infrastructure	63	30.43%
Resistance to change and adoption of new technologies among emergency responders	19	9.18%
Limited access to technology in remote areas	18	8.7%
Interoperability issues with legacy systems	7	3.38%
No answer	16	7.73%
Data privacy and security concerns related to sharing sensitive information on the platform	3	1.45%
All of the above	80	38.65%

In response to the question regarding encountering negative public attitudes, emergency responders have indicated that they have indeed experienced some negative feedback, albeit not frequently (Figure 11). This finding highlights the reality that, despite their dedicated service and commitment to public safety, responders may occasionally face criticism or adverse reactions from certain members of the community. This is a wider issue that may reflect the general public's reaction to the state, rather than on a personal level, especially after catastrophic events. It is essential to acknowledge and address these negative attitudes constructively to maintain effective relationships with the public and uphold trust in emergency response agencies.

While the occurrence of negative public attitudes may be sporadic, it is crucial for responders to proactively engage with the community, listen to concerns, and communicate transparently to mitigate misunderstandings and foster positive relationships. By promoting open dialogue, empathy, and responsiveness, responders can work towards building mutual respect and understanding with the public, ultimately enhancing collaboration and support during emergency situations. Addressing negative attitudes with professionalism and empathy can contribute to strengthening community partnerships and promoting a culture of appreciation for the vital work that emergency responders undertake to ensure public safety and well-being.

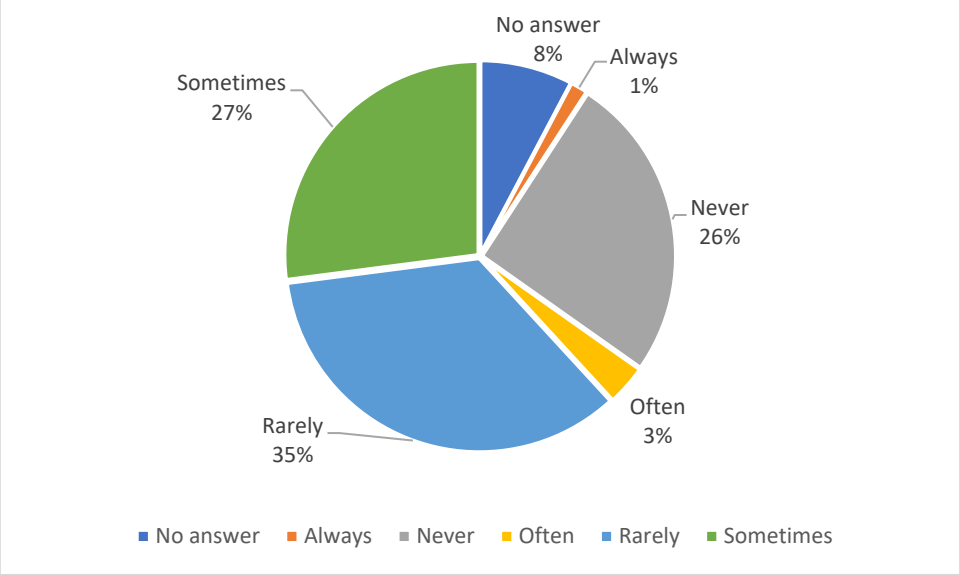


Figure 11. How often emergency responders face negative attitudes from the public.

In assessing societal awareness of the risks and challenges associated with responding to wildfires, emergency responders and local authorities exhibit a divided sentiment, with 50% acknowledging public understanding and 43% expressing skepticism. This divergence underscores the need for continued efforts to enhance public education and awareness regarding the complexities of wildfire response. Despite this, a notable 75% of respondents believe that society values the work of firefighters and other stakeholders involved in wildfire management, highlighting a positive perception of their contributions.

Concerning personal experiences, 21% of responders have encountered attacks or threats while responding to wildfires, underscoring the risks and vulnerabilities faced in the line of duty. However, the majority (71%) have not faced such incidents, reflecting a mix of challenges and support encountered during wildfire responses. Additionally, approximately 15% of respondents have experienced discrimination issues, emphasizing the importance of fostering inclusive and supportive environments within emergency response settings.

Moreover, the survey reveals a prevailing sentiment among responders and local authorities that funding for wildfire response is inadequate, with around 71% expressing concerns about resource availability. Despite training and preparedness measures, 58% of firefighters have felt their health and safety compromised during response efforts, signaling the imperative of prioritizing responder well-being and operational support.

Looking ahead, respondents emphasize the need for increased education and awareness campaigns about wildfires, with 85% advocating for enhanced public understanding. To shift societal perspectives, responders underscore the importance of better risk comprehension, augmented funding and resources, and heightened appreciation and recognition for emergency responders' vital contributions to wildfire management efforts (Table 39).

Table 39. Changes from emergency responders' perspective to change society acceptance and support to wildfire.

What changes would you like to see in society's acceptance of and support to wildfire responders?	No of answers	Percentage
Better understanding of the risks and challenges	45	21.74%
Increased funding and resources	42	20.29%
More appreciation and recognition	9	4.35%
No answer	16	7.73%
No changes	1	0.48%
All of the above	94	45.41%

In presentations of SILVANUS at various events, emergency responders have identified key improvements related to evacuation as the most significant enhancements as an independent element, although the vast majority (52%) answered that SILVANUS can improve provision on real-time updates on evacuation, identify individuals who may need assistance during evacuation and coordinate transportation and shelter resources. These improvements, as outlined in Table 40, represent crucial advancements in evacuation procedures aimed at enhancing the safety and efficiency of evacuation processes during wildfire incidents. By prioritizing these enhancements, responders aim to streamline evacuation operations, minimize risks, and ensure the well-being of individuals in wildfire-affected areas. Through ongoing collaboration and innovation, responders seek to leverage technological solutions such as SILVANUS to optimize evacuation strategies and mitigate the impact of wildfires on communities effectively.

Table 40. Evacuation procedures that can be improved by SILVANUS according to emergency responders' opinion.

How can the SILVANUS Integrated Technological and Information Platform be used to improve the efficiency and effectiveness of evacuation procedures during a wildfire?	No of answers	Percentage
Provide real-time updates on evacuation orders and routes	57	27.54%
Identify individuals who may need assistance with evacuation	16	7.73%
Coordinate transportation and shelter resources for evacuees	10	4.83%
No answer	15	7.25%
None of the above	2	0.97%
All of the above	107	51.69%

Emergency responders recognize the potential of SILVANUS in offering stress-reducing activities and resources, as well as facilitating access to mental health services and other supporting resources to promote the health and well-being of responders. The provision of such services is viewed as essential for supporting the mental and emotional resilience of responders in the face of challenging and high-stress environments. Notably, responders unanimously consider all potential options, including stress-reduction activities, mental health resources, and supporting services, as crucial components that SILVANUS should integrate to better support the health and well-being of emergency responders (Table 41).

By incorporating stress-reducing activities, mental health resources, and other supporting services within the SILVANUS platform, responders can access a comprehensive suite of tools to address their well-being needs effectively. These resources play a vital role in safeguarding the mental health and resilience of responders, ultimately enhancing their capacity to cope with the demands of their roles in emergency situations. Recognizing the significance of holistic support for emergency responders, the unanimous endorsement of all proposed

options underscores the collective commitment to prioritizing responder well-being and fostering a supportive and resilient emergency response community through the utilization of SILVANUS.

Table 41. Opinion of emergency responders on how SILVANUS can contribute to the support of mental health and wellbeing of emergency responders and affected communities.

How can the SILVANUS Integrated Technological and Information Platform support the mental health/wellbeing of emergency responders/affected communities?	No of answers	Percentage
By providing stress-reducing activities or resources for emergency responders	34	16.43%
By providing access to mental health resources and other supporting services	25	12.08%
By identifying and addressing mental health issues among affected individuals	14	6.76%
By providing health related information/services to emergency responders	16	7.73%
None of the above	6	2.9%
No answer	17	8.21%
All of the above	95	45.89%

Respondents emphasize the importance of various factors to ensure equitable access to the SILVANUS Platform in wildfire prevention, response, and restoration efforts. Among the available options, increased funding for technology development and implementation emerges as a critical consideration, highlighting the essential role of financial resources in facilitating widespread access to innovative solutions like SILVANUS. Additionally, the update of the EU and national legal framework concerning the use of Decision Support Systems (DSS) and their independent modules by emergency responders garners significant attention, underscoring the regulatory and policy aspects that can influence access to advanced technological tools.

By prioritizing increased funding for technology development and aligning legal frameworks to support the utilization of DSS systems such as SILVANUS, responders can ensure equitable access to cutting-edge resources for wildfire management. These measures are essential for overcoming barriers to adoption and implementation, promoting inclusivity, and empowering emergency responders with the necessary tools to enhance their operational capabilities effectively. By addressing both financial and regulatory considerations, stakeholders can foster a conducive environment for the widespread deployment and utilization of the SILVANUS Platform, ultimately advancing equity in access to critical technological solutions for wildfire prevention, response, and restoration efforts (Table 42).

Table 42. Results on ensuring equitable access to SILVANUS Platform in wildfire prevention/ response/restoration efforts according to emergency responders.

What is needed to ensure equitable access to SILVANUS Platform in wildfire prevention/ response/restoration efforts?	No of answers	Percentage
Increased funding for technology development and implementation	38	18.36%

Update of the EU and national legal framework related to the use of DSS systems and their independent modules by emergency responders	19	9.18%
Enhanced training on the use and judgment of outputs of systems similar to SILVANUS	17	8.21%
Policies to ensure privacy and security of data collected through new technologies	11	5.31%
Programs to provide technology access and training in remote areas	9	4.35%
No answer	15	7.25%
None of the above	2	0.97%
All of the above	96	46.38%

Vice versa, emergency responders highlight funding as a major issue alongside the necessity of supportive policies to garner societal backing for the development and implementation of new technologies such as SILVANUS in wildfire response and prevention efforts. According to responders, securing adequate financial resources is crucial for driving technological advancements in wildfire management. Additionally, the establishment of favorable policies that encourage public support and engagement in adopting innovative solutions is deemed essential for the successful integration of advanced technologies like SILVANUS.

By addressing funding challenges and advocating for supportive policies, emergency responders aim to foster a conducive environment for the advancement of technological capabilities in wildfire response and prevention. Adequate funding not only enables the research and development of cutting-edge tools but also ensures their effective deployment in real-world scenarios. Moreover, policies that promote public awareness, acceptance, and participation in technology-driven initiatives play a pivotal role in garnering societal support for endeavors like SILVANUS.

Through a combined focus on securing funding and advocating for supportive policies, emergency responders seek to pave the way for the successful development, implementation, and utilization of new technologies in wildfire management. By aligning financial resources and regulatory frameworks with the needs of responders and communities, stakeholders can enhance the effectiveness and efficiency of wildfire response and prevention efforts, ultimately bolstering resilience and safety in the face of wildfire threats (Table 43).

Table 43. How can society better support the development/implementation of new technologies, like SILVANUS, in wildfire response and prevention efforts according to emergency responders' opinion.

How can society better support the development/implementation of new technologies, like SILVANUS, in wildfire response and prevention efforts?	**No of answers**	**Percentage**
Increased funding for technology development and implementation	42	20.29%
Policies to support the development and use of new technologies	28	13.53%
Programs to provide technology access and training in affected communities	18	8.7%
No answer	17	8.21%

None of the above	4	1.93%
All of the above	98	47.34%

In response to the question regarding familiarity with wildfire management strategies and policies in their region, a majority of responders and local authorities indicate a high level of familiarity. Specifically, 27% report being very familiar, while a significant portion, 50%, express that they are quite familiar with the existing wildfire management frameworks. However, 15% of respondents admit to not being familiar with the strategies and policies currently in place (Figure 12).

The substantial percentage of respondents who are either very familiar or quite familiar underscores the importance placed on understanding and adhering to established wildfire management protocols. This level of awareness and knowledge among responders and local authorities is essential for effective coordination, decision-making, and response efforts during wildfire incidents. Nevertheless, the presence of a minority who are not familiar highlights the need for ongoing education and training initiatives to ensure a comprehensive understanding of wildfire management strategies and policies across all stakeholders.

By enhancing familiarity with wildfire management strategies and policies, responders and local authorities can better navigate the complexities of wildfire response and prevention, ultimately improving the overall resilience and preparedness of communities in the face of wildfire threats. Continued efforts to educate and engage stakeholders will contribute to a more informed and coordinated approach to wildfire management, enhancing safety and mitigation outcomes in regions prone to wildfire activity.

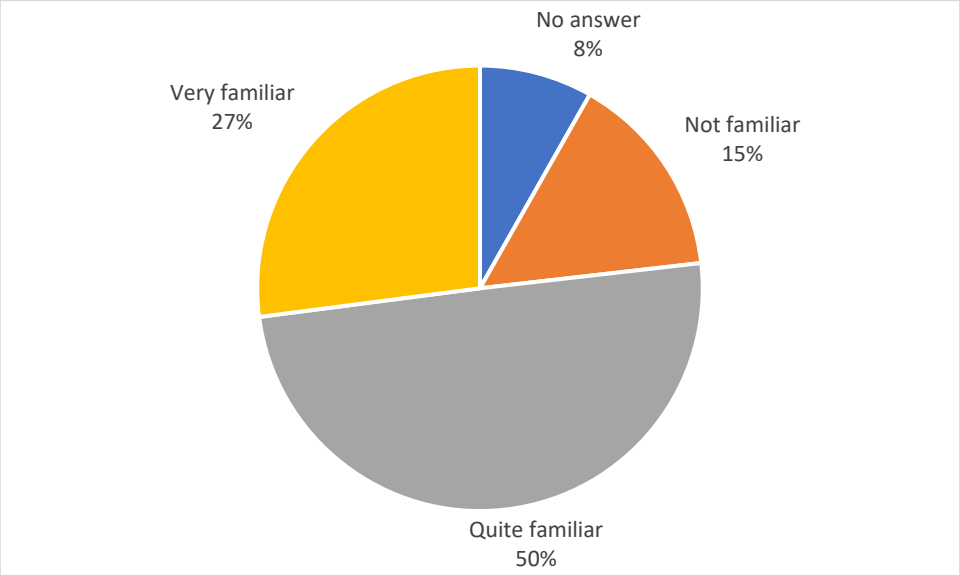


Figure 12. Percentage of familiarity of emergency responders and local authorities with wildfire management strategies and policies in their regions.

Emergency responders and local authorities identify insufficient funding for prevention and preparedness efforts, along with limited public awareness and education on fire safety, as the primary obstacles hindering effective wildfire management. These challenges, highlighted in Table 44, underscore critical barriers that impact the readiness and response capabilities of stakeholders involved in wildfire prevention and mitigation initiatives.

Insufficient funding for prevention and preparedness efforts poses a significant challenge, as adequate financial resources are essential for implementing proactive measures, conducting training programs, and maintaining essential equipment and resources to mitigate wildfire risks. The lack of funding can impede the effectiveness of preparedness activities and hinder the timely response to wildfire incidents, underscoring the importance of securing adequate resources to bolster resilience against wildfires.

In parallel, limited public awareness and education on fire safety emerge as a key obstacle, emphasizing the need for comprehensive outreach and educational campaigns to enhance community understanding of wildfire risks and preventive measures. By fostering a culture of fire safety awareness and preparedness among the public, stakeholders can empower individuals to take proactive steps to mitigate fire hazards and respond effectively in the event of wildfires.

Addressing these major obstacles requires a multi-faceted approach that includes advocating for increased funding for prevention and preparedness, as well as implementing targeted education and awareness initiatives to enhance public engagement and understanding of fire safety practices. By prioritizing these areas, emergency responders and local authorities can strengthen their wildfire management strategies and foster a more resilient and fire-safe community environment.

Table 44. Major obstacles in effectively managing and preventing wildfires in your region according to emergency responders and local authorities in the social SILVANUS questionnaire.

What do you see as the major obstacles in effectively managing and preventing wildfires in your region?	No of answers	Percentage
Insufficient funding for prevention and preparedness efforts	88	42.51%
Limited public awareness and education on fire safety	76	36.71%
Challenges in enforcing regulations and guidelines	25	12.08%
No answer	15	7.25%
Other	3	1.45%

Enhanced collaboration and information sharing among regional authorities and emergency responders emerge as the most crucial aspect that SILVANUS can contribute to improving forest fire management efforts, as indicated by 38% of respondents. This emphasis on collaboration underscores the significance of coordinated efforts and shared information among stakeholders to effectively combat forest fires and enhance response capabilities. By facilitating seamless communication and collaboration through the SILVANUS platform, responders can optimize resource allocation, streamline decision-making processes, and enhance overall operational efficiency during wildfire incidents.

Additionally, improved monitoring and early detection of wildfires are highlighted as essential components, with a little less than 38% of respondents recognizing the importance of early identification to initiate timely response actions. By leveraging advanced monitoring technologies and data analytics within SILVANUS, responders can enhance their capacity to detect and address forest fires swiftly, minimizing potential damages and enhancing overall wildfire management effectiveness (Figure 13).

Moreover, the potential for improved decision-making through data-driven insights is also deemed significant, with respondents acknowledging the value of leveraging data analytics and predictive modeling to inform strategic decision-making processes. By harnessing the

power of data analytics and artificial intelligence capabilities embedded in SILVANUS, responders can gain valuable insights into fire behavior, risk assessment, and resource optimization, empowering them to make informed decisions that enhance the efficacy of their wildfire management strategies.

By focusing on enhanced collaboration, early detection, and data-driven decision-making, SILVANUS holds the potential to revolutionize forest fire management efforts, improving response efficiency, mitigating risks, and ultimately safeguarding communities and natural landscapes from the devastating impact of wildfires.

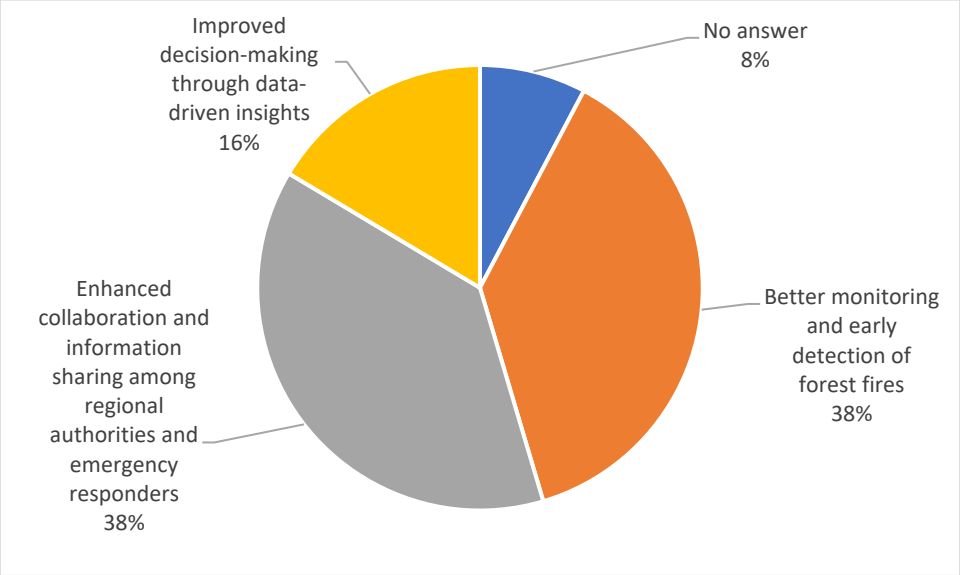


Figure 13. Contribution of SILVANUS to improve forest fire management efforts according to the opinion of the respondents.

Risk assessment, mapping tools, policies and regulation management systems, and community engagement and communication features emerge as the most valuable functionalities for regional authorities in the SILVANUS platform, according to Table 45. These essential components play a critical role in enhancing the effectiveness of wildfire management efforts and fostering collaboration among stakeholders to mitigate risks and improve response capabilities.

Risk assessment functionality enables authorities to evaluate and prioritize potential fire threats, guiding strategic planning and resource allocation to address high-risk areas proactively. Mapping tools provide visual representations of fire-prone zones, facilitating spatial analysis and decision-making processes for targeted interventions and response strategies based on geographical data.

Policies and regulation management systems within the platform help authorities ensure compliance with legal frameworks and standards governing wildfire management practices, streamlining regulatory processes and enhancing accountability in fire prevention and response activities.

Community engagement and communication features are vital for fostering public awareness, participation, and preparedness in wildfire prevention efforts. By facilitating direct communication with communities, authorities can disseminate critical information,

evacuation procedures, and safety guidelines, promoting a culture of shared responsibility and active involvement in wildfire mitigation initiatives.

By integrating these key functionalities into the SILVANUS platform, regional authorities can enhance their capacity to assess risks, coordinate response efforts, comply with regulations, and engage with communities effectively in wildfire management endeavors. This comprehensive suite of tools empowers authorities to leverage technology-driven solutions to address complex challenges, optimize resource utilization, and promote resilience in the face of wildfire threats.

Table 45. Specific functionalities/tools that according to the emergency responders would be most valuable for regional authorities to exist in the platform.

What specific functionalities or tools do you believe would be most valuable for regional authorities in the platform? (multiple answers may be selected)	No of answers	Percentage
Risk assessment and mapping tools	64	30.92%
Policy and regulation management system; Risk assessment and mapping tools; Community engagement and communication feature	58	28.02%
Policy and regulation management system	16	7.73%
Policy and regulation management system; Risk assessment and mapping tools	18	8.7%
Community engagement and communication feature	20	9.66%
Risk assessment and mapping tools; Community engagement and communication feature	20	9.66%
Policy and regulation management system; Community engagement and communication feature	7	3.38%
Policy and regulation management system; Risk assessment and mapping tools; Community engagement and communication feature; Other	2	0.97%
No answer	2	0.97%

3.4.2 Analysis and results of the community category

A total of 670 responses were collected from 20 countries, with the majority of answers originating from Indonesia (301 answers, 44.93%) and Greece (193 answers, 28.81%). Additionally, responses were received from other European Union countries, including Portugal (4.63%), Cyprus (3.58%), Italy (3%), Spain, Sweden, Slovakia, Czechia, Poland, Croatia and Georgia. Furthermore, responses were obtained from Albania, Argentina, Australia, Brazil, France, Ghana, Iran, Lithuania (Figure 14), showcasing a diverse geographic representation in the dataset.

In terms of gender distribution among respondents, 63% of the answers were provided by male respondents, while 34% were contributed by female respondents. Approximately 2% of respondents opted not to disclose their gender preference. This gender distribution highlights a majority of male participants in the survey, indicating a potential gender disparity in engagement with wildfire management initiatives. Nevertheless, by excluding the answers from Indonesia, the ratio is totally different with 56% being male and 42% being female. In

the respective sample from Indonesia males represent 71% of the answers while 25% are females. From this internal distinction to the sample, it is clear that the gender balance is not representative for Europe and it is clear that in Europe a better representation between men and women answering the questionnaire exists.

In order to deep dive to the European citizens needs and understanding of wildfires and how technological tools such as SILVANUS can help society to better cope with wildfires the analysis was carried out in two levels: (a) analysing the international sample with international data (607 responses) and (b) analysing European territory data separately (303 responses). The European sub-group sample includes answers for the countries of Albania, Croatia, Cyprus, Czechia, France, Georgia, Greece, Italy, Lithuania, Poland, Portugal, Slovakia, Spain and Sweden.

Regarding the age demographics of respondents, the data reveals that the majority of participants of the international sample belongs to the 18-24 age group (Figure 15). This age distribution suggests a significant representation of younger individuals in the survey sample, indicating a keen interest and involvement of the younger generation in community-based wildfire management efforts. This is also the case for the European sub-group sample with the group of 18-24 representing 33% of the responses, with a more uniform distribution between the other classes from 16% to 21% for the groups 25-34, 35-44 and 45-54 years old. The active participation of younger respondents underscores the importance of engaging diverse age groups in wildfire prevention and preparedness initiatives to foster a comprehensive and inclusive approach to community resilience and disaster management.

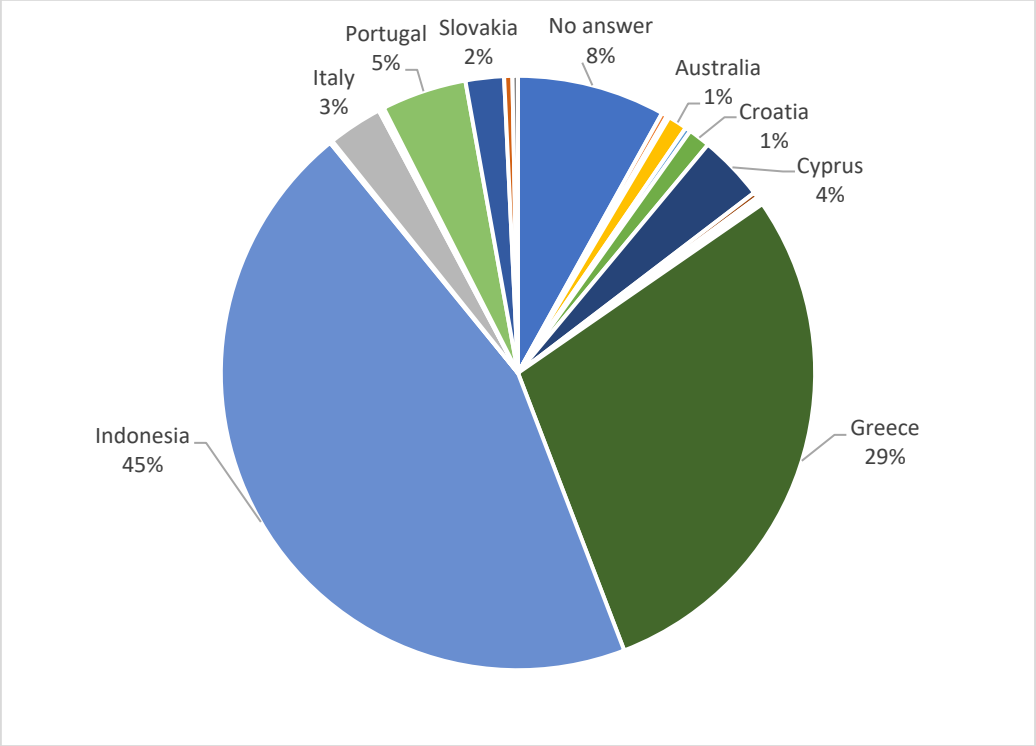


Figure 14. Percentage of countries responded in the questionnaire as member of local communities (international sample).

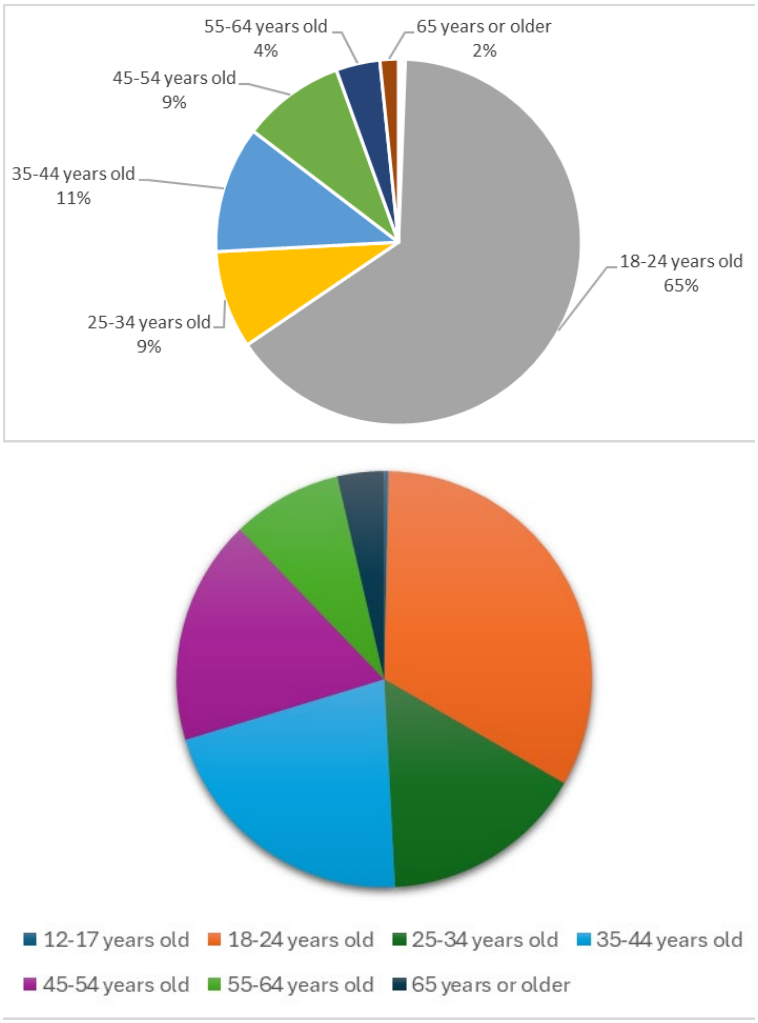


Figure 15. Age class distribution and percentage (%) of the respondents for the member of the community category for the international sample (Top: International sample. Bottom: European sub-group sample).

Upon analyzing the profiles of local community members involved in wildfire management efforts, it was found that the majority, comprising approximately 37% of respondents, identified themselves as local inhabitants. Furthermore, 20% of participants identified as members of the local community, while around 31% chose the category "Other" instead of the provided options (Figure 16). Similar figures are valid for the European sub-group sample.

Within the "Other" category, the majority of individuals were students, followed by researchers within the local community. This diversity in the "Other" category signifies a range of backgrounds and roles among respondents, contributing to a multifaceted perspective on wildfire management within the community. While a small percentage of respondents identified as local industry employees or affiliated with critical infrastructures, the majority fell under the broad category of citizens/general public.

The presence of students and researchers highlights the active engagement of academic and educational institutions in wildfire management initiatives, bringing expertise and innovative perspectives to community-based efforts. Additionally, the significant representation of local inhabitants and members of the community underscores the grassroots involvement and local ownership of wildfire prevention and response activities. By encompassing a diverse range of

stakeholders, including citizens, students, researchers, and industry professionals, community-driven wildfire management endeavors can benefit from a collaborative and inclusive approach that leverages the collective knowledge, resources, and experiences of various community members.

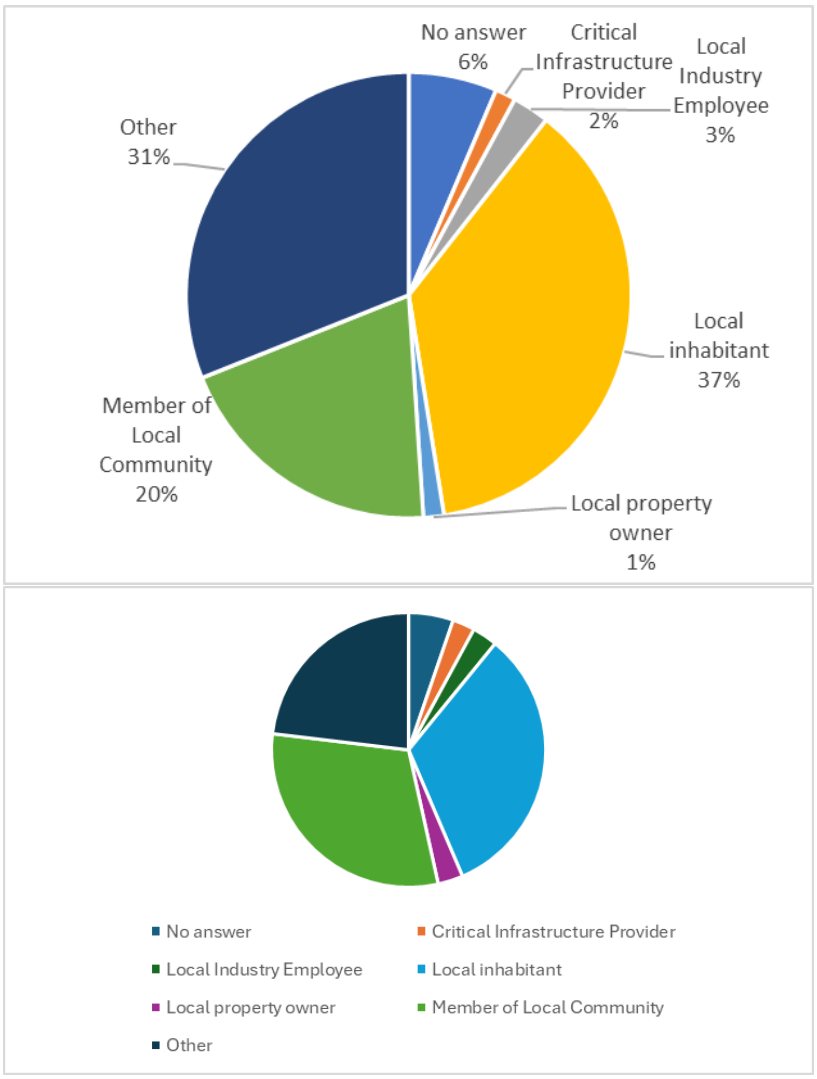


Figure 16. Profile type of population answered the questionnaire (Top: International sample. Bottom: European Sub-group sample).

The analysis of survey data from the community members reveals several key insights regarding their experiences, perceptions, and attitudes towards wildfires and disaster management efforts:

- A significant majority (78%) of respondents have never utilized online resources or platforms similar to SILVANUS to access wildfire-related information, indicating a potential gap in digital engagement and information access within the community. However, among those who have used such resources (22%), the vast majority (82%) found them helpful, suggesting a positive reception to online platforms for wildfire

information. In this question, there is no difference between the international sample and the European sub-group sample.

- For the international sample, while the majority of respondents (82%) have not been directly involved in responding to a wildfire incident, a high percentage (34%) have been impacted by wildfires in their communities, underscoring the widespread effects of wildfires on local populations. In this question, for the European sub-group, while 74% of the respondents has not been directly involved in responding to a wildfire (similar trend with the international sample), a very high percentage of respondents 51% considers that have been affected by wildfires in Europe. This is higher than the international sample (51% vs 34%) and we can see an indication of extent of the "wildfire problem" in Europe.
- In the international sample, the majority of respondents indicated a lack of adequate preparedness against a wildfire occurrence (76%). A similar, slightly higher, number (83%) is valid for the European sub-group.
- There is a widespread belief (63%) that local communities lack sufficient resources and support for rehabilitation and restoration post-wildfire, highlighting a perceived gap in recovery efforts (international sample). For the European sub-group this percentage is higher, equal to 78%.
- Respondents emphasize the importance of education and awareness campaigns in improving societal attitudes towards individuals affected by wildfires, with a strong belief that increased community involvement and support can enhance rehabilitation and restoration efforts post-disaster. It is important to note that there no significant differences between the two samples (international ~ 85%, European sub-group ~90%).
- While the majority of respondents do not report experiencing discrimination or blame for being affected by wildfires (85%), there is a notable percentage (19%) that has encountered negative attitudes from others in their community. This finding underscores the importance of fostering empathy and understanding towards wildfire-affected individuals within society.
- Respondents express a varied mix of actions for enhancing society's acceptance and support towards wildfire-affected individuals, indicating a multifaceted approach to promoting inclusivity, resilience, and community cohesion in the aftermath of wildfire events (Table 46).

Overall, the survey data reflects the complexity of community perspectives on wildfire management, highlighting the need for comprehensive support mechanisms, enhanced communication strategies, and proactive measures to address the diverse needs and challenges faced by communities affected by wildfires.

Table 46. Changes from citizens' perspective to change society acceptance and support to wildfire.

What changes would you like to see in society's acceptance and support of people affected by wildfires?	International sample	European sub-group
Increased funding and resources for recovery effort	22.39%	22%
Improved understanding of the impacts of wildfires on communities	14.33%	10%
More compassion and understanding	2.39%	1%
No answer	1.49%	3%
Other	0.6%	1%
All of the above	58.81%	63%

Respondents acknowledge the potential of SILVANUS in providing more accurate and timely information on the location of wildfires and fire spread, emphasizing the critical role of technology in enhancing situational awareness and response efficiency (Table 47). By leveraging advanced monitoring and data analytics capabilities, SILVANUS can offer real-time updates on wildfire dynamics, aiding responders in mapping fire progression and allocating resources effectively to combat the spread of wildfires.

Additionally, respondents recognize the value of SILVANUS technologies in identifying areas at high risk for wildfires and supporting proactive prevention efforts. Through predictive modeling and risk assessment functionalities, SILVANUS can analyze environmental factors, historical data, and other relevant parameters to pinpoint vulnerable regions and prioritize mitigation strategies. By empowering stakeholders with valuable insights into wildfire risk factors, SILVANUS facilitates targeted interventions and resource allocation to mitigate potential fire threats.

Moreover, respondents highlight the potential of SILVANUS technologies in facilitating the delivery of supplies and resources to emergency responders operating in remote areas. By utilizing innovative solutions such as drones, autonomous vehicles, or communication networks, SILVANUS can streamline logistics operations, enhance coordination among response teams, and ensure the timely and efficient provision of essential supplies to responders deployed in challenging or inaccessible terrains.

Overall, the recognition of SILVANUS as a powerful tool for improving wildfire management underscores the transformative impact of technology in enhancing response capabilities, risk mitigation strategies, and resource allocation in the face of wildfire incidents. By harnessing the capabilities of SILVANUS technologies, stakeholders can strengthen their preparedness, response, and recovery efforts, ultimately bolstering resilience and safety in wildfire-affected regions.

Table 47. Contribution of SILVANUS technologies will improve wildfire prevention, response and restoration efforts based on citizens' opinion.

How do you think SILVANUS Integrated Technological and Information Platform for wildfire Management with innovative capabilities such as drones, robots, sensors, satellite imagery, Remote Sensing Instruments, Earth observations can be utilized to impro	International sample	European sub-group
They can provide more accurate and timely information on the location and spread of wildfires	17.91%	16%
They can help identify areas at high risk for wildfires and support prevention efforts	14.78%	8%
They can be used to deliver supplies and resources to emergency responders in remote areas	5.37%	5%
No answer	1.94%	4%
None of the above	0.75%	1%
All of the above	59.25%	67%

It is particularly intriguing to note that the majority of citizens and other local community members expressed a high level of awareness regarding wildfire risk and current wildfire

management practices in their area. According to Figure 17, a significant portion of respondents indicated being very aware or somewhat aware of the wildfire risk and existing management strategies, demonstrating a proactive approach to understanding and addressing potential wildfire threats within their communities. The fact that only 12% of respondents reported not being aware of wildfire risks and management practices highlights a strong foundation of knowledge and awareness among the surveyed individuals. This level of awareness is crucial for fostering preparedness, promoting community engagement, and enhancing collaborative efforts in wildfire prevention and mitigation initiatives. Nevertheless, when studying only the European sub-group, the figures are not so similar. 16% of the European respondents declared that are not aware of wildfire risk and current management practices in their area, 54% are somewhat aware of and only 26% are aware of when compared to the international sample (41%) (Figure 17). The high awareness levels (in the international sample) observed among citizens and local community members underscore the effectiveness of ongoing education and outreach efforts aimed at increasing public understanding of wildfire risks and management protocols. Considering the results from the European sub-group more efforts towards awareness are probably necessary. By empowering individuals with knowledge about wildfire prevention, safety measures, and response protocols, communities can better prepare for potential incidents and work collectively towards safeguarding lives, property, and natural resources from the impact of wildfires.

Moving forward, sustaining and building upon this heightened awareness can further strengthen community resilience, foster a culture of shared responsibility for wildfire management, and contribute to more effective preparedness and response outcomes in the face of evolving wildfire challenges. Continued efforts to educate, inform, and engage community members in wildfire risk awareness and management practices will play a vital role in enhancing overall community safety and resilience in wildfire-prone areas.

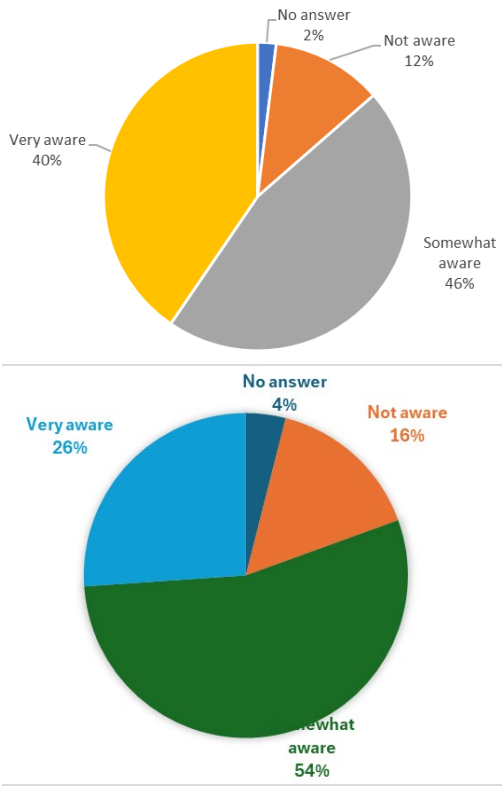


Figure 17. Level of awareness of wildfire risk and risk management practices in the areas of the local communities' respondents (Top: International sample. Bottom: European sub-group).

The local community respondents have identified key challenges in preventing and managing wildfires, shedding light on critical barriers that impact wildfire resilience and response efforts at the community level. Notably, the majority of respondents highlighted "Lack of community-wide fire safety awareness and education" and "Limited access to fire prevention resources (e.g., firefighting equipment, training)" as primary challenges, underscoring the importance of proactive education and resource availability in enhancing community preparedness and response capabilities (Table 48). Between the international sample and the European sub-group, no significant differences have been found.

Furthermore, environmental factors such as "dry climate" and "dense vegetation" were also recognized as significant challenges, emphasizing the role of natural conditions in exacerbating wildfire risks and complexities. These environmental factors pose unique challenges that require targeted mitigation strategies and adaptive responses to effectively address wildfire threats in communities. Additionally, a small percentage of respondents identified "Other" challenges, including issues such as "lack of sustainable forest management and prevention measures," and human factors such as arson. These specific challenges highlight the multifaceted nature of wildfire risk mitigation, encompassing not only environmental conditions but also human activities and land management practices that can influence the severity and frequency of wildfires.

By acknowledging and addressing these identified challenges, communities can take proactive steps to enhance their wildfire preparedness and resilience. Through targeted education and awareness campaigns, improved access to firefighting resources and training, and strategic interventions to address environmental and human-related factors, communities can strengthen their capacity to prevent, mitigate, and respond to wildfires effectively. Collaborative efforts that involve stakeholders at the local level, including residents, authorities, and organizations, are essential in overcoming these challenges and fostering a collective approach to wildfire management that prioritizes safety, sustainability, and community well-being.

Table 48. Challenges in preventing and managing wildfires at local communities as perceived by the population.

What challenges do you perceive in preventing and managing wildfires in your community?	International sample	European sub-group
Lack of community-wide fire safety awareness and education	38%	42%
Limited access to fire prevention resources (e.g., firefighting equipment, training)	35%	27%
Environmental factors (e.g., dry climate, dense vegetation)	22%	23%
No answer	2%	5%
Other	2%	4%

In response to the question on how the SILVANUS platform could contribute to improving wildfire risk management and restoration efforts in their area, respondents highlighted key functionalities that they believe would be instrumental in enhancing community safety and response capabilities. According to Table 49 the provision of real-time updates on fire incidents and evacuation notices is highlighted by the respondents for the international sample (36%). Moreover, resources and information on fire prevention and preparedness measures for households, as well as, facilitation of communication of between residents and

emergency responders during fire incidents were identified as essential features that the SILVANUS platform could provide to support wildfire risk management and response activities. By delivering timely and accurate information on fire dynamics, evacuation procedures, and safety alerts, SILVANUS can empower residents and emergency responders with the necessary insights to make informed decisions and take swift actions to protect lives and property in the face of wildfires.
For the European sub-group the offering resources and information on fire prevention and preparedness measures for households ranked highest (34%) and the provision of real-time updates on fire incidents and evacuation notices (29%) ranked second.

The emphasis on communication facilitation and real-time updates reflects the community's recognition of the importance of information sharing, coordination, and situational awareness in mitigating wildfire risks and enhancing response effectiveness. By leveraging the capabilities of SILVANUS to streamline communication channels, disseminate critical information, and provide up-to-date alerts, communities can improve their readiness, response coordination, and overall resilience in managing wildfire incidents.

Through enhanced communication infrastructure and real-time monitoring features, SILVANUS has the potential to revolutionize wildfire risk management practices, fostering a more connected, informed, and prepared community ecosystem. By empowering residents and emergency responders with actionable information and communication tools, SILVANUS can play a pivotal role in enhancing community safety, response efficiency, and restoration efforts in the aftermath of wildfire events.

Table 49. SILVANUS contribution in improving wildfire risk management and restoration efforts in an area from the population perspective.

How do you think SILVANUS platform could help in improving wildfire risk management and restoration efforts in your area?	International sample	European sub-group
By providing real-time updates on fire incidents and evacuation notices	36%	29%
By offering resources and information on fire prevention and preparedness measures for households	34%	34%
By facilitating communication between residents and emergency responders during fire incidents	19%	19%
By organizing community initiatives for forest restoration after fire incidents	8%	12%
Other	2%	2%
No answer	1%	4%

Figure 18 reveals insights into the level of awareness and preparedness among respondents regarding evacuation plans and procedures in their communities in the event of a wildfire. Regarding the international sample:

- Nearly half of the respondents stated that they are somewhat informed about evacuation plans and procedures, suggesting a moderate level of awareness and knowledge regarding the steps to take in case of a wildfire emergency. This group may have some understanding of evacuation routes, assembly points, and safety

protocols, but may benefit from further clarification and reinforcement of evacuation procedures.

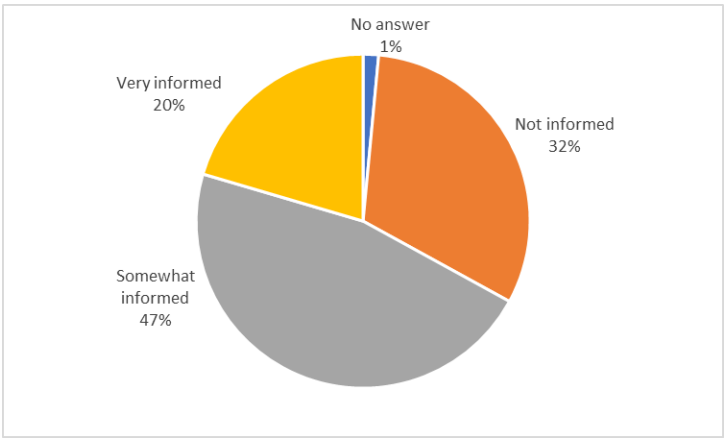
- Approximately 20% of respondents reported being very informed about evacuation plans and procedures, indicating a high level of preparedness and understanding of the necessary actions to take during a wildfire evacuation. These individuals are likely well-versed in evacuation protocols, emergency contacts, and safety measures, demonstrating a proactive approach to wildfire readiness and response.
- Interestingly, close to one-third of respondents (31%) admitted to not being informed about evacuation plans and procedures, highlighting a significant portion of the community that may lack essential knowledge and guidance on how to respond during a wildfire evacuation. This group may require targeted education, training, and communication efforts to enhance their preparedness and ensure their safety in the event of a wildfire threat.

Regarding the data of the European sub-group only:

- Almost have of the respondents (49%) are not informed on existing evacuation plans and procedures in your community in the event of a wildfire.
- Approximately 41% are somewhat informed and only 8% are very well informed.

Clearly for Europe more work needs to be done in this field on informing citizens on evacuation measures and plans. Targeted education, training and communication to enhance their preparedness and to ensure their safety should be of primary importance.

Overall, the data underscores the importance of ongoing education, communication, and community engagement initiatives to improve awareness, preparedness, and adherence to evacuation plans and procedures in wildfire-prone areas. By addressing gaps in knowledge and understanding, communities can enhance their resilience, response efficiency, and overall safety during wildfire events, ultimately mitigating risks and protecting lives and property in times of crisis.



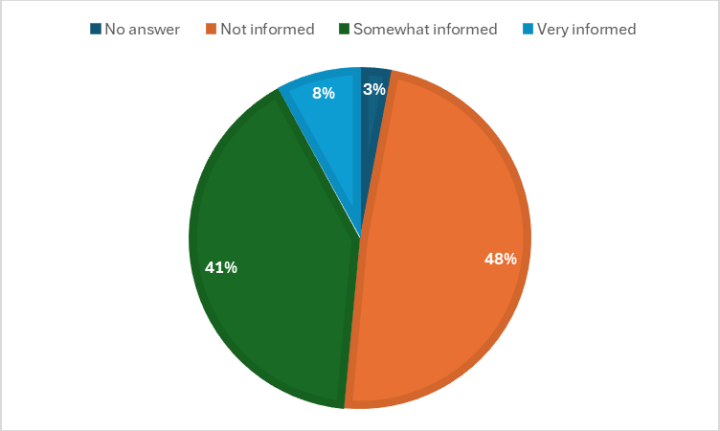


Figure 18. Information level on evacuation plans/procedures in case of wildfire in their community as perceived by the respondents (general population) (Top: International sample. Bottom: European sub-group).

Respondents highlighted keyways in which the SILVANUS platform could significantly enhance the safety and preparedness of inhabitants during forest fire incidents, reflecting a strong emphasis on proactive measures and effective communication strategies. According to Table 50, the following priorities emerged as crucial contributions of SILVANUS to improving community resilience and response capabilities. At this point, it is important to note that no significant differences exist between the international sample and the European sub-group:

- Real-time alerts and evacuation instructions to affected areas were identified as the most critical aspect by 41% of respondents (international sample), underscoring the importance of timely and accurate information dissemination during wildfire emergencies. By providing real-time alerts and clear evacuation instructions, SILVANUS can empower residents to make informed decisions and take swift actions to safeguard themselves and their property in the face of evolving fire threats.
- Offering resources and information on fire prevention and preparedness measures for households was highlighted by 34% of respondents as a key area where SILVANUS could make a substantial impact (international sample). By equipping residents with essential knowledge, tools, and guidelines for fire prevention and preparedness, SILVANUS can enhance community readiness, promote proactive risk mitigation, and foster a culture of safety and resilience within households.
- Facilitating communication and coordination between residents and emergency responders garnered 21% of responses, emphasizing the critical role of effective communication channels in enhancing response coordination and collaboration during wildfire incidents (international sample). By enabling seamless communication between residents and emergency personnel, SILVANUS can streamline response efforts, optimize resource allocation, and improve overall incident management outcomes.

These priorities underscore the multifaceted role of SILVANUS in bolstering community safety and preparedness in the face of forest fire incidents. By prioritizing real-time alerts, fire prevention resources, and communication enhancements, SILVANUS has the potential to revolutionize wildfire response strategies, empower residents with actionable information, and enhance the collective resilience of communities in mitigating wildfire risks and protecting lives and property during emergency situations.

Table 50. How SILVANUS platform could contribute to improving the safety and preparedness of inhabitants during forest fire incidents from the population perspective.

In your opinion, how could SILVANUS platform contribute to improving the safety and preparedness of inhabitants during forest fire incidents?	International sample	European sub-group
Providing real-time alerts and evacuation instructions to affected areas	41%	40%
Offering resources and information on fire prevention and preparedness measures for households	34%	30%
Facilitating communication and coordination between residents and emergency responders	21%	25%
Other	2%	2%
No answer	2%	3%

3.5 Discussion and conclusions

The insights gathered from the societal acceptance survey data offer valuable perspectives on wildfire management, community preparedness, and the potential role of the SILVANUS platform in enhancing protection and resilience in wildfire-prone areas. The findings underscore:

a) the importance of proactive education,
b) effective communication, and
c) resource availability in mitigating wildfire risks and fostering community engagement in disaster preparedness response and restoration.

Overall, 877 responses were collected, 207 from professionals and 670 from citizens. For the citizens category a sub-division between the international sample and the European responses was also made as it was deemed as necessary to export specific results from Europe only as well as with the overall results. Thus, it was avoided any potential biases that may arise from the answers from Indonesia which provided a really big number of answers from the general public (citizens). This was necessary in order to examine if the potential cultural differences affect or not the final results. This subsequent analysis showed that in some questions there are remarkably similar results, where in other questions differences do exist.

For the category of professionals, there was no need of differentiating between the international sample and a European sub-group as the differences are not worthy of consideration as the overall contribution from Indonesian professionals in wildfires represent only 12% which is in a good balance with inputs from other European countries.

For the citizens category, among the most important differences that have already been mentioned is the gender balance, which is this case it is 45% female and 53% of male respondents. Also, in this case the age class of the respondents is extremely more uniform with the majority being the 33% of 18-24 years old, but having representation to the 25-34, 35-44 and 45-54 years old from 16% to 21%. Another difference is that 51% of the respondent in Europe have answered that they have been affected by a wildfire in their community, where in the greater sample this is less equal to 34%. 78% of the EU respondents believe that their community does not have adequate resources to rehabilitate after a wildfire while in the international sample this percentage is equal to 63%. In the international sample, 60% of the respondents have felt that their health and safety were compromised during or after a wildfire due to inadequate resources or support, while in Europe this percentage is lower and equal to 47%. In Europe 35% of the respondents feel that society adequately values and supports the needs of wildfire affected communities, while in the international sample this is equal to 60%. Another example is the question “How informed do you feel about the existing evacuation plans and procedures in your community in the event of a forest fire?” in which differences appear between the two samples, with 49% of the European respondents declaring not informed, where in the international sample this is only 32%, somewhat informed equals 41% in the European sample while this is equal to 47% in the international sample and very informed is only 8% in the European territory while this is equal to 20% in the international sample.

Despite the differences there are questions in which the answers are close or remarkably similar between European countries and the international sample. For example, the vast majority of the population have never used tools like SILVANUS to access information about

wildfires. The results on the “increased education and awareness campaigns could help improve societal attitudes towards people affected by wildfires?” are the same irrespective of the sample. Similar answers exist in the case respondents may have experienced negative attitudes or blame with the vast majority in both entire and sub-group declaring “No”. Increased community involvement and support could help improve rehabilitation and restoration efforts after a wildfire is seen positive by citizens in both samples. Also, in the question “What changes would you like to see in society's acceptance and support of people affected by wildfires?” results are very close (see Table 46). Environmental factors (e.g., dry climate, dense vegetation), lack of community-wide fire safety awareness and education, limited access to fire prevention resources (e.g., firefighting equipment, training) score similarly in both samples (entire and European sub-group). In the question “How do you think SILVANUS platform could help in improving wildfire risk management and restoration efforts in your area?” the answers between the two samples present similar ratios not on the absolute percentages of the various options but have the same trend. Finally, in the question “In your opinion, how could SILVANUS platform contribute to improving the safety and preparedness of inhabitants during forest fire incidents?” the results are very close between the two samples (see Table 50).

Overall, one key theme that emerges from the survey responses is the critical need for enhanced awareness and education regarding wildfire risks and management practices. While a significant number of respondents, especially the younger ones (see section 3.1.2), demonstrated a high level of awareness, there is also a notable percentage that may benefit from targeted education and outreach initiatives to improve their understanding of evacuation procedures, fire prevention measures, and community-wide safety protocols. At this point, it should be noted that first responders claim that more education, training and awareness is needed. This could be explained by the fact that young people are more inexperienced (they have not been in a wildfire) and therefore cannot assess the danger well, or that the education and training programmes of the different countries are indeed better. It could also be a matter of fairness, as younger people are more familiar with technology and are in a better position to acquire relevant information more quickly and easily than older people.

Moreover, the identification of challenges such as the lack of community-wide fire safety awareness, limited access to fire prevention resources, and environmental factors underscores the complex nature of wildfire risk mitigation. Addressing these challenges requires a multifaceted approach that integrates community engagement, technology-driven solutions, and collaborative efforts among stakeholders to enhance preparedness, response capabilities, and recovery strategies.

The perceived value of the SILVANUS platform in facilitating communication, providing real-time alerts, and offering resources for fire prevention and preparedness signifies its potential to revolutionize wildfire risk management and response efforts at the community level. By leveraging the capabilities of SILVANUS to enhance communication channels, deliver timely information, and empower residents with essential knowledge and tools, communities can bolster their readiness, coordination, and resilience in the face of wildfire incidents.

In conclusion, the findings suggest that by harnessing technology, fostering collaboration, and prioritizing community engagement, stakeholders can strengthen their capacity to mitigate wildfire risks, protect vulnerable populations, and enhance overall disaster resilience. The insights gleaned from the survey data serve as a foundation for developing targeted

interventions, enhancing emergency preparedness initiatives, and advancing the collective efforts to build safer, more resilient communities in the face of wildfire challenges.

References

[1] A. Westin, Privacy and Freedom. New York: Atheneum, 1967, p. 7.

[2] European Commission, Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation) (Text with EEA relevance)".

[3] "Global Privacy & Security by Design," [Online]. Available: https://gpsbydesign.org/.

[4] "Privacy-enhancing technologies," Decentriq, Jan. 2024. [Online]. Available: https://www.decentriq.com/article/what-are-privacy-enhancing-technologies.

[5] European Data Protection Supervisor (EDPS), "Opinion 5/2018 Preliminary Opinion on Privacy by design," May 2018. [Online]. Available: https://www.edps.europa.eu/sites/default/files/publication/18-05-31_preliminary_opinion_on_privacy_by_design_en_0.pdf

[6] A.C. García, N.N. McDonnell, C. Troncoso, D. Le Métayer, I. Kroener, D. Wright, J.M. del Álamo, Y.S. Martín, PRIPARE-Privacy and Security-by-Design Methodology Handbook, PRIPARE project deliverable, 2015.

[7] F. Bravo, "Data Management Tools and Privacy by Design and by Default," in Springer, 2024. [Online]. Available: https://link.springer.com/chapter/10.1007/978-981-16-3049-1_8.

[8] ENISA, "Privacy and data protection in mobile applications -A study on the app development ecosystem and the technical implementation of GDPR," Nov. 2017. [Online]. Available: www.enisa.europa.eu. Last accessed 10/11/204.

[9] N. Leligou et al., "SILVANUS Deliverable D5.3 - Demonstration of SILVANUS decision support system for response coordination 1st version", 2023.

[10] D. Anastasopoulou et al., "SILVANUS D8.1 – Report on SILVANUS reference architecture," 2022.

[11] N. Leligou and T. Orfanoudakis, "SILVANUS Deliverable D8.2 - SILVANUS Deliverable D9.3 - Report on formal assessment of trial period #1," 2023.

[12] N. Leligou et al., "SILVANUS Deliverable D8.3 Report on SILVANUS final reference architecture," 2024.

[13] "A guide to GDPR data privacy requirements," GDPR EU portal. [Online]. Available: https://gdpr.eu/data-privacy/.

[14] IPCC, "AR6 Synthesis Report: Climate Change 2023," 2023.

[15] JRC, "https://joint-research-centre.ec.europa.eu/jrc-news-and-updates/wildfires-mediterranean-effis-data-reveal-extent-summer-2023-09-08_en," 2023. [Accessed: Mar. 28, 2024].

[16] European Commission, "A new EU Strategy on Adaptation to Climate Change," Feb. 24, 2021. [Online]. Available: https://ec.europa.eu/commission/presscorner/detail/en/ip_21_663.

[17] "Horizon 2020 work programme: Building a low-carbon, climate resilient future: Research and innovation in support of the European Green Deal (H2020-LC-GD-2020)."

[18] UN, "United Nations Sustainable Agenda 2030," 2015. [Online]. Available: https://www.un.org/sustainabledevelopment/development-agenda/.

[19] A. Majilingova et al., "SILVANUS Deliverable D2.1 - Report on existing sustainable forest management services and formalisation of functional specification requirements," 2021.

[20] M. Segarceanu et al., "SILVANUS Deliverable D9.2 - Report on first trial period activities for Phase A, B and C," 2023.

[21] J. Passagem Santos and M. Pio Silva, "SILVANUS Deliverable D9.3 - Report on formal assessment of trial period #1," 2024.

Appendix I – Privacy by Design Questionnaire

Privacy by Design Questionnaire for Technology Partners

Introduction

This Questionnaire is dedicated to conducting a Privacy Impact Assessment (PIA) prior to the use of any personal information by SILVANUS technology. It adheres to the seven (7) principles of Privacy by Design (PbD):

1. Proactive, Not Reactive; Preventative, Not Remedial
2. Privacy as the Default
3. Privacy Embedded into Design
4. Full Functionality – Positive Sum, Not Zero Sum
5. End-to-End Security – Lifecycle Protection
6. Visibility and Transparency
7. Respect for User Privacy

PbD means that privacy measures are built into the design of systems. It is an approach for the design and development of digital solutions that require privacy to be embedded right from the design stage and then throughout the development lifecycle, so that privacy becomes an integral part of core functionality, as opposed to an afterthought.

Article 25 of the GDPR requires Privacy by Design. Specifically, it requires the use of technical and organisational measures designed to implement data protection principles effectively and with the necessary safeguards to protect EU citizens' rights and fulfil the GDPR requirements.

Privacy emphasizes data protection and responsible data handling practices. It encompasses various information principles, including security.

Security addresses the measures taken to secure the surrounding systems and to safeguard any type of data from unauthorized access, destruction, or loss of integrity.

This Questionnaire consists of two main parts: the first one includes general questions that cover main PbD information on SILVANUS platform and all related products, and the second includes more targeted/detailed questions for specific SILVANUS products and services.

Each Partner needs to provide information for the product (e.g. platform, citizen mobile application, etc.) they design, develop, and deliver. Please provide the product's name, a short description (key issues related to privacy by design) and the deliverable(s) that contains (contain) information for the product that you are responsible for delivering.

Note: For legal questions please consult your Legal Department, especially for questions that require information on national legislation.

General Questions

* Which SILVANUS partner do you represent?

* Please enter your full name and job title.

* Please enter your e-mail address

Product-related Questions

* Which SILVANUS User Product (UP) is your organization developing?

If you work on multiple UPs, please submit a separate questionnaire for each UP UP1 - AR/VR training toolkit for trainers

- ○ UP2 - Fire Danger risk assessment
- ○ UP3 - Fire Detection based on social sensing
- ◉ UP4 - Fire Detection form IoT devices
- ○ UP5 - Fire Detection from UAV/UGV
- ○ UP6 - Fire Spread forecast
- ○ UP7 - Biodiversity profile mobile application
- ○ UP8 - Citizen engagement programme and mobile application
- ○ Other User Product, not included in the first version of the Reference Architecture Generic SILVANUS platform functionality.

* Please provide a short description of the product/functionality you develop.

* Which stakeholder groups are the intended audience for your product?

* Will the SILVANUS product you develop collect personal or sensitive data?

- ○ Yes
- ◉ No

* Do you employ privacy-enhancing technologies, such as anonymization or pseudonymization?

- ○ Yes
- ◉ No

* Will the SILVANUS product you develop involve the processing of personal data?

- ○ Yes
- ◉ No

* Will the SILVANUS product you develop involve the use of an external contractor or supplier to process personal data or other confidential information?

- ○ Yes
- ◉ No

* Will the SILVANUS product you develop involve the processing of other high-risk personal data? *e.g., personal information relating to vulnerable adults or children?*

- ○ Yes
- ◉ No

* Will the SILVANUS product you develop use information about individuals for purposes other than the current ones, or in a way not currently used?

Dual use or misuse, e.g. data collected for military purposes.

- ◉ Yes
- ○ No

* Does the SILVANUS product you develop involve the use of technology which might be perceived as being Privacy intrusive?

e.g., the use of facial recognition or biometrics?

- ○ Yes
- ◉ No

* Does SILVANUS product that you develop comply with relevant national and EU privacy laws and regulations?

- ◉ Yes
- ○ No

* Please provide the national legal framework that regulates or impacts sharing of law enforcement data for research purposes.

* Which entity oversees the “Necessity & Proportionality” assessment in case you must deal with requests for data sharing?

- ○ Legal team
- ○ DPO
- ○ Other oversight body

* Does the SILVANUS product you develop require users to connect/register through any type of personal account?

e.g., mail account, vendor account, social media account etc.

- ○ Yes
- ○ No

* Is the principle of Data Minimization respected in the SILVANUS product you develop?

- ○ Yes
- ○ No
- ○ I do not know.

*Is the SILVANUS product you develop designed to ensure end-to-end encryption of sensitive data?

- Yes
- No

*Does the SILVANUS product you develop implement strong access controls and authentication mechanisms to ensure Data Security?

- Yes
- No

*Does the SILVANUS product you develop prevent unauthorized access, disclosure, or alteration of data within the cloud platform?

- Yes
- No

*Is your organization part of the SILVANUS Cloud development team?

- Yes
- No

Questions for SILVANUS UPs/Services

*Does the SILVANUS product you design enable secure data transfer and integration with other systems or applications (data flows within SILVANUS apps and services)?

- Yes
- No

*Have you conducted a Self-Privacy Impact assessment for your product?

- Yes
- No

*Have you implemented robust backup and disaster recovery mechanisms within your SILVANUS product(s) to ensure data availability and resilience?

- Yes
- No

*Does the SILVANUS product employ end-user tracking technologies?

e.g., cookies, IP addresses, other data, links, log files

- Yes
- No

*Is SILVANUS platform designed to enable secure data transfer and integration with other systems or applications (cross-border data flows)?

- Yes
- No

*Is the “data analytics toolkit, which will be developed to enable the collection and aggregation of complex data structures” * privacy-friendly?

**as defined in D8.1, pg. 20 (pdf)*

- Yes
- No

*Is the image-based Fire Detection Algorithm privacy- friendly when it comes to footage that includes frames showing/depicting people faces (image or video from any source)?

- Yes
- No

*Are there any other factors to consider besides facial characteristics?

- Yes
- No

Appendix II – Societal acceptance questionnaire

The societal acceptance questionnaire available at https://ec.europa.eu/eusurvey/runner/SILVANUS_SocialImpactQ and also available via the project website: https://silvanus-project.eu/social-acceptance-questionnaire/

Societal Acceptance Questionnaire

Introduction

Project Overview

SILVANUS envisages the development of a climate resilient and innovative technological platform, providing decision-making support in preparedness, response and recovery of wildfire management cycle, and increasing the human, environmental and economical resilience to wildfires.

The project relies on environmental, technical and social sciences experts to support regional and national authorities responsible for wildfire management in their respective countries. SILVANUS scientists and research engineers will aid civil protection authorities to efficiently monitor forest resources, evaluate biodiversity, generate more accurate fire risk indicators, and promote - through awareness campaigns- safety regulations among the local population affected by wildfires.

The project is funded by the EU Horizon 2020 Green Deal program and coordinated by Università Telematica Pegaso; SILVANUS includes 49 partners from the European Union, Brazil, Indonesia, and Australia, has a budget of €24 million and runs for a period of 42 months.

Purpose of Questionnaire

The active engagement of citizens is a vital part of the SILVANUS development process. Within the activities of wildfire prevention and preparedness, SILVANUS organizes live and online engagement campaigns, where citizens are informed on the project objectives and on the best practices for wildfire suppression and prevention. To that end, input from citizens and first responders is crucial for assessing the potential impact of SILVANUS on local societies.

Confidentiality & Data Usage

*

☐ I wish to participate in the SILVANUS Online Social Acceptance Questionnaire.

*

☐ I am aware of my rights; I have been given the contact details of the responsible persons and I consent to the processing of my personal data for the purpose and under the conditions explained in the attached file below.

Legal information

SILVANUS_Societal_Acceptance_Questionnaire_consent.docx

Demographics

What is your nationality?

What is your gender?

- Male
- Female
- Prefer not to answer

What is your age?

- 12-17 years old
- 18-24 years old
- 25-34 years old
- 35-44 years old
- 45-54 years old
- 55-64 years old
- 65 years or older

Are you an Emergency Responder or a local authority employee?

- Yes
- No

Which of the following describes better your job/responsibility?

Please specify

What are the key challenges faced by emergency responders in managing and responding to wildfires? *(multiple answers may be selected)*

- Limited resources and equipment
- Communication & coordination between emergency organizations
- Communication with residents who refuse to evacuate
- Lack of timely and sufficient actionable data
- Unpredictable weather conditions
- Other

Please specify

When responding to a wildfire, what is your highest priority?

Use drag&drop or the up/down buttons to change the order or accept the initial order.

- Protecting human life
- Protecting property/infrastructure
- Containing fire spread
- Protecting wildlife/natural resources

In what capacity do you participate in ths pilot?

Please specify

Have you ever used online resources or platforms such as SILVANUS to access information about wildfires, and if so, how helpful were they?

- Yes
- No

Please indicate how helpful they were

Move the slider or accept the initial position.

Not helpful at all Very helpful

0 0 10

How do you think platforms such as SILVANUS could support your work in the field?

Use drag&drop or the up/down buttons to change the order or accept the initial order.

- Provide real-time monitoring and early warnings
- Assist coordination and communication during response
- Support post-fire restoration and rehabilitation

Please share any more thoughts you might have, using keywords or key phrases

How do you contact inhabitants in wildfire-prone areas? *(multiple answers may be selected)*

- Social media
- Emergency alerts
- Door-to-door visits
- All of the above

How do you prioritize which areas to evacuate during a wildfire?

Use drag&drop or the up/down buttons to change the order or accept the initial order.

- Places of special interest (children camps, elderly care facilities, cultural sites)
- Areas with the highest wildfire risk profile
- Areas with the highest population density
- Areas closest to wildfire
- Areas of high property value

Does your country/region/state emphasize more on procuring specific equipment to fight wildfires?

- Fire trucks and hoses
- Air tankers and helicopters
- Hand tools (e.g. shovels, axes etc.)
- All of the above
- Not aware of

What can data analytics do in predicting or preventing wildfires?

- Help identify high-risk areas and support prevention
- Provide more accurate and timely information on location/spread of wildfires
- Develop more effective strategies for wildfire management
- All of the above
- None of the above
- Not aware of

SILVANUS Integrated Technological & Informational Platform (e.g., social sensing, mobile apps) can be useful in:

- Providing real-time updates on the location/spread of wildfires
- Sending evacuation alerts and other important information to the affected communities
- Connecting affected individuals with emergency resources and support
- All of the above
- None of the above

What specific SILVANUS features/functionalities would be most helpful to emergency responders?

- Wildfire mapping and visualization tools
- Incident reporting and tracking system
- Resource allocation and logistics management
- Other

Please specify

Based on your experience, what are the primary communications challenges during a wildfire incident?

- Lack of reliable communications infrastructure in remote areas
- Interoperability between different emergency reponse agencies
- Difficulty in disseminating timely and accurate information to the public
- Other

Please specify

What potential barriers or challenges do you anticipate in the adoption and implementation of SILVANUS Integrated Technological and Information Platform in wildfire prevention, response and restoration efforts?

- Limited funding for acquiring and maintaining the necessary technology infrastructure
- Limited access to technology in remote areas
- Resistance to change and adoption of new technologies among emergency responders
- Data privacy and security concerns related to sharing sensitive information on the platform
- Interoperability issues with legacy systems
- All of the above
- None of the above
- Other

Please specify

Have you encountered any negative public attitudes towards you?

- Never
- Rarely
- Sometimes
- Often
- Always

Do you feel that society understands the risks and challenges associated with responding to wildfires?

- Yes
- No

Have you ever been personally attacked or threatened while responding to a wildfire?

- Yes
- No

Do you feel that society values the work of wildfire responders?

- Yes
- No

Have you ever witnessed or experienced discrimination on the basis of race, ethnicity, gender or other characteristics while responding to a wildfire?

- Yes
- No

Do you feel that resources and funding for wildfire responders are adequate?

- Yes
- No

Have you ever felt that your health and safety were compromised while responding to a wildfire due to inadequate resources or support?

- Yes
- No

Do you think that more education and awareness campaigns could help to improve society's attitude towards wildfire responders?

- Yes
- No

What changes would you like to see in society's acceptance of and support to wildfire responders?

- Increased funding and resources
- More appreciation and recognition
- Better understanding of the risks and challenges
- All of the above
- No changes
- Other

Please specify

How can the SILVANUS Integrated Technological and Information Platform be used to improve the efficiency and effectiveness of evacuation procedures during a wildfire?

- Provide real-time updates on evacuation orders and routes
- Identify individuals who may need assistance with evacuation
- Coordinate transportation and shelter resources for evacuees
- All of the above
- None of the above

How can the SILVANUS Integrated Technological and Information Platform support the mental health/wellbeing of emergency responders/affected communities?

- By providing access to mental health resources and other supporting services
- By identifying and addressing mental health issues among affected individuals
- By providing stress-reducing activities or resources for emergency responders
- All of the above
- By providing health related information/services to emergency responders
- None of the above

What is needed to ensure equitable access to SILVANUS Platform in wildfire prevention/ response/restoration efforts?

- Increased funding for technology development and implementation
- Policies to ensure privacy and security of data collected through new technologies
- Update of the EU and national legal framework related to the use of DSS systems and their independent modules by emergency responders
- Enhanced training on the use and judgment of outputs of systems similar to SILVANUS
- Programs to provide technology access and training in remote areas
- All of the above
- None of the above

How can society better support the development/implementation of new technologies, like SILVANUS, in wildfire response and prevention efforts?

- Increased funding for technology development and implementation
- Policies to support the development and use of new technologies
- Programs to provide technology access and training in affected communities
- All of the above
- None of the above

How familiar are you with the wildfire management strategies and policies currently in place in your region?

- Very familiar
- Quite familiar
- Not familiar

What do you see as the major obstacles in effectively managing and preventing wildfires in your region?

- Insufficient funding for prevention and preparedness efforts
- Limited public awareness and education on fire safety
- Challenges in enforcing regulations and guidelines
- Other

Please specify

How can SILVANUS platform contribute to improving forest fire management efforts in your area?

- Enhanced collaboration and information sharing among regional authorities and emergency responders
- Better monitoring and early detection of forest fires
- Improved decision-making through data-driven insights
- Other

Please specify

What specific functionalities or tools do you believe would be most valuable for regional authorities in the platform? *(multiple answers may be selected)*

- Policy and regulation management system
- Risk assessment and mapping tools
- Community engagement and communication feature
- Other

Have you ever been involved in responding to a wildfire?
- Yes
- No

Have you ever been affected by a wildfire in your community?
- Yes
- No

Do you feel that you or your community are adequately prepared for a wildfire?
- Yes
- No

Have you ever witnessed or experienced discrimination based on race, ethnicity, gender, or other characteristics during or after a wildfire?
- Yes
- No

Do you feel that your community has adequate resources and support to rehabilitate and restore itself from the impacts of a wildfire?
- Yes
- No

Do you think that increased education and awareness campaigns could help improve societal attitudes towards people affected by wildfires?
- Yes
- No

Have you ever felt that your health and safety were compromised during or after a wildfire due to inadequate resources or support?
- Yes
- No

Do you feel that society adequately values and supports the needs of wildfire affected communities?
- Yes
- No

Have you ever experienced negative attitudes or blame from others in your community or society for being affected by a wildfire?
- Yes
- No

Do you think that increased community involvement and support could help improve rehabilitation and restoration efforts after a wildfire?
- Yes
- No

What changes would you like to see in society's acceptance and support of people affected by wildfires?
- Increased funding and resources for recovery effort
- More compassion and understanding
- Improved understanding of the impacts of wildfires on communities
- All of the above
- Other

Please specify

How do you think SILVANUS Integrated Technological and Information Platform for wildfire Management with innovative capabilities such as drones, robots, sensors, satellite imagery, Remote Sensing Instruments, Earth observations can be utilized to improve wildfire prevention, response and restoration efforts?

- They can provide more accurate and timely information on the location and spread of wildfires
- They can be used to deliver supplies and resources to emergency responders in remote areas
- They can help identify areas at high risk for wildfires and support prevention efforts
- All of the above
- None of the above

How much aware are you of the wildfire risk and the current wildfire management practices in your area?

- Very aware
- Somewhat aware
- Not aware

What challenges do you perceive in preventing and managing wildfires in your community?

- Limited access to fire prevention resources (e.g., firefighting equipment, training)
- Lack of community-wide fire safety awareness and education
- Environmental factors (e.g., dry climate, dense vegetation)
- Other

Please specify

How do you think SILVANUS platform could help in improving wildfire risk management and restoration efforts in your area?

- By providing real-time updates on fire incidents and evacuation notices
- By facilitating communication between residents and emergency responders during fire incidents
- By offering resources and information on fire prevention and preparedness measures for households
- By organizing community initiatives for forest restoration after fire incidents
- Other

Please specify

How informed do you feel about the existing evacuation plans and procedures in your community in the event of a forest fire?

- Very informed
- Somewhat informed
- Not informed

In your opinion, how could SILVANUS platform contribute to improving the safety and preparedness of inhabitants during forest fire incidents?

- Providing real-time alerts and evacuation instructions to affected areas
- Facilitating communication and coordination between residents and emergency responders
- Offering resources and information on fire prevention and preparedness measures for households
- Other

Please specify

Other remarks or comments