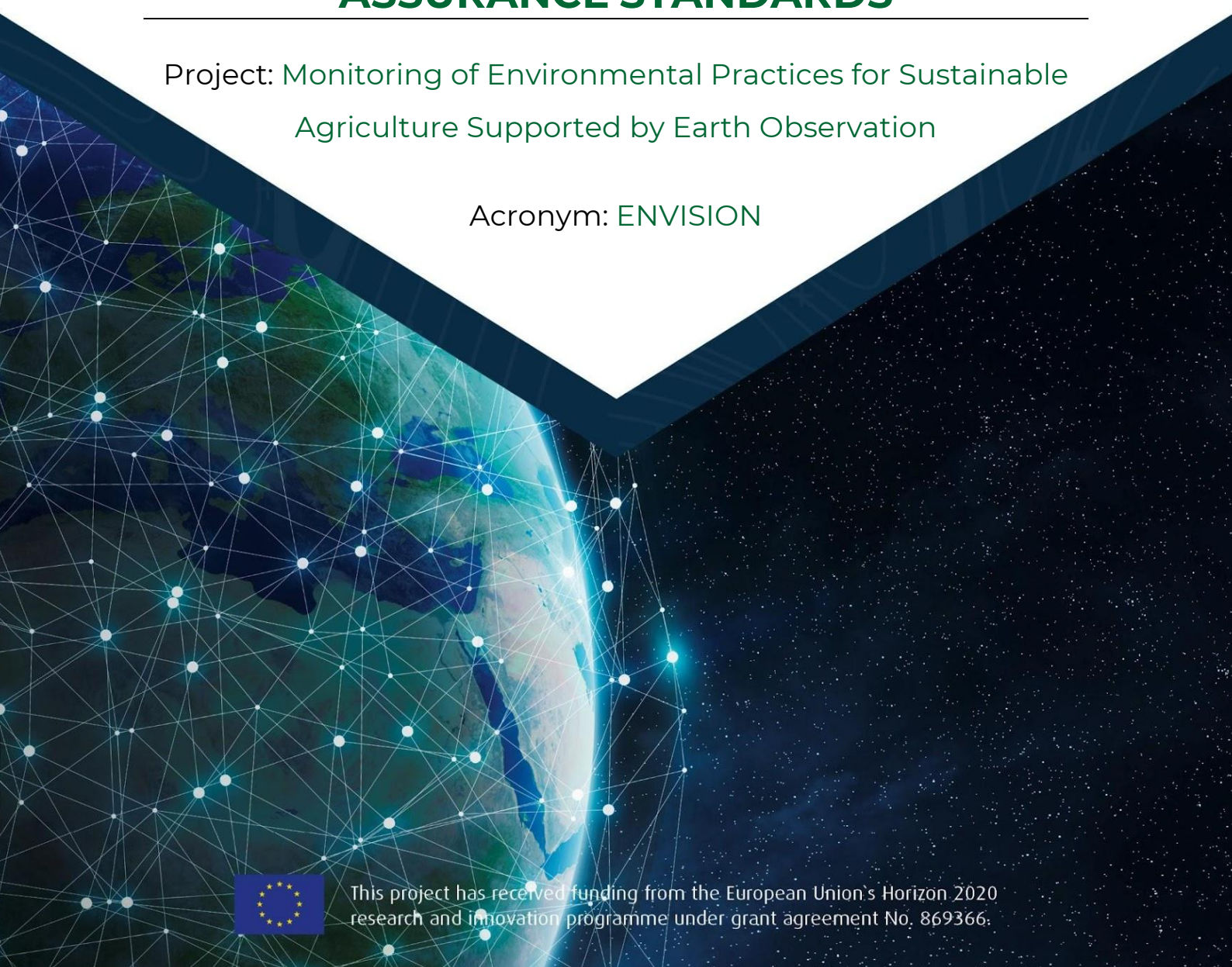
D6.10 ROADMAP FOR THE INCORPORATION OF EO-BASED MONITORING IN ENVIRONMENTAL ASSURANCE STANDARDS

Project: Monitoring of Environmental Practices for Sustainable Agriculture Supported by Earth Observation

Acronym: ENVISION



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ABBREVIATIONS AND ACRONYMS

EO	Earth Observation
CEN	European Committee for Standardization
CENELEC (CLC)	European Committee for Electrotechnical Standardization
AI	Artificial Intelligence
CWA	CEN or CENELEC Workshop Agreement
EN	European Standard
ISO	International Organization for Standardization; International Standard
IEC	International Electrotechnical Commission
SC	Subcommittee
TC	Technical Committee
TR	Technical Report
TS	Technical Specification
WG	Working Group
WI	Work Item

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CONTENT

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1 Executive Summary

Based on feedback from reviewers, rhis chapter has been revised to eliminate marketing text in the summary and to provide a clear update on the roadmap's current status.

The central aim of this report is to provide a roadmap for the integration of EO-based monitoring within environmental assurance standards, aligning with the objectives of the ENVISION project. This roadmap is instrumental in evaluating the current state of EO-based monitoring practices and identifying pertinent standards and guidelines within the environmental standardization landscape.

Current Status of the Roadmap: The roadmap has undergone rigorous analysis, including both Gap and Needs Analyses. The Gap Analysis evaluates existing standardization gaps in EO-based monitoring for environmental assurance, while the Needs Analysis identifies standardization requirements and potential avenues proposed by consortium members and Lighthouse customers, rooted in their professional experience and case studies.

Based on these analyses, this report delineates standardization potentials, presenting them to the Consortium and the Advisory Board (AB) for further evaluation and feedback. Recommendations for promising future standardization activities are made, aiming to enhance the efficacy and applicability of EO-based monitoring in environmental standards.

However, it is crucial to note that while the ENVISION consortium has proactively engaged with standardization bodies like CEN-CENELEC, and prepared the necessary materials for evaluation and potential standardization, the final decision rests with these independent standards bodies.

Overview of Assurance Standards: This document provides a thorough review of assurance standards relevant to EO-based monitoring. It highlights existing standards and identifies areas where new standards could be developed to better support the integration of EO technologies in environmental monitoring and assurance.

Inclusion of EO and ISO Standards: We have conducted a comprehensive review of EO standards, drawing from resources such as the IEEE Geoscience and Remote Sensing Society's standards for Earth Observations. Additionally, relevant ISO standards have been examined to ensure that our recommendations are in alignment with international best practices.

Engagement with Standardization Bodies: The roadmap outlines a framework for technical cooperation and information exchange between ENVISION, its partners, and standards organizations. This approach is designed to facilitate practical implementation initiatives and encourage active participation in the standards development process. Our engagement in initiatives such as Projects Hub of HSBooster.eu exemplifies our commitment to this cause, ensuring that our progress is communicated to and recognized by leading standardization bodies, laying the groundwork for future standardization efforts beyond the lifespan of the project.

In summary, this updated report provides a clear roadmap, supported by comprehensive analyses and reviews of relevant standards. It reflects our commitment to advancing EO-based monitoring within environmental assurance standards, ensuring that the ENVISION platform and its toolbox of services are aligned with best practices, interoperable, and poised for market acceptance and success.

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2 Introduction

Task 6.5, "Contribution to Standards," is crucial for the success of the ENVISION project by ensuring that its services and solutions align with industry standards and best practices, making them more attractive to potential customers and investors.

Additionally, for this deliverable, we have compared ENVISION services with the LEAF Marque Standard Control Point (both current and potential applications), paving the way for integration into environmental assurance standards.

By doing so, it maximizes the opportunities for future exploitation, market uptake, and commercialization of the ENVISION platform, ultimately leading to its wider adoption in the market. As part of this task, *Deliverable D6.10, "Roadmap for the incorporation of EO-based monitoring in environmental assurance standards,"* implemented several actions throughout the final stage of the ENVISION project (M19-M36), including meeting with standardization experts from **HSBooster.eu**, exploring the standards landscape, and identifying areas for new or revised standards. The task has also planned contributions to standards organisations to ensure efficient and strategic involvement in the standardization process. The objective is to make ENVISION an active player in the development of standards in the corresponding area or domain, and to enable its success in the market.

The approach for this deliverable is illustrated in Figure 1, which provides an outline of the methodology employed. It encompasses an introduction to the methodological approach **(Chapter 3)**, a condensed depiction of the existing Standardization Landscape **(Chapter 4)**, and an overview of the ENVISION Platform **(Chapter 5)**, which serve as the groundwork for conducting the Needs Analysis **(Chapter 5)**.

In addition to the Needs Analysis, the Gap Analysis **(Chapter 6)** will also be presented, based on current standardization requirements and potential requirements proposed by members of the consortium. These were identified based on their expertise and work conducted within INOSENS.

Chapter 6 of this report will cover the Gap Analysis, which compares the existing and ongoing standardization activities with the envisaged ENVISION platform and incorporates feedback from the completed Needs Analysis. The Gap Analysis will cover three categories:

- aspects/components of ENVISION that are already addressed in standardization activities,
- aspects of ENVISION that are partially addressed in standardization activities, and:
- aspects of ENVISION that are not addressed in standardization activities.

In **Chapter 7** of this report, recommendations will be presented regarding potential future standardization endeavors. These recommendations are based on the identification of key activities that are either not addressed or only partially covered by existing standardization efforts concerning the utilization of EO data for agricultural monitoring. **Chapter 8** will outline the Standardization Outreach Strategy, including the process for initiating standardization activities. Finally, **Chapter 10** will summarize the process and results of the roadmap for further standardization activities.

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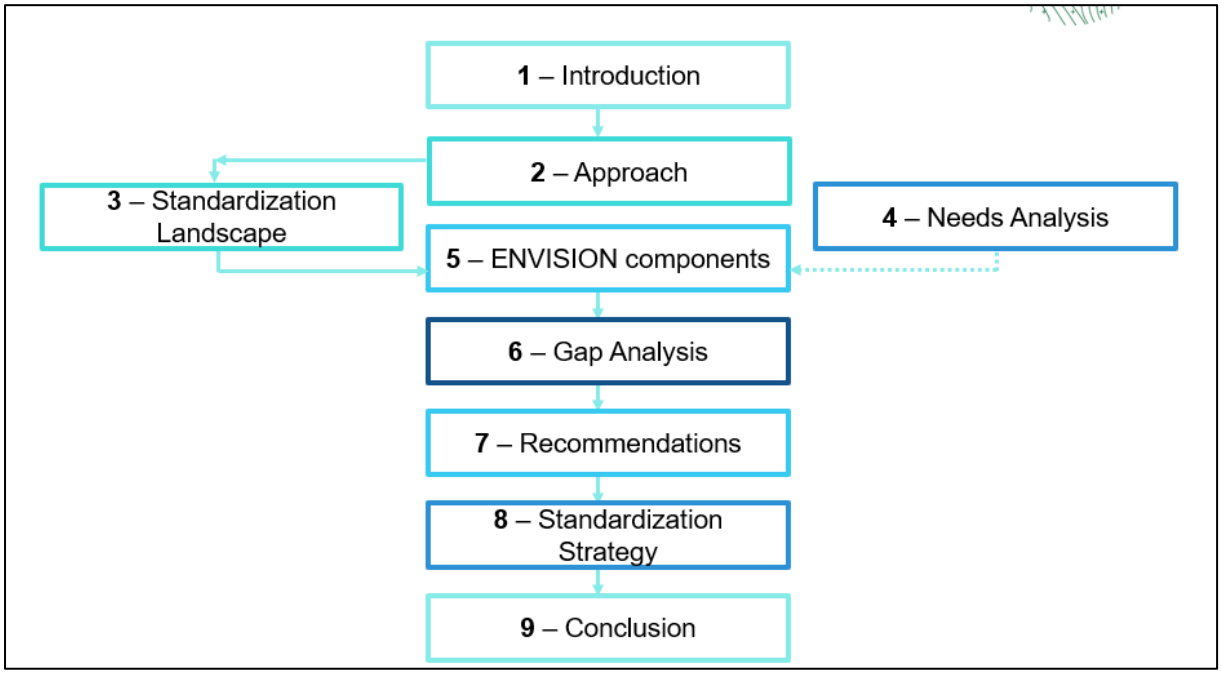

Figure 1 Approach for the creation of a Roadmap for further standardization activities

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3 Approach

This section has been revised to incorporate an overview of assurance standards, along with an examination of EO standards from the IEEE Geoscience and Remote Sensing Society's Technical Committees, and relevant ISO standards.

We acknowledge the importance of standardization as a collaborative and innovative process, essential for the success of the ENVISION platform throughout post-project exploitation. In order to achieve this, we have conducted a comprehensive mapping exercise that encompasses relevant standards, procedures, guides, and best practices. This mapping exercise has been carried out in a collaborative and inclusive manner, with input and contributions from project partners and associated stakeholders in the last phase of the project (M19-M36).

However, this mapping exercise is only the beginning of our ongoing standardization process, which is crucial to ensure that ENVISION remains at the forefront of the EO-based agro-environmental monitoring. By continuously updating and refining our standards and practices, we can finetune this platform to meets the evolving needs of our customers and stakeholders, including paying agencies, certification bodies, farmers, and third-party developers.

Continuous standardization forms the foundation of ENVISION's reliable, accurate, and compliant solutions for monitoring farmers' compliance with the agri-environmental standards of CAP. We leverage state-of-the-art EO and AI techniques, combined with cutting-edge ICT, to continually enhance our capabilities.

Our standardization study encompasses both European standards, including those developed by CEN, CENELEC, and ETSI, as well as international standards. Our aim is to provide a comprehensive and inclusive overview of existing standards and best practices relevant to EO-based monitoring in the agricultural environmental domain.

Keywords related to the relevant standards include Earth observation, environmental monitoring, remote sensing, data processing, quality assurance, validation, metadata, standardization, interoperability, data sharing, and sustainability. Additionally, specific environmental domains such as agriculture, water resources, biodiversity, and climate change are also considered. These keywords help us search for relevant standards and procedures in various databases and repositories, ensuring the mapping exercise is comprehensive and inclusive.

This mapping exercise is an initial step in our efforts to align the ENVISION project with existing standards and best practices. We anticipate that further updates and refinements to this mapping will be necessary as the project progresses and enters its post-project exploitation phase.

In order to identify relevant standards for ENVISION's EO-based environmental monitoring, **a keyword search** was conducted. These keywords include Earth Observation, environmental monitoring, remote sensing, data processing, quality assurance, validation, metadata, standardization, interoperability, data sharing, and sustainability. It is also important to consider specific environmental domains such as agriculture, water resources, biodiversity, and climate change. By utilizing these keywords, databases and repositories were then searched to ensure a comprehensive and inclusive mapping exercise that encompasses all relevant standards and procedures. This initial step aims to align the ENVISION project with existing standards and best practices, with the understanding that further updates and refinements to the mapping will be necessary during the post-project exploitation phase.

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To initiate the search for existing standards and standard documents relevant to the ENVISION project, a list of key concepts has been compiled. These concepts were carefully chosen, considering the project's objectives, goals, integration levels, and use cases. These concepts can serve as a basis for searching and identifying standards and best practices that align with the objectives and scope of the ENVISION project, particularly in the field of EO-based environmental monitoring.

Table 1 Key concepts used in preliminary search

Key concepts used in preliminary research	
1	Earth Observation (EO)
2	Environmental Monitoring
3	Remote Sensing
4	Data Processing
5	Quality Assurance
6	Validation
7	Metadata
8	Standardization
9	Interoperability
10	Data Sharing
11	Sustainability
12	Agriculture
13	Water Resources
14	Biodiversity
15	Climate Change

A search using the mentioned keywords produced a significant number of results, allowing for the identification of the relevant technical bodies (TC, SC, and WG) responsible for drafting these standards. Furthermore, an additional search was conducted within the work program of each technical body to uncover standards that may have been missed in the initial search. Utilizing multiple search engines enhanced the coverage of the search space.

In addition, the reference standards contributed by project partners were included, and the relevant standards pertaining to the scope of the ENVISION project are listed in Table 2. **The upcoming section will delve into an extensive exploration of standards pertinent to Earth Observation (EO) and environmental surveillance, showcasing contributions from renowned entities such as the IEEE Geoscience and Remote Sensing Society, ISO, as well as standards and solutions that facilitate data interchange, including OGC standards, CEF building blocks, and the INSPIRE directive.**

Table 2 ENVISION Reference standards

Organisation	Standard Code	Title	Relevance to ENVISION	Scope
IEEE GRSS	IEEE 1852	Airborne Visible/Infrared Imaging Spectrometers	Relevant for EO-based data acquisition, ensuring standardization in imaging spectrometers.	Specifies requirements for design, performance, and data processing of airborne imaging spectrometers.
ISO	ISO 19130-1:2018	Sensor and data models for	Addresses standardization of	Provides a framework for describing the

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		imagery and gridded data	sensor data, crucial for ENVISION's data integration and analysis.	geometric relationship between the Earth's surface and raster EO data.
OGC	OGC 06-080r4	Sensor Web Enablement: Overview and High Level Architecture	Supports ENVISION in integrating various sensor networks and data into a cohesive framework.	Describes integration of EO sensors into the web and enabling interoperable usage of sensor data.
ISO	ISO/TS 19159-1:2019	Calibration and validation of remote sensing imagery sensors and data	Ensures the quality and reliability of remote sensing data used by ENVISION.	Provides a framework for the calibration and validation of optical remote sensing sensors.
CEF	CEF Building Blocks	Various	Facilitates interoperability and seamless data exchange, enhancing ENVISION's toolbox functionality.	Provides a set of reusable and standardized solutions for various digital interactions and data exchanges.
EU	INSPIRE Directive	Infrastructure for Spatial Information in Europe	Aligns with ENVISION's goal for systematic and continuous monitoring by promoting data sharing and accessibility.	Establishes a framework for the sharing of environmental and spatial information across Europe.
IEEE GRSS	IEEE 19130-2	Calibration and Validation of LIDAR Remote Sensing and Derived Data	Relevant for ensuring the quality of LIDAR data used in ENVISION for agricultural monitoring.	Provides a framework for the calibration and validation of LIDAR remote sensing data.
ISO	ISO 19157	Geographic Information — Data Quality	Ensures that the EO data used by ENVISION meets the required quality standards.	Provides guidelines for describing the quality of geographic data and identifying quality parameters.
OGC	OGC 07-057r7	Observations and Measurements - XML Implementation	Facilitates standardization of observation data format, aiding in ENVISION's data integration processes.	Defines an XML encoding for the Observations and Measurements conceptual model.

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ISO	ISO 19115	Geographic Information — Metadata	Supports ENVISION in providing comprehensive metadata for its EO datasets, enhancing data discovery and usage.	Defines the schema required for describing geographic information and services.
W3C	RDF	Resource Description Framework	Helps in creating interoperable data formats and linking data in ENVISION.	A framework for representing information in the Web.
ISO	ISO 19101-2	Geographic Information — Reference Model — Part 2: Imagery	Relevant to the modeling and data structuring for imagery in ENVISION.	Describes how imagery and gridded data should be treated in the context of geographic information.
ISO	ISO 19123	Geographic Information — Schema for Coverage Geometry and Functions	Pertinent for ENVISION's use of coverage data in agricultural monitoring.	Defines a schema for the spatial and non-spatial characteristics of coverage geometry and functions.
INSPIRE	INSPIRE Data Specifications	Various Thematic Areas	Provides data specifications for various environmental and geographical themes relevant to ENVISION.	Sets out rules for how specific types of spatial data should be made available and shared.
ESA	EO Data Standards	Various	Provides specific standards and protocols for the use and distribution of EO data from ESA missions.	Defines formats, protocols, and standards for EO data from European Space Agency missions.
ISO	ISO 14001	Environmental Management Systems — Requirements with Guidance for Use	Aligns with ENVISION's focus on environmental monitoring and can guide the project's internal management processes.	Specifies requirements for an environmental management system, enabling an organization to develop and implement policies and objectives.
ISO	ISO 14001	Environmental Management Systems — Requirements	Aligns with ENVISION's focus on environmental monitoring, guiding	Specifies requirements for an environmental management system, enabling an

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		with Guidance for Use	the project's internal environmental management practices.	organization to develop and implement policies and objectives considering legal and other requirements to which the organization subscribes, and information about significant environmental aspects.
ISO	ISO/IEC 27001	Information Security Management Systems — Requirements	Ensures the security of ENVISION's data, protecting against unauthorized access and data breaches.	Specifies the requirements for establishing, implementing, maintaining, and continually improving an information security management system within the context of the organization.

Please note that the list above is a sample representation and may not be exhaustive. It includes some of the European and international committees, subcommittees, and working groups identified as technical bodies working on subjects relevant to the ENVISION project. The standards listed are those considered relevant to ENVISION's objectives.

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4 Standardization Landscape Overeview

Per DoA, T6.5, this chapter provides a list of organizations, while a strategy and specific plan for engagement is detailed in chapter 9.

The standardization landscape overview provides a comprehensive understanding of the current status of Earth Observation (EO)-based monitoring within the environmental standardization domain. This overview examines relevant standards, procedures, and guides that are of significance to the ENVISION project, aiming to establish a framework for technical cooperation and information exchange between ENVISION, its partners, and various standards organizations.

A **Standardisation Landscape Matrix** has been sent out to ENVISION project partners in December 2022 and has been updated with INOSENS's own desk research. The purpose of this overview is to identify and highlight key standards organizations, technical committees, working groups, guidelines, and protocols that are directly relevant to ENVISION's objectives. By focusing on organizations with which ENVISION and its partners have direct contact, both nationally and internationally, a precise and detailed understanding of the standardization landscape can be obtained. This information, combined with the input from project partners, is crucial for shaping future standardization activities and facilitating practical implementation actions. It enables ENVISION to establish a framework for technical cooperation, information exchange, and collaboration with standards organizations, fostering the development and adoption of EO-based monitoring in environmental assurance standards.

The identified organisations, committees, subcommittees, and working groups are classified into two primary categories within the standardization landscape overview: **vertical organisations and horizontal organisations**. Vertical organisations focus on specific subject matters relevant to ENVISION, such as Earth Observation, Environmental policies, Sustainability, Agricultural Policies, Smart Farm Assurance Solutions, Organic Farming & Quality Scheme Control. On the other hand, horizontal organisations address ICT systems or management matters. This classification allows for a comprehensive representation of the organisations and technical bodies working on topics that align with the goals of the ENVISION project.

In addition to the categorization of committees, the table below provides an overview of standards organizations and other relevant entities that could contribute to the development of standards. While some organizations may not directly provide publicly available guidelines or standards, they are affiliated and potentially useful in the standards development process. The table also includes different types of organizations, including international organizations, non-governmental organizations (NGOs), industry and business entities, government bodies, research and academia, consultancy firms, standardization bodies, and others engaged in various types of activities such as standards, guidelines, operational processes, education, and regulations.

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Organization	Type of Organization	Area of Expertise	Level of Involvement
CEN (European Committee for Standardization)	Standardization Body	Various fields	Standards
CEN is a leading provider of European standards across multiple sectors, promoting innovation, safety, and efficiency. They develop and publish harmonized standards that contribute to the European Single Market.			
ISO (International Organization for Standardization)	International Organization	Various fields	Standards
ISO develops and publishes international standards, ensuring consistency and compatibility across different countries. They provide guidelines and specifications to enhance quality, safety, and efficiency in various industries.			
European Space Agency (ESA)	International Organization	Earth Observation	Not specified.
ESA focuses on space-related research and development, including Earth Observation. They collaborate with partners to promote the use of satellite data for environmental monitoring and provide technical expertise in the field.			
EuroGeographics	International Organization	Geospatial Information	Not specified.
EuroGeographics is an association of European National Mapping, Cadastral, and Land Registration Authorities. They contribute to the development of geospatial standards and ensure the availability of accurate and up-to-date geospatial information for environmental monitoring and other applications.			
European Committee for Electrotechnical Standardization (CENELEC)	Standardization Body	Electrotechnical Standards	Standards
CENELEC develops and harmonizes standards in the field of electrotechnical engineering, ensuring safety, compatibility, and interoperability of electrical products and systems in Europe. Their standards can be relevant for environmental monitoring equipment and technologies.			
European Environmental Agency (EEA)	Government	Environmental Policies	Regulations
EEA provides information and expertise on environmental issues in Europe. They support the development and implementation of environmental policies and initiatives, including those related to monitoring and assessment. Collaboration with EEA can contribute to the harmonization of standards and guidelines for environmental monitoring in the region.			
European Space Imaging	Industry & Business	Satellite Imagery and Services	Not specified.
European Space Imaging is a leading supplier of very high-resolution satellite imagery and related services. They provide geospatial solutions for various applications, including environmental monitoring. Collaboration with European Space Imaging can contribute to the integration of satellite data and technologies into environmental assurance standards.			
European Association of Remote Sensing	Industry & Business	Earth Observation Services	Not specified.

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Companies (EARSC)			
EARSC represents companies providing remote sensing and geospatial services. They promote the use of Earth Observation data and advocate for the development of standards and best practices in the industry. Collaboration with EARSC can facilitate knowledge exchange and the integration of EO-based monitoring into environmental assurance standards.			
European Committee for Standardization in Electrotechnics (CENELEC)	Standardization Body	Electrotechnical Standards	Not specified.
CENELEC develops and harmonizes standards in the field of electrotechnical engineering, ensuring safety, compatibility, and interoperability of electrical products.			
EURISY	Non-Governmental Organization	Space Applications and Services	Not specified.
EURISY promotes the use of space-related technologies and applications for societal benefits. They facilitate the dialogue and collaboration between space agencies, industry, and end-users to foster innovation and development. Collaboration with EURISY can contribute to leveraging space-based monitoring technologies in the development of environmental assurance standards.			
Open Geospatial Consortium (OGC)	International Organization	Earth Observation	Not specified.
INSPIRE	Government	Environmental policies	Regulations
EOCC (The European Organic Certifiers Council)	International Organization	Association of control bodies and authorities	Regulations
EOCC aims to increase the reliability of control and certification activities and decisions in relation to European organic agriculture. It acts towards an improvement of the European organic legislation and is recognized as a valuable partner at the EU level.			
IFOAM (International Federation of Organic Agriculture Movements)	International Organization	Sustainability in Agriculture	Regulations
IFOAM works on behalf of its membership, the global organic movement, supporting the development and revision of policies, regulations, and public and private organic guarantee systems.			
Rural Payment Agency (RPA)	Government	Agricultural Policy	Operational
The RPA is the only accredited paying agency in England, making payments to farmers, traders, and landowners, and managing various schemes to ensure a healthy rural economy and strong communities.			
Joint Nature Conservation Committee (JNCC)	Government		Operational
JNCC utilizes Earth Observation (EO) expertise to provide high-quality evidence on biodiversity and ecosystems, supporting environmental decision-making.			

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National Centre of Earth Observation (NCEO)	Research and Academia	Earth Observation	Operational
NCEO provides national capability in Earth observation science, monitoring the health of the planet through satellite instruments and data interpretation.			
Organic Farmers and Growers	UK Government-approved certification body	Organic Farming	Regulations
OF&G certifies farmers and businesses, ensuring adherence to organic standards in the UK.			
The Organic Food Federation (OFF)	Farm Assurance Scheme (UK)	Organic Farming	Regulations
The Organic Food Federation promotes organic methods, maintains high standards, and creates opportunities for the UK's organic sector.			
Biodynamic Association Certification	Farm Assurance Scheme (Global)	Organic Farming	Regulations
Biodynamic Association Certification guarantees environmentally friendly, ethical, and sustainable production and processing methods, surpassing organic standards.			
European Agricultural Guarantee Fund (EAGF)	Government	CAP Payments	Operational
The European Agricultural Guarantee Fund (EAGF) manages financial support under the Common Agricultural Policy (CAP). They oversee the payment of direct aids, including environmental and rural development measures, to farmers in the European Union. The EAGF plays a role in ensuring compliance with environmental and quality standards in agriculture.			
European Network for Rural Development (ENRD)	Government	Rural Development	Operational
ENRD is a network that connects rural development stakeholders across Europe. They facilitate knowledge sharing, exchange of good practices, and cooperation in rural development. Their activities include promoting sustainable agriculture, environmental management, and support for rural businesses. Collaboration with ENRD can contribute to the development and dissemination of guidelines and best practices related to environmental certification and sustainable rural development.			
European Sustainable Investment Forum (Eurosif)	NGO	Sustainable Investment	Not specified.
Eurosif is a network promoting sustainable and responsible investment in Europe. They work with investors, asset managers, and other stakeholders to integrate environmental, social, and governance (ESG) criteria into investment practices. Eurosif's activities involve research, advocacy, and the development of standards and guidelines for sustainable investment. Collaboration with Eurosif can contribute to aligning environmental certification and investment practices, including those related to agricultural and rural development.			
European Environmental Bureau (EEB)	Government	CAP Implementation and Rural Development Policies	Not specified.

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DG AGRI is a department of the European Commission responsible for the implementation of the Common Agricultural Policy (CAP) and rural development policies. They develop and implement policies related to environmental sustainability, rural development, and agricultural support programs. Collaboration with DG AGRI can provide insights into CAP payments, environmental certification requirements, and policy developments at the EU level.			
European Platform on Biodiversity and Ecosystem Services (EPBES)	International Organization	Biodiversity and Ecosystem Services	Not specified.
EPBES is an intergovernmental platform that provides information and assessments on biodiversity and ecosystem services. They support decision-making processes by promoting the use of scientific knowledge and expertise. EPBES activities include the development of guidelines, assessments, and policy recommendations related to biodiversity conservation and the sustainable use of ecosystems. Collaboration with EPBES can contribute to integrating biodiversity considerations into environmental certification and agricultural practices at the EU level.			
European Centre for Nature Conservation (ECNC)	Research and Academia	Biodiversity Conservation	Not specified.
ECNC is an independent organization focused on biodiversity conservation and sustainable development. They provide expertise, research, and guidance on nature conservation policies and practices. ECNC's activities include supporting the implementation of EU environmental policies, collaborating with stakeholders, and developing guidelines for biodiversity conservation and environmental certification. Collaboration with ECNC can contribute to the development of environmental certification standards that align with biodiversity conservation goals at the EU level.			

By exploring the standardization landscape, ENVISION aims to collaborate closely with relevant standards organizations, technical committees, and working groups. **A strategy and specific plan for engagement is detailed in chapter 9.** This collaboration will facilitate knowledge exchange, technical cooperation, and the development of harmonized standards and guidelines in areas where there is a common interest between ENVISION and other organizations.

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5 Insights from Needs Analysis

This chapter has been revised to respond to the feedback from reviewers concerning quality management.

The standardization needs and potentials were extensively discussed among the consortium members who expressed interest in the area. Their valuable contributions played a crucial role in conducting a comprehensive needs analysis, which considered both technical deliverables and user requirements. To ensure the relevance and novelty of the proposed standardization efforts, a thorough research endeavor was undertaken to identify any existing standards or ongoing standardization activities that cover the identified needs. This involved conducting a state-of-the-art analysis to bridge any gaps in the current landscape.

In order to gather additional insights and validate the standardization needs and potentials, experts were invited to participate in an online panel titled "Bridging the Gap between EO, ICT, and Environmental Monitoring" held in June. The feedback received from the panel, along with the research findings, contributed to the identification of promising results from the ENVISION project. These results, which include **the development of domain-specific standards, standardized terms, definitions, symbols, and data exchange formats**, are deemed crucial for advancing standardization proposals within the field of EO-based environmental monitoring.

Furthermore, among the identified needs, it is essential to prioritize the establishment of EU-wide semantics and syntactic interoperability standards. Achieving syntactic interoperability can be accomplished through the adoption of Web Services APIs, user/service authentication, and authorization schemes, alongside the utilization of interoperability enablers.

Additionally, contributing to the creation of a federated ecosystem of agro-environmental data sources holds significant importance. The sharing of farm-level and group-level agricultural data presents untapped potential in enhancing environmental monitoring practices and facilitating data-driven decision-making in the agricultural domain.

In summary, the standardization needs and potentials were comprehensively discussed, taking into account both **technical and user perspectives**. The research efforts and expert feedback led to the identification of promising results from the ENVISION project, including the development of domain-specific standards and the establishment of EU-wide semantics and syntactic interoperability. Moreover, contributing to a federated ecosystem of agro-environmental data sources is crucial for advancing environmental monitoring practices and promoting data-driven decision-making.

Addressing the Comment on Quality Measurement:

To ensure the reliability and trustworthiness of ENVISION's EO-based products, it is imperative to establish a robust quality assessment mechanism. Akin to the QA/sampling criteria set up by JRC for AMS products, a similar approach can be adopted and tailored for ENVISION services.

The ENVISION consortium acknowledges the importance of quality assurance, particularly given the variability and complexity of environmental data. Ensuring the accuracy and reliability of EO-based products demands a systematic approach to quality measurement. The following measures can be implemented:

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Quality Assurance Framework: Building on the JRC's QA criteria, ENVISION can implement a framework that incorporates routine checks, validations, and calibrations to ensure the accuracy and precision of EO-based outputs.

Standardization of Quality Metrics: By adopting standardized metrics, the quality of ENVISION's EO-derived products can be consistently assessed. This not only ensures internal consistency but also provides users with a transparent understanding of the data quality they are engaging with.

Validation with Ground Truth Data: To ascertain the accuracy of ENVISION's EO-derived products, they can be validated against ground truth data or other reputable sources. This validation process should be recurrent to account for any changes in the environmental parameters.

Feedback Loop: Integrating a feedback mechanism allows users to report inconsistencies or anomalies, thereby continually refining the quality of ENVISION's products.

Adherence to Existing Standards: Leveraging and adhering to current industry or international standards ensures that the EO-derived products are consistent with global best practices.

Incorporating these measures into ENVISION's framework will ensure that the EO-derived products meet the highest standards of quality, thereby promoting trust and wider acceptance among users.

Furthermore, addressing the quality of products, as mentioned above, also complements the overarching goals of standardization discussed in this chapter. Ensuring that ENVISION's products adhere to recognized quality standards reinforces the objective of bridging the gap between EO, ICT, and Environmental Monitoring.

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6 Gap Analysis

This chapter was revised based on reviewers' suggestions to clarify the selected solution, when there was a doubt of applying a standard.

Gap analysis is a structured assessment that aims to compare existing and ongoing standardization activities with the envisioned future state of a system, project, or framework. It serves the purpose of identifying and evaluating the gaps or discrepancies between the current standardization efforts and the desired level of standardization for the target system.

The goal of conducting a gap analysis is to identify areas where standardization activities align with the desired future state, areas where they partially align, and areas where no alignment exists. By understanding these gaps, stakeholders can develop strategies to bridge the identified discrepancies and move closer to the desired standardization level.

This chapter focuses on conducting a gap analysis for the ENVISION Platform. The chapter is divided into four logical sections to systematically analyze and present the findings of the gap analysis.

- ***Gap Analysis:*** This section describes the methods and approaches used to evaluate and compare the existing standardization activities with the ENVISION Platform. It provides an overview of the analytical techniques, criteria, and metrics employed in the analysis process.
- ***Aspects of the ENVISION Platform Already Addressed in Standardization Activities:*** This section examines the aspects or components of the Platform that have already been addressed in ongoing standardization activities. It highlights the areas where existing standardization efforts align with the desired future state.
- ***Aspects of the ENVISION Platform Partly Addressed in Standardization Activities:*** In this section, the aspects of the Platform that are partially addressed in standardization activities are discussed. It identifies areas where some standardization efforts have been made but further developments or improvements are needed to fully align with the desired future state.
- ***Aspects of the ENVISION Platform Not Addressed in Standardization Activities So Far:*** This section focuses on the aspects or components of the Platform that have not been addressed in standardization activities. It identifies areas where no standardization efforts exist and highlights the gaps between the current state and the desired future state.
- ***Results:*** The final section presents the results of the gap analysis. This section provides a clear overview of the identified gaps and sets the stage for further discussions and actions to address those gaps.

Gap Analysis

The chosen method for addressing the comparison between the standardization landscape and the ENVISION Platform is a gap analysis. This approach allows for a clear identification of the differences between the desired state in the post-project exploitation period and the current situation. It does not require the introduction of a rating system for comparison purposes. The focus of the analysis is on

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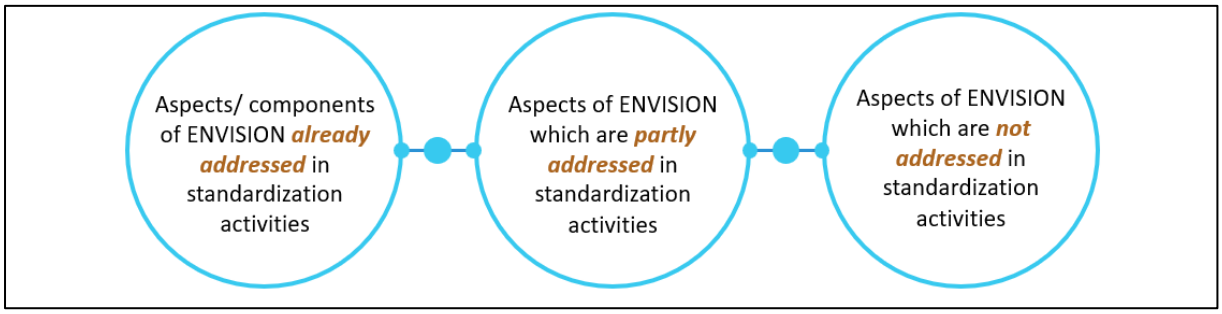
identifying gaps between standardized and unaddressed requirements, rather than pinpointing errors in the envisioned future platfrom. The gap analysis involves comparing the actual state with the desired circumstances, highlighting areas for improvement. The execution of a gap analysis typically involves several steps. Firstly, target objectives are established through mission statements, improvement objectives, and strategic goals. Then, the current processes are examined by gathering relevant data from various sources. Finally, activities and recommendations are proposed to bridge the gap between the current and desired states.

The gap analysis was conducted on the components of the ENVISION platform, as outlined in the **D4.3 Integrated and Validated Version of ENVISION Platform**, including the Geospatial Server, Web Server, Authorization Server, Geospatial Database, Web Application User Interface, Web API, Mobile Application, Parcel import component, Data product import components, GeoServer Protection component, and Notifications service. Additionally, the analysis encompassed ENVISION Services Specifications such as Cultivated Crop type Maps, Data fusion, Sentinel data Preprocess, Grassland Mowing Events Detection, Analytics on vegetation and Soil Index Time-series, Identification of organic farming practices, and Soil Organic Carbon monitoring.



Aspects/Components of ENVISION Already Addressed in Standardization Activities

- ***System Components:*** The various system components, such as the Geospatial Server (GeoServer), Web Server (NGINX), Authorization Server (KeyCloak), Geospatial Database (PostgreSQL/PostGIS), Web Application (Vue.js and Vuetify), Mobile Application (Vue.js and Capacitor), Parcel Import & Product Import components, GeoServer Protection component, and Notifications component adhere to established standards and best practices in their respective domains.

- ***Docker Containers:*** The utilization of Docker containers has been standardized and widely adopted in the industry. Docker containers provide portability and consistency in deploying applications, ensuring that the ENVISION platform can run reliably across different computing environments.

- ***Component Interface:*** The internal interfaces between the components of ENVISION, such as the integration between GeoServer and PostGIS, Django/Backend and PostgreSQL, KeyCloak and Django/Backend, Web Application and Backend, Mobile Application and Backend, and Notifications Component and Mail Server, interface designs and communication protocols adhere to established standards, promoting compatibility and seamless integration between the components.

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- ***Data Inputs/Outputs:*** The input and output data formats utilized by the ENVISION platform, including vector files (Shapefiles), raster files (GeoTIFF), REST payloads (JSON), and database data, have been addressed in standardization activities. This indicates that the ENVISION platform can effectively handle and process data in standardized formats, facilitating data interoperability and compatibility with external systems.

- ***Application Interface:*** ENVISION provides capabilities for communication with external systems through various protocols. These include RESTful APIs, which allow third-party systems or developers to consume platform functionalities, OGC services (such as WMS and WCS), which enable third-party SDI or Desktop GIS software to consume geospatial products, and Postgres Connector, which allows third-party Postgres clients to access the system's database. These interfaces have been addressed in standardization activities, ensuring compatibility and interoperability with external systems.

- ***Security:*** The security measures implemented in ENVISION, such as the use of HTTPS over TLS, OAuth2, OpenID Connect, and SSH, adhere to established industry standards and best practices. The choice to employ these measures was likely influenced by their widespread adoption and proven reliability in maintaining platform integrity and data protection. The application firewall offers an additional layer of protection against potential threats, highlighting the platform's commitment to ensuring user and data safety. **In cases of ambiguity regarding security measures, the platform prioritized tried-and-true methods with a history of effectiveness.**

- ***Parcel Import & Product Import components:*** These components use HTTP/RESTful APIs, which adhere to standard communication protocols for data exchange.

- ***Notifications' component:*** The notifications' component, such as email protocols such as SMTP are widely standardized.

- ***Web App and Mobile App Application Programming Interfaces (APIs):*** The APIs for the web and mobile use RESTful APIs, which follow standard architectural principles for web services.

- ***Backend Data Processing:*** The ENVISION backend consists of the Business Layer and the Storage Layer, responsible for handling parcel information from end-users (Paying Agencies and Certification Bodies) and services/products from service providers. The connections between the User Interface Layer and the Business Layer are established using the HTTP/TLS protocol and aligns with the industry best practices.

Aspects of ENVISION Partly Addressed in Standardization Activities

- ***ENVISION as an Open-Source Platform:*** Being an open-source platform allows ENVISION to tap into the collaborative and innovative nature of open-source communities. The alignment with open-source licensing frameworks and principles signifies the platform's commitment to transparency, adaptability, and community-driven improvements. **When choosing specific**

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open-source licenses or frameworks, the platform weighed the benefits of community support, flexibility, and the forward-compatibility these licenses offer.

Aspects of ENVISION Not Addressed in Standardization Activities

- ***Integration of Services:*** The extensive integration of services from different providers into the ENVISION platform demonstrates its adaptability and versatility. While the platform has effectively incorporated a diverse range of services, the decision to integrate specific ones was likely based on their compatibility with the platform's architecture and their potential to enhance the platform's functionality. **If there were any ambiguities regarding integration standards, the platform chose solutions that promise seamless interoperability and user experience.**

- ***Mobile Application:*** The decision to develop the mobile application using hybrid technologies like Vue.js and Capacitor indicates a strategic move to ensure cross-platform compatibility and rapid development. While Vue.js boasts a robust ecosystem, hybrid technologies offer the advantage of using a single codebase to deploy on multiple platforms, ensuring consistency and reducing developmental overhead**. In scenarios where the application of a specific technology standard was unclear, the platform favored solutions that prioritize user accessibility across devices and operational efficiency.**

Results

In summary, the analysis of the ENVISION architecture reveals that several aspects and components of the platform have been addressed in standardization activities. These include the system components, Docker containers, component interfaces, data inputs/outputs, application interfaces, and security measures. The adherence to established standards and best practices in these areas ensures compatibility, interoperability, and the use of industry-standard protocols.

However, some aspects of ENVISION are only partly addressed or not explicitly mentioned in standardization activities. The mobile application development, and the open-source nature of the platform fall into this category. While there may be implicit alignment with standards, further work in the post-project period would provide even greater alignment with standardization needs.

Recommendations have been made to build upon the existing standardization efforts. This includes continuing to engage in relevant standardization initiatives, documenting the specific activities undertaken, exploring standardization of integration interfaces, considering standardization for backend data processing, engaging with open-source standardization initiatives, and staying aware of emerging standards and best practices.

Furthermore, the subsequent chapter will delve deeper into these recommendations based on a comprehensive needs analysis and gap analysis.

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7 Recommendations

The chapter has been updated to offer detailed recommendations that are directly aligned with distinct services of the platform.

Based on the thorough needs analysis and gap analysis conducted, several key recommendations have emerged to enhance the standardization efforts within the ENVISION platform. These recommendations aim to address the identified gaps, promote interoperability, and align with established industry standards and best practices. By implementing these recommendations, ENVISION can further solidify its position as a reliable and efficient geospatial solution for the agricultural sector.

Deepened Standardization Engagement:

- Targeted Focus: Prioritize initiatives directly impacting the agricultural geospatial spectrum.
- Networking: Attend specific workshops like the Geospatial World Forum to foster direct relationships with industry leaders.

Explicit Documentation of Standardization:

- Detailed Cataloging: Log each standard implemented, its version, date of integration, and rationale for its choice.
- Public Repository: Host this documentation on platforms like GitHub, promoting transparency and community involvement.

Focused Integration Standardization:

- Vendor-specific Protocols: Identify major external systems interfacing with ENVISION. Develop bespoke protocols for these prominent systems.
- Regular Collaboration: Initiate biannual meetings with leading standardization bodies in the agricultural domain.

Strategic Open-Source Initiatives Engagement:

- Project Contributions: Allocate dedicated resources to contribute to projects like GeoServer and PostGIS which have industry traction.
- Community Forums: Create ENVISION-led forums discussing standardization in open-source geospatial platforms, emphasizing agricultural nuances.

Rigorous Interoperability Testing:

- Testing Suite: Develop a comprehensive testing suite that simulates real-world scenarios of data exchange, integration, and service compatibility.
- Certification Workshops: Organize quarterly certification workshops ensuring stakeholders are compliant with ENVISION's standards.

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Stakeholder-centric Development:

- Feedback Portals: Create online feedback channels for direct input from service providers and users.
- Annual Stakeholder Meetups: Host sessions to gauge market needs, presenting an opportunity to showcase upcoming standardization efforts.

Precision in Geospatial Data Standards:

- OGC Specializations: Focus on OGC standards like Web Map Service (WMS) and Sensor Observation Service (SOS) which directly correlate with ENVISION's offerings.
- Regular Audits: Conduct biannual audits to ensure complete adherence to chosen standards.

Targeted Agricultural Data Compatibility:

- Crop Classification Collaboration: Engage with entities like the FAO to shape and adhere to evolving crop classifications.
- Open Data Repositories: Align with global agricultural data repositories to ensure ENVISION's data is both contributory and compliant.

Holistic Accessibility and Usability:

- Inclusive Design Teams: Collaborate with accessibility experts during the design phase, ensuring firsthand insights.
- Usability Testing: Conduct monthly usability tests, especially focusing on differently-abled user groups, refining the platform iteratively.

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8 Standardization Strategy

In this chapter, we explore the role of EO-based products developed by ENVISION in the management of environmental assurance standards.

Contribution of ENVISION Services to Environmental Assurance Standards via EO-Based Products

The agricultural sector constantly seeks advancements that harmonize productivity with environmental conservation. The LEAF Marque standards epitomize this aspiration by setting stringent environmental assurance benchmarks. ENVISION, utilizing Earth Observation (EO)-based products, has crafted tools that play a pivotal role in assisting agricultural businesses to adhere to these benchmarks. This chapter elucidates the synergy between ENVISION services and LEAF Marque standards.

- **Cultivated Crop type Maps/Crop Diversification/Crop Classification:**

Accurate documentation of farm details and production data is essential for sound environmental management. ENVISION's classification tools facilitate precision in documenting crop types, assisting in the formulation of long-term cropping plans, landscape conservation efforts, and maintenance of natural habitats.

Potential applications: Validates that farms assess their crops retrospectively and submit accurate data. Ensures farms adhere to their long-term cropping plans. Monitors changes in the farm's operations, such as size or crop types, ensuring compliance with legislative and local standards. Provides empirical proof of areas left uncropped, promoting sustainable agriculture.

- **Data fusion/Sentinel Data Preprocess:**

ENVISION employs advanced data preprocessing techniques to enhance the quality and reliability of data acquired, ensuring that environmental assessments are based on accurate and consistent information.

Potential applications: Enhances the accuracy and validation of information captured in Crop Type Maps.

- **Grassland Mowing Events Detection:**

Optimized mowing events are integral to the preservation of grassland biodiversity. ENVISION's detection system aids in determining optimal mowing times, minimizing adverse impacts on grassland ecosystems.

Potential applications: Assesses and monitors any alterations made to grassland areas.

- **Vegetation Status Maps:**

Real-time monitoring of crop health is crucial for sustainable farming practices. The Vegetation Status Maps provide timely insights into crop health, supporting informed decisions that align with long-term cropping plans.

Potential applications: Monitors soil health and spots any evidence of soil damage or erosion. Ensures conservation and maintenance of natural habitats, trees, boundaries, and prevents unauthorized conversions of protected land.

- **Run-off Risk Assessment:**

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Mitigating pollutant run-off is of paramount importance in conserving water bodies. ENVISION's risk assessment tools identify potential pollutant sources, enabling preemptive measures to prevent contamination of watercourses.
Potential applications: Guarantees farms keep informed about any new storage areas, ensuring ecological safety.

- **Buffer Strips:**

The judicious use of plant protection products is central to environmental protection. ENVISION's tools help in demarcating zones, ensuring the restricted application of these products, thus safeguarding surrounding habitats and communities.
Potential applications: Validates the presence and maintenance of protective buffer strips adjacent to sensitive areas, bolstering environmental safety.

- **Soil Erosion:**

Soil conservation is a cornerstone of sustainable agriculture. ENVISION's tools support the implementation of soil management plans, emphasizing measures that deter soil erosion.

- **Automated Burnt Scar Mapping for Maintenance of Organic Matter in Soil:**

Maintaining soil organic matter is imperative for soil health. This service aids in tracking and conserving organic content, promoting fertile and productive soils.

- **Identification of Organic Farming Practices:**

Promotion of organic farming practices stands as a testament to sustainable agriculture. ENVISION offers tools that validate and promote these practices, furthering the cause of environmental conservation.
Potential applications: Acts as evidence for farms engaging in sustainable and environmentally friendly practices.

- **Soil Organic Carbon monitoring:**

Carbon sequestration in soils plays a crucial role in combatting global climate change. ENVISION's monitoring tools provide detailed insights into soil carbon content, supporting initiatives that aim to enhance carbon storage.
Potential applications: Encourages and tracks practices that elevate soil health through improved organic carbon levels.

- **Mobile Service:**

Timely communication is pivotal for adherence to environmental standards. ENVISION's mobile services facilitate instant notifications related to audits, inconsistencies, and evidence submission, ensuring seamless compliance with the LEAF Marque certification process.
Potential applications: Provides real-time monitoring, feedback, and communication tools for farmers and certifying entities. Ensures timely actions through warning messages about imminent tasks. Actively monitors significant business changes, especially unreported ones, with notifications about inconsistencies and the use of geotagged photos as evidence.

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Conclusion

Through its array of EO-based products, ENVISION profoundly augments the capabilities of agricultural entities to adhere to and manage environmental assurance standards set by LEAF Marque. The integration of these tools not only elevates the precision and efficiency of agricultural practices but also underscores the commitment to a sustainable and environmentally-conscious future.

Furthermore, this chapter points out how workshop agreements and formal standards could be initiated during the post-project exploitation period.

The standardization strategy within the ENVISION project aims to address the identified gaps and promote interoperability by proposing the development of workshop agreements and formal standards.

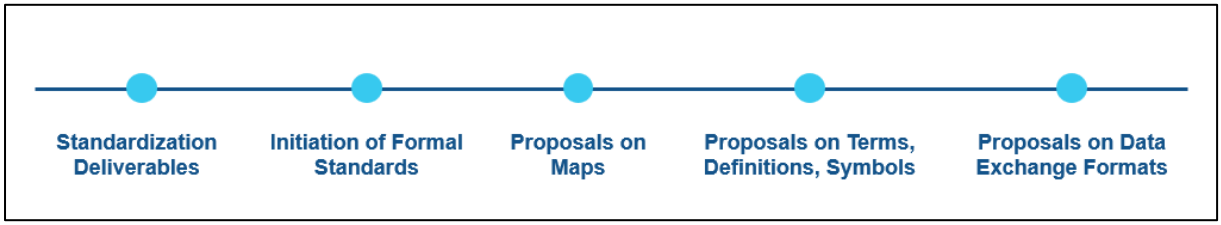

Figure 2 Standardization Strategy

Most relevant for ENVISION during post-project period are:

1. ***Standardization Deliverables***

Based on the gap analysis conducted, key areas for standardization within ENVISION have been identified. The standardization deliverables focus on the following aspects:

- ***Data exchange formats:*** Develop standardized formats for exchanging data within ENVISION, ensuring seamless integration and interoperability.
- ***Interoperability protocols:*** Define protocols and interfaces for enabling smooth communication and interaction between different components and services within ENVISION.
- ***Data security standards:*** Establish standards and best practices to ensure the confidentiality, integrity, and availability of data exchanged within ENVISION.
- ***Geospatial data standards:*** Define standardized formats and models for representing geospatial data, enabling effective geospatial analysis and visualization.
- ***Metadata standards:*** Develop standardized metadata schemas to facilitate the discovery, understanding, and management of data and services within ENVISION.
- ***Quality assurance frameworks:*** Establish frameworks and guidelines for assessing and ensuring the quality and reliability of data and services in ENVISION.

2. ***Initiation of Formal Standards***

To address the identified gaps and enhance integration within ENVISION, proposals for the development of formal standards are recommended. These proposals should include comprehensive

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information on the title, background, scope, and existing standards related to the specific standardization area. The suggested areas for formal standards development include:

- ***Data exchange formats:*** Develop formal standards for exchanging data in ENVISION, ensuring compatibility and interoperability across different systems and services.
- ***Interoperability protocols:*** Propose the development of standards for defining protocols and interfaces, facilitating seamless integration and communication between various components and services.
- ***Authentication and authorization mechanisms:*** Establish formal standards for authentication and authorization mechanisms to ensure secure access and control of ENVISION resources.
- ***Geospatial data models:*** Define formal standards for representing geospatial data structures, enabling consistent and efficient geospatial analysis within ENVISION.
- ***Metadata standards:*** Propose the development of formal standards for metadata representation, ensuring consistent and comprehensive documentation of ENVISION data and services.

3. Proposals on Terms, Definitions, Symbols

Standardized terminology, definitions, and symbols play a crucial role in ensuring consistent understanding and communication within ENVISION. Proposals should be developed to establish standardized terms, definitions, and symbols for various aspects of ENVISION integration, including:

- ***Agricultural practices:*** Define standardized terms and definitions for different agricultural practices and techniques used within ENVISION.
- ***Environmental indicators:*** Establish standardized terminology and definitions for key environmental indicators monitored within ENVISION.
- ***Monitoring parameters:*** Propose standardized terms and definitions for parameters measured and monitored within ENVISION.
- ***Data classification symbols:*** Develop standardized symbols and notations for classifying and representing different data types and categories within ENVISION.

4. Proposals on Data Exchange Formats

To ensure seamless integration and interoperability, proposals should be developed to define standardized data exchange formats within ENVISION. These formats should cover various aspects, including:

- ***Metadata formats:*** Establish standards for metadata representation, such as ISO 19115, to ensure consistent documentation and discovery of ENVISION data and services.

By developing these proposals and promoting the adoption of formal standards and workshop agreements, ENVISION can enhance its integration capabilities, promote interoperability, and ensure consistency and compatibility across different components and services within the platform.

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The implementation of these recommendations falls in the scope of post project exploitation and heavily relies on our links with relevant standards organisations and initiatives.

In the post-project phase, ENVISION's primary emphasis is on advancing our capabilities in data interoperability. Recognizing the heterogeneity in FMIS data, our aim is to bolster the quality and reliability of this data, eliminating fragmentation and minimizing both intentional and unintentional discrepancies. On the technical front, ENVISION is adopting best practices such as REST API-based web services and secure authorization/authentication mechanisms, ensuring seamless data exchange and system interactions. Organisational interoperability is also a focus, with strategies in place to reduce administrative burdens and promote cohesive solutions across different platforms. By addressing these critical areas, ENVISION seeks to forge a future where data flow is smooth, reliable, and universally comprehensible, leading the way in setting industry standards.

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9 Standardization Outreach Strategy

The Outreach Strategy outlined in this chapter serves as **a suggested approach for the post-project exploitation period of the ENVISION platform and its associated services**. It focuses on establishing technical cooperation, promoting information exchange, and enhancing standardization efforts within the platform. It is important to note that the initial work towards implementing this strategy has already commenced at an online workshop organized by InoSens on June 28, 2023. This workshop featured an interactive panel discussion aimed at bridging the gap between EO and environmental monitoring through ICT. Key themes explored during the discussion included data sharing, management, and standardization principles, alongside the presentation of exemplary cases highlighting best practices in agri-tech utilization, which also served the purpose of CAP monitoring and evaluation.

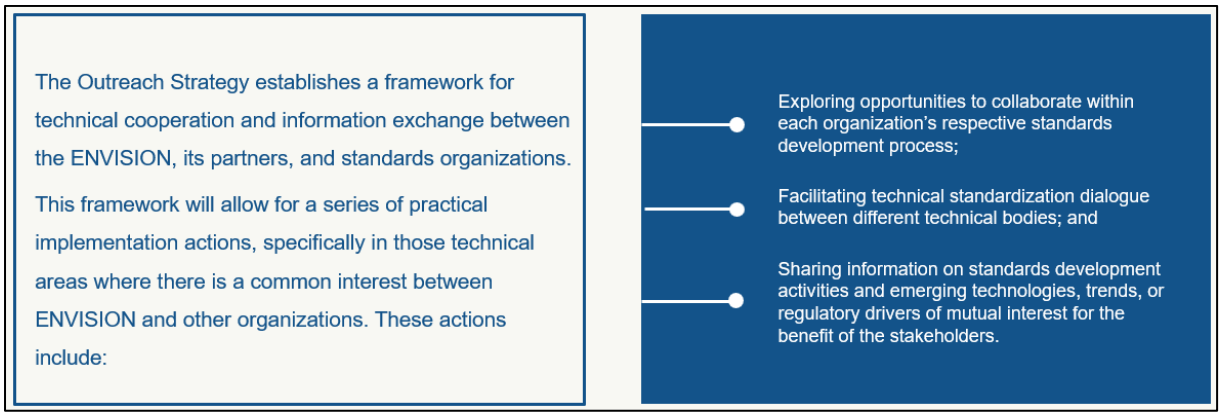

Figure 3 Standardization Outreach Strategy

- ***Framework for Technical Cooperation:*** The Outreach Strategy aims to establish a well-structured framework for practical collaboration in technical areas of common interest among ENVISION, relevant organizations, and EU initiatives and projects (such as CALLISTO, SPACE4GREEN, VITIGEOSS, Agribit, MEF4CAP, Quantifarm). This framework serves as a catalyst for cooperation, promoting progress and alignment within these initiatives. Through this framework, ENVISION can facilitate collaboration, encourage dialogue on technical standardization, and share valuable information on emerging technologies, trends, and regulatory drivers. These efforts contribute to the advancement and wider adoption of standards in the agricultural and geospatial domains..

- ***Identifying Stakeholders:*** To ensure effective outreach and collaboration, it is essential to identify key stakeholders. These stakeholders include standardization bodies such as CEN, ISO, government agencies (EEA), research institutions, industry associations like OGC, GAIAX–AgriGaia, and environmental monitoring organizations like GEO. By engaging with these stakeholders, ENVISION can align its standardization efforts with industry experts and promote the adoption of best practices.

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- **Communication Channels:** A variety of communication channels, including joint initiatives with sister projects and clustering events, can be utilized to disseminate information and engage with stakeholders. Conferences, workshops, webinars, online platforms, and clustering events provide effective means for sharing updates, progress, and knowledge related to standardization efforts within ENVISION and its collaborative projects. These channels and events facilitate dialogue, encourage feedback, and create opportunities for collaboration, ensuring that the solutions developed align with the current and future needs of CAP monitoring and agriculture sustainability. As an example, the upcoming **clustering event** on June 30, 2023, titled **"Solutions to support the current and future needs of CAP monitoring and agriculture sustainability in general; presentation and discussion,"** will further contribute to the exchange of ideas and the advancement of standardization efforts in the agricultural sector.

- ***Collaboration and Best Practices Sharing:*** Collaboration with standardization bodies such as CEN-CENELEC, ISO, OGC, and other relevant organizations is essential for promoting alignment and sharing best practices. ENVISION, as part of the HSbooster.eu service, has initiated discussions with these organizations to actively engage in ongoing dialogues, working groups, and initiatives. By participating in these collaborative efforts, ENVISION can contribute to the development of standards and foster interoperability in the agricultural and geospatial domains. The **HSbooster.eu** service serves as a platform for initiating and facilitating these discussions, enabling ENVISION to leverage existing expertise and promote the adoption of standards across the industry.

- ***Knowledge Sharing and Resource Online Repository:*** Establishing an online repository dedicated to standardization resources and documentation is crucial for knowledge sharing within the ENVISION stakeholder community and beyond. This portal can serve as a central repository for standards, guidelines, technical specifications, and other relevant materials. Regular updates should be provided to ensure that stakeholders have access to the most up-to-date information and resources. In addition, it is important for ENVISION to establish links with **Common European data spaces for agriculture and mobility**.

- ***Engagement with Stakeholders:*** To gather valuable input and ensure the relevance of standardization efforts, ENVISION should conduct stakeholder meetings, focus groups, and working sessions. These interactive sessions facilitate direct engagement, foster collaboration, and provide a platform for stakeholders to share their insights and perspectives. Feedback collection from stakeholders, including standardization bodies, legal experts, and information security officers, is crucial for continuous improvement and alignment with industry requirements. Initial feedback on ENVISION's standardization approach has already been received from our assigned expert/mentor within the HSbooster.eu services, further validating and informing our efforts.

- ***Education and Training:*** In the post-project exploitation phase, it is crucial for ENVISION **to prioritize education and training** as a suggested activity. ENVISION should actively collaborate with standardization bodies and research institutions to provide training opportunities. These training programs can enhance the understanding of standardization principles, promote best

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practices, and empower stakeholders to contribute effectively to the standardization process. By investing in education and training, ENVISION can cultivate a knowledgeable community of add-on service developers, paying agencies, certification bodies, and data providers that actively supports and contributes to standardization efforts.

- ***Regular Updates and Adaptation:*** To maintain alignment with evolving needs and emerging standards, ENVISION should regularly share progress and plans with standardization bodies and organizations. This ongoing communication ensures that ENVISION remains up-to-date with the latest developments and allows for timely adaptations to meet changing requirements. During the post-project exploitation period, ENVISION can significantly contribute to the implementation of optimised and sustainable agricultural practices, advancement of CAP and environmental monitoring and evaluation initiatives, as well as certification schemes and traceability efforts.

Initiating the outreach strategy: Online Workshop and Panel Discussion on Advancing EO-based Monitoring within Environmental Assurance Standards

In order to initiate the outreach strategy and foster collaboration in the areas of standardization, collaborative research and innovation, environmental assurance standards, and EO-based monitoring, InoSens has organized an online workshop and panel discussion: "Advancing Environmental Monitoring: State-of-the-Art Technologies, Collaborative Initiatives, Standardisation, and Best Practices." This workshop provided a platform for experts and stakeholders to explore recent advancements in ICT-enabled EO-based environmental monitoring and the significance of standardisation in environmental monitoring practices.

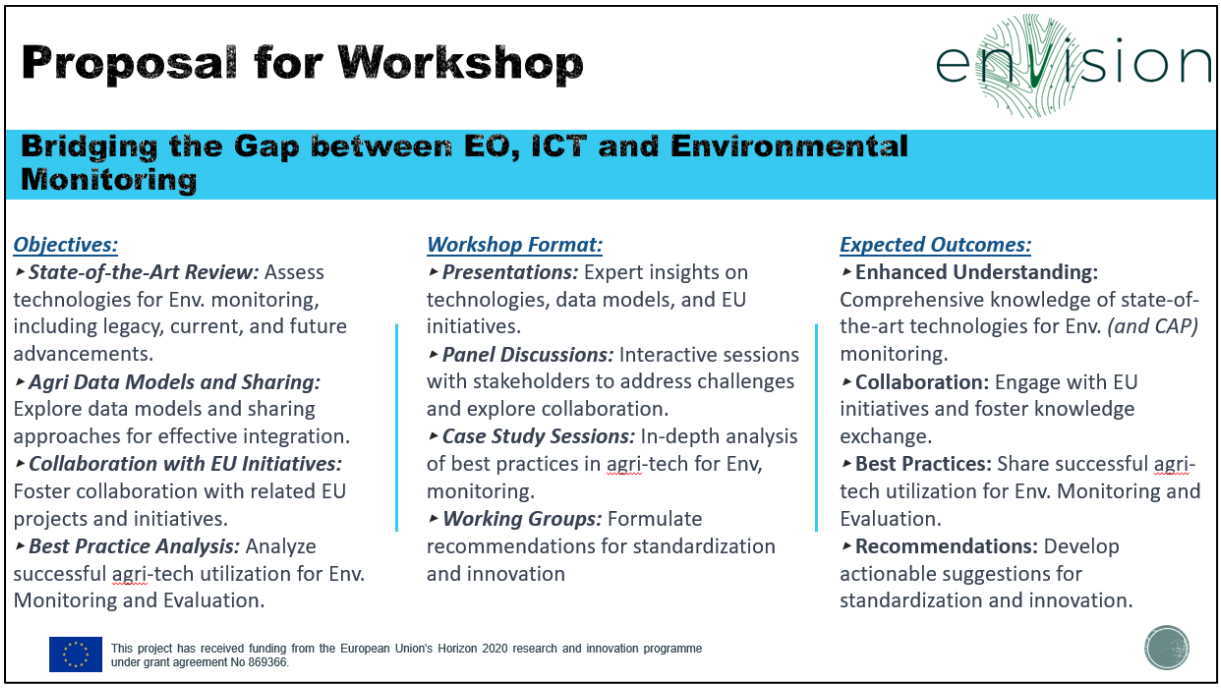

Figure 4 ENVISION Workshop and Panel

The workshop, which was held on June 28, 2023, brought together professionals from diverse backgrounds, including academia, research institutions, standardisation bodies, government agencies, and environmental monitoring organisations. Through interactive sessions, presentations, and panel

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discussions, participants had the opportunity to delve into key topics such as EO data sharing, management, ICT technologies, collaboration, and standardisation.

During the workshop, a variety of informative presentations were delivered by renowned experts. Maja Fišić, representing InoSens, warmly welcomed the participants and provided an introduction to the workshop's objectives. Farhan Sahito, an expert from the Standardisation Sphere, delivered a keynote presentation that shed light on the critical role of standardisation initiatives in bridging the gap between EO and environmental monitoring practices.

Additionally, insights were provided on the ENVISION project by **Ifigeneia Tsioutsia**, the Project Manager from AgroApps, who outlined the overall architecture, and **Abbigail Holman from LEAF**, who discussed the integration of ENVISION services with the LEAF Marque Standard.

Another notable highlight was the presentation by **Nikos Kalatzis** from Neuropublic, who shared the findings and recommendations of **the MEF4CAP project**. This project explored the utilization of digital technologies for monitoring Common Agricultural Policy (CAP) indicators.

The workshop concluded with a lively panel discussion, covering topics such as integrating EO data sharing in certification schemes, advancements in ICT-enabled environmental monitoring, and stakeholder collaboration. Valuable insights were shared, setting the stage for future exploration and action.

Regrettably, we were unable to have representatives from space agencies, including the European Space Agency (EASA) or Copernicus, participate in the workshop. However, they were provided with comprehensive information and valuable perspectives shared during the event to ensure their awareness and engagement in the discussion.

This text below has been revised to focus on the actual outcomes of the workshop rather than the plans or presentations given during the workshop.

Key Highlights and Recommendations: Bridging the Gap between EO, ICT, and Environmental Monitoring

The workshop successfully convened experts and stakeholders from various domains, providing a fertile ground for discussions and exchange of insights. The key outcomes of the workshop are summarized below, capturing the essence of the discussions and their implications for the future of environmental monitoring practices.

Standardization in EU Projects

Farhan Sahito's insights underscored the realized importance of standardization across EU projects, emphasizing that it transcends technical aspects, becoming a strategic necessity for global market penetration, cost reduction, safety improvement, innovation, and establishing frameworks for emerging technologies. A notable outcome was the consensus on ENVISION's role in driving standardization efforts, with specific recommendations to develop domain-specific standards, foster international collaborations, and engage stakeholders comprehensively.

Open-Source Architecture and Service-Based Platforms

The workshop underscored the viability and strengths of ENVISION's open-source, service-based architecture. The active participation and engagement during Ifigeneia's presentation translated into a shared understanding of the technical backbone of the ENVISION platform, and a communal

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commitment to contribute to its growth and capabilities, recognizing the benefits of collaboration, innovation, and customization that an open-source approach brings.

Incorporating EO into Assurance Standards and Environmental Monitoring

Abbey Holman's session on environmental farm assurance schemes, particularly the Leaf Marque standard, turned out to be a catalyst for discussions on integrating Earth Observation (EO) into monitoring and evaluation processes. The workshop culminated in a collective realization of EO's potential to revolutionize environmental standards, providing robust data for continuous improvements and aiding the transition towards hybrid and outcome-based standards.

Agricultural Data Sharing and Data Models in CAP Monitoring

Nikos Kalatzis's presentation on the MEF4CAP project highlighted the increasing need for agricultural data sharing and robust data models. The workshop led to an acknowledgment of the complexities involved in CAP monitoring and the necessity for interoperable agricultural data technologies. A federated ecosystem of agro-environmental data sources emerged as a pivotal theme, with a call for ongoing efforts in data standardization and interoperability enablers to facilitate data sharing while ensuring compliance with access control and GDPR.

Future Directions

In sum, the workshop not only provided a platform for knowledge exchange but also fostered a sense of commitment among the participants to actively contribute to the advancement of environmental monitoring practices. The discussions set a clear direction for future initiatives, emphasizing the importance of standardization, the potential of open-source platforms, the integration of EO in environmental assurance, and the necessity for interoperable agricultural data solutions.

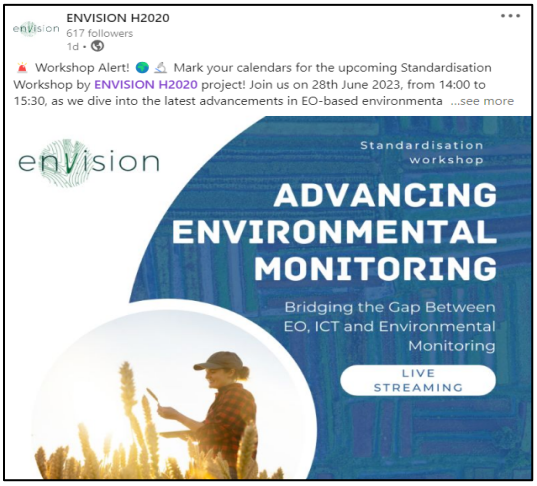

Figure 5 Workshop announcement

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Proposed Governance Model for Standardization Activities in the Post-project Period

To effectively manage and drive standardization activities within ENVISION during post-project exploitation, a governance model is proposed. This model outlines the roles and responsibilities of key stakeholders, with InoSens taking the lead in coordinating and overseeing the standardization efforts. The governance model aims to ensure accountability, collaboration, and efficient decision-making throughout the standardization process.

InoSens, as the lead organization for standardization activities, should assume the responsibility of coordinating and driving the standardization activities within ENVISION. They would take on a leadership role in establishing partnerships, engaging with standardization bodies, and promoting the adoption of industry standards. InoSens acts as a focal point for communication, collaboration, and knowledge sharing related to standardization initiatives.

A Standardization Committee should be formed, consisting of representatives from ENVISION project partners, standardization bodies, government agencies, research institutions, industry associations, and environmental monitoring organizations. This committee serves as a platform for discussions, decision-making, and the development of standardization strategies. The committee members contribute their expertise and work collaboratively to align ENVISION with relevant standards and best practices.

- **Roles and Responsibilities:** In addition to its lead role, InoSens is responsible for overall project coordination, ensuring alignment between ENVISION's objectives and standardization activities. They facilitate communication among stakeholders, organize workshops and meetings, and provide regular progress updates to the Standardization Committee. Committee members actively participate in standardization discussions, share their knowledge and insights, and contribute to the development of standardization guidelines and strategies. They represent their respective organizations and contribute to the overall standardization objectives of ENVISION.

- **Decision-Making Process:** The governance model encourages a collaborative and consensus-driven decision-making process. The Standardization Committee, led by InoSens, engages in open discussions, evaluates proposals, and makes decisions regarding the adoption of standards, integration approaches, and other standardization-related matters. The decisions are based on the consensus reached among the committee members, taking into account the requirements of ENVISION and the wider standardization community.

- **Communication and Reporting:** Effective communication and reporting mechanisms are established to ensure transparency and information flow between the Standardization Committee, ENVISION project partners, and external stakeholders. Regular updates on standardization activities, progress reports, and documentation are shared through various channels, such as meetings, workshops, online platforms, and dedicated portals. InoSens takes the lead in disseminating information and fostering collaboration among stakeholders.

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- **Evaluation and Continuous Improvement:** The governance model includes periodic evaluations of the standardization activities to assess their effectiveness and impact. Feedback is collected from stakeholders, including standardization bodies, legal experts, and information security officers, to identify areas for improvement. The Standardization Committee, led by InoSens, reviews the feedback, identifies necessary adjustments, and implements measures to enhance the standardization processes and outcomes.

By implementing this governance model, ENVISION establishes a structured approach to standardization activities. This model ensures a coordinated effort, active engagement from stakeholders, and effective decision-making, leading to the successful integration of standards and best practices within the ENVISION platform.

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10 Conclusion

In summary, the roadmap presented outlines a holistic and inclusive strategy for advancing standardization efforts in EO-based monitoring within environmental assurance standards. It underscores the importance of international collaboration and active engagement with a diverse range of stakeholders, including standardization bodies, government agencies, research institutions, industry associations, and environmental monitoring organizations such as GEO, EuroGEO, Copernicus, and key European in situ data providers. By fostering these partnerships, the roadmap aims to drive the development and adoption of standardized practices that promote interoperability, data harmonization, and effective environmental monitoring across Europe and beyond.

The roadmap highlights the significance of developing workshop agreements in close collaboration with technical committees such as **CEN-CENELEC**. Through the **HSbooster.eu** service, we have proactively reached out to CEN-CENELEC and are awaiting their response. These agreements will serve as a foundation for addressing the identified gaps and advancing standardization practices in key areas of environmental monitoring. By initiating discussions and fostering collaboration among experts, InoSens has taken a leading role in mobilizing key stakeholders and driving the standardization dialogue forward.

Moreover, the roadmap recognizes the importance of not only developing new standards but also evolving existing ones. It emphasizes the need to replace previous versions with updated standards that reflect the latest advancements in technology and align with emerging industry requirements.

The roadmap recommendations serve as the foundation for a comprehensive standards series aimed at enhancing environmental monitoring practices. This series should focus on improving interoperability, data sharing, and harmonization to foster collaboration and facilitate the exchange of information and resources.

A specific recommendation for ENVISION is to prioritize the establishment of EU-wide semantics and syntactic interoperability standards. By achieving better data interoperability in the area of environmental monitoring, ENVISION can facilitate seamless data exchange and integration, ultimately enhancing the effectiveness of CAP monitoring and evaluation. This effort would contribute to the broader goal of improving environmental monitoring practices and ensuring the sustainability of agricultural systems.

Additionally, ENVISION should explore and leverage the potential of sharing farm-level and group-level agricultural data. By combining policy monitoring with data-driven farm advisory and involving farmers and advisors, ENVISION can enable evidence-based decision-making and drive the adoption of improved sustainability practices. This approach harnesses the power of farm-level agricultural data to inform and guide agricultural management, leading to more informed and sustainable practices.

In order to ensure the effective implementation and validation of the recommended standards, the Roadmap highlights the importance of conducting **pilot projects in close partnership with relevant standards committees**, including CEN/TC 287 - Geographic Information, ISO/TC 211 - Geographic Information/Geomatics, OGC, GAIAX–AgriGaia, and GEO. These collaborative projects will serve to test and refine the workshop agreements, ensuring their practicality and suitability for real-world use cases.

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Furthermore, the recommendations outlined in the roadmap provide valuable input for the ongoing development of the **Final Exploitation Strategy (D6.9) by ETAM**. This strategic approach will pave the way for enhanced collaboration, improved data interoperability, and standardized practices within the environmental monitoring domain.

Upon the completion of this deliverable, a dedicated press release will be crafted to provide a concise summary of the key achievements stemming from our standardization efforts and the recent workshop. This press release will be disseminated through various channels, including ENVISION's online platforms, media contacts, and the relevant standards organizations listed above, ensuring broad visibility and awareness of our standardization-related work.

In summary, this Roadmap establishes a clear vision and strategy for advancing standardization efforts in mainstreaming EO-based environmental monitoring. By fostering collaboration, engaging with stakeholders, and developing workshop agreements, the roadmap sets the stage for the adoption of formal standards that promote the use of EO data in support of EU environmental policy and decision making and address the evolving needs of the industry.

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11 Annex

Advancing Environmental Monitoring: State-of-the-Art Technologies, Collaborative Initiatives, Standardisation, and Best Practices

Workshop Agenda

28 June 2023, 14:00 - 15:30

Join Zoom Meeting | Meeting ID: 889 4587 1546 | Passcode: 515451

An interactive session for questions and discussion aimed at exploring recent advancements in ICT-enabled EO-based environmental monitoring. This session will focus on integrating principles of EO data sharing, management, and ICT technologies to enhance environmental support in Europe, while also emphasizing the importance of standardisation in environmental monitoring practices. Through a state-of-the-art review, discussion on agri data models and sharing approaches, collaboration with EU initiatives, examination of standardisation efforts, and analysis of best practices, participants will gain insights into the latest developments in environmental monitoring and explore effective strategies for leveraging technology, collaboration, and standardisation to address environmental challenges.

14:00 - 14:05: Introduction and Welcome

Speaker: Maja Fišić, InoSens [Workshop Organizer]

14:05 - 14:10: Keynote Presentation

Speaker: Farhan Sahito, PRIVANOVA SAS [Expert from the Standardisation Sphere]

14:10 - 14:25: Perspectives from the Space Agencies

Speaker: Representative from the European Space Agency (EASA) or Copernicus [To be announced]

14:25 - 14:50: ENVISION Project Insights

a) Overall Architecture

- Speaker: Ifigeneia Tsioutsia, AgroApps [ENVISION Project Manager]

b) Presentation on the LEAF Marque Standard and Integration of ENVISION Services

- Speaker: Abbigail Holman, LEAF

14:50 - 15:05: Insights from MEF4CAP

Findings of MEF4CAP regarding the utilization of digital technologies for monitoring CAP indicators, Nikos Kalatzis, Neuropublic

15:05 - 15:25: Panel Discussion

An interactive session for questions and discussion aimed at exploring recent advancements in ICT-enabled EO-based environmental monitoring, with a specific focus on integrating principles of EO data sharing, management, and ICT technologies to enhance environmental support in Europe.

15:25 - 15:30: Closing Remarks

Speaker: Maja Fišić, InoSens [Workshop Organizer]

Tentative Questions for Panel Discussion:

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1. How can standardisation initiatives help bridge the gap between Earth Observation (EO) and environmental monitoring practices?
2. **What are the current challenges in integrating EO data sharing and management principles into environmental monitoring processes?**
3. In your opinion, what are the key advancements in ICT-enabled EO-based environmental monitoring that have significantly impacted standardisation efforts?
4. **How can collaboration between space agencies, standardisation experts, and environmental monitoring stakeholders enhance the development and implementation of standardised practices?**
5. **What are the potential benefits and drawbacks of integrating the LEAF Marque Standard with ENVISION services? How can standardisation support this integration?**
6. **In the context of digital technologies for monitoring CAP indicators, what are the key findings and recommendations from MEF4CAP?**
7. How can digital technologies and ICT solutions facilitate the effective sharing and utilization of environmental monitoring data across different stakeholders and domains?
8. What strategies and best practices can be implemented to ensure interoperability and harmonisation of environmental monitoring systems and technologies?
9. How can standardisation efforts and ICT-enabled solutions contribute to the achievement of sustainable development goals related to environmental monitoring?
10. What are the potential barriers or challenges in adopting standardised practices for EO-based environmental monitoring, and how can they be overcome?

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End of Document

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