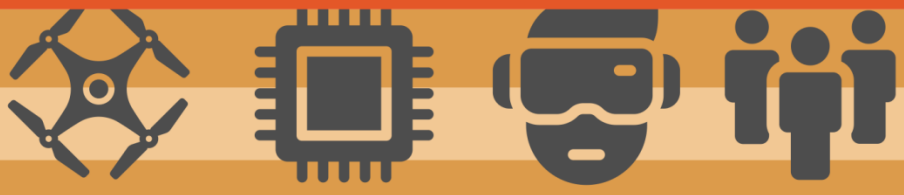
CALLISTO

Copernicus Artificial Intelligence Services and data fusion with other distributed data sources and processing at the edge to support DIAS and HPC infrastructures

D2.3 – Requirements communication and stakeholder engagement

WP2– Use case design and user requirements



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Abstract	This document describes stakeholder involvement and communication of user requirements between users and development partners. The public deliverable starts with a short introduction leading to the process adopted to select and engage the stakeholders and an overview of the stakeholders' feedback about the CALLISTO projects' results. These sections are followed by an overview of the interaction activities and requirements communication. The results presented in the deliverable are the final step in the iterative process of specifying and communicating the use cases and user requirements. D2.3 builds on the previous deliverables *D2.1 - Pilot use case design and user requirements*, M6, and *D2.2 - Detailed pilot use cases and user requirements*, M25. With the submission of this deliverable, WP2 is officially closed. However, much of the work lives on and will continue in the user-driven *WP8 Pilot implementation, evaluation and training*.		

Document History

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0.1	09.06.2023	Draft	Creation of ToC	Marco Cerri (Serco), Eva Lopez (DW)
0.2	13.07.2023	Draft	Input by WP2-partners	Eva Lopez (DW), Marco Cerri (Serco), George Choumos (NOA), Beatrice Coloru (SMAT), Sara Steffenino (SMAT), Jose Santos (SatCen)
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0.4	17.07.2023	Review Draft	Updated according to internal review comments	George Choumos (NOA), Paris Oikonomou (ACCELI)
0.5	27.07.2023	Delivery Candidate	Version approved by the internal reviewers	Eva Lopez (DW)
1.0	28.7.2023	Delivered	Final adjustments	Eva Lopez (DW)

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Executive summary

The current deliverable *D2.3 - Requirements communication and stakeholder engagement* is the third and final deliverable of *WP2 - Use case design and user requirements*. The work on use case design and user requirements has already been reported in *D2.1 Pilot use case design and user requirements*, delivered in month 6, and *D2.2 Detailed pilot use cases and user requirements*, delivered in month 25. Although the results of all four tasks of WP2 are reflected in this deliverable, D2.3 focuses mainly on tasks *T2.3 Stakeholder engagement and business requirements*, led by Serco, and *T2.4 Requirements communication and knowledge transfer*, led by DW. With the submission of this deliverable in M31, WP2 is officially concluded. However, much of the work lives on and will continue in the user-driven *WP8 Pilot implementation, evaluation and training*.

After a short introduction, the deliverable summarises the results of the stakeholder engagement activity, including information on how key stakeholders from very different industries were identified, and discusses the results of the stakeholder survey. This analysis is followed by a comprehensive overview of the survey results and providing an insightful analysis of the valuable feedback received on the CALLISTO project.

Finally, the deliverable covers the communication of user requirements and knowledge transfer. First, the strategy of how interaction activities were planned and carried out is reported, along with some concrete examples. Then the actual communication of requirements is discussed by summarising the user requirements, explaining how the requirements are reflected in the evaluation, presenting the four pilot use cases (1) *CAP Monitoring*, (2) *Water Quality Monitoring*, (3) *Satellite Journalism* and (4) *Land Border Monitoring*, and finally presenting how the key results of the project have been matched to the user scenarios.

The deliverable ends with a conclusion.

References

i ISO, "Systems and software engineering – Systems and software Quality Requirements and Evaluation (SquaRE) – System and software quality models", ISO/IEC 25010:2011, 2011, obtainable from http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=35733

ii MoSCoW, acronym stands for Must have, Should have, Could have and Will not have, obtained from https://www.techtarget.com/searchsoftwarequality/definition/MoSCoW-method

Acronyms

Acronym	Full name
AoI	Area of Interest
AQ	Air Quality
AR	Augmented Reality
CAP	Common Agricultural Policy
CAPO	Cyprus Agricultural Payments Organisation
D	Deliverable
DNN	Deep Neural Networks
EO	Earth Observation
EU	European Union
JSON	JavaScript Object Notation
KR	Key Results
PA	Paying Agency
T	Task
TRL	Technological Readiness Level
PUC	Pilot Use Case
UAV	Unmanned Aerial Vehicle
WP	Work package
WPC	Water Production Centre

1 Introduction

1.1 Purpose and Scope

This is the third and final deliverable of *WP2 - Use case design and user requirements* of the CALLISTO project. This WP aims at describing scenarios for the four PUCs, deriving user requirements from these scenarios, organising stakeholder engagement and developing business requirements, and finally transferring knowledge to technical partners.

Specifically, the following sections deal with activities to engage the different stakeholders of all four pilot use cases *PUC1 - CAP Monitoring*, *PUC2 - Water quality monitoring* process at two different sites, *PUC3 - Satellite journalism* and *PUC4 - Land Border Monitoring.* Furthermore, the activities aimed at communicating user requirements to the consortium are presented.

1.2 Document Structure

The document is organized as follows:

- Section 1 - Introduction: Describes the purpose and scope of the document and its structure.
- Section 2 - Stakeholder Analysis: Focuses on the adopted methodology to engage stakeholders.
- Section 3 - Stakeholder Perspectives: Provides an overview of stakeholders' feedback.
- Section 4 - Interaction activities: Addresses exchange between user and developing partners.
- Section 5 - Requirements Communication: Outlines user requirements communication.
- Section 6 - Conclusion: The deliverable ends with a short summary and the main conclusions.

2 Stakeholder Analysis

The primary purpose of the *Task 2.3: Stakeholder engagement and business requirements* is to perform a full requirement analysis study. This chapter describes how the activity of *processing analysis and interviews with key stakeholders and end-users* has been carried out.

The target is to gather valuable feedback from stakeholders and gain a deeper understanding of their interest in the project, particularly regarding its potential market impact. The focus is primarily on assessing interest in the project's outcomes and applications rather than the technology itself. It is of particular importance to collect feedback from stakeholders who are currently not familiar with the CALLISTO project, and that are not utilising satellite data in their activities, as their perspectives provide valuable insights into the potential market appeal and opportunities for the project.

This stakeholder engagement activity has been mainly conducted by selecting identified users according to some defined criteria, and then by performing a structured survey to each of them.

By doing so, this task supports the crucial purpose of gathering valuable insights, fostering collaboration, building trust, maximizing impact, and promoting transparency and a sense of ownership. Additionally, to engage the stakeholders at the correct phase of the project as it occurred with CALLISTO, facilitates reaching out to end users and garnering their support for potential adoption of the project's relevant outcomes even after its completion. This proactive engagement ensures that end users are aware of the project's results, and it builds a foundation for their continued involvement beyond the project's lifespan.

2.1 Identification of key stakeholders

In order to ensure effective stakeholder engagement, a comprehensive identification and selection process was conducted to determine the key stakeholders and the relevant industries who would benefit the most from the platform's results. Indeed, the involvement of the correct figures brings to the inclusion of diverse perspectives and experiences, ensuring that the project outcomes align with end users' needs and expectations.

The stakeholder selection process has been based on criteria such as:

- **Easiness of contacting**: selecting stakeholders who are easily accessible, with known contacts and that can be easily approached can help streamline the stakeholder engagement process, reducing potential delays and barriers to information exchange,
- **Availability and commitment**: considering persons who demonstrate availability and willingness to participate in the engagement process and contribute to the project's success. Their availability to attend the planned engagement activity and to provide feedback, supports an effective stakeholder engagement,
- **Expertise and knowledge in the PUC sector**: engaging figures who have domain-specific expertise, knowledge, and insights relevant to the specific PUC sector can bring valuable insights, practical knowledge, and a deep understanding of the sector-specific challenges and requirements,
- **Technical proficiency and tech-savviness**: considering interviewees' level of technical proficiency and their familiarity with technology, with digital platforms, data analysis tools, and technological solutions, ensures that the selected stakeholders can provide meaningful feedback regarding the usability and functionality of the platform,
- **Representativeness and diversity**: ensuring a diverse representation of stakeholders from different organizations, sectors, geographic locations, and user groups, who represent different perspectives

according to each specific PUC. This promotes inclusivity and captures a wide range of points of view, ensuring the platform's applicability and relevance to a broader audience,

- **Potential impact and benefit**: evaluating the potential impact and benefit that stakeholders can derive from the project's outcomes, and identifying stakeholders who will benefit the most from the platform's results,
- **Collaboration potential**: assessing the stakeholders' ability and willingness to collaborate with the project team and other stakeholders, by looking for stakeholders who are open to collaboration, information sharing, and working together to achieve common goals.

Based on the identified criteria, the chosen approach was to **select stakeholders and users categorizing and grouping them based on the four PUCs**. By aligning the stakeholder selection process with the specific PUCs, the project team ensured that the selected users possessed direct relevance to the targeted application areas of the platform. This approach enabled the users to provide specific and focused feedback regarding the PUC activities, facilitating valuable insights and informed contributions from stakeholders. This targeted approach enabled focused and meaningful stakeholder involvement, maximizing the potential for valuable and specific inputs to each use case.

The following is a list of participants and their roles for each PUC interview, with the purpose to provide the reader an overview of the type and expertise of the involved figures. All individuals were carefully selected based on their potential ability to be potential end users of the CALLISTO platform, taking into consideration their skills, technical proficiency, and overall tech-savviness. The chosen participants possessed the necessary capabilities to effectively provide valuable feedback on the platform, contributing to its development and usability in real-world scenarios.

2.1.1 PUC1 - CAP Monitoring

The involved personnel are from the Cyprus Agricultural Payments Organisation (CAPO), the Paying Agency (PA) of Cyprus:

- **Interviewee #1** Field inspector: responsible for conducting on-site visits, assessing the condition of agricultural realities, and verifying compliance with regulations governing agriculture practices, apiculture guidelines, animal welfare protocols, and other applicable standards. Their expertise and knowledge contribute to the identification of potential issues, such as non-compliance or anomalies, and provide recommendations for improvement.

2.1.2 PUC2 - Water Quality Assessment

The involved personnel are from two different groups, according to the two different use cases CALLISTO is operating for the PUC2. One group of interviewees is from the Turin water utilities SMAT - Società Metropolitana Acque Torino, partner of the consortium, and the second group is from the Belgian De Watergroep - the utility managing more than 180 municipalities in Flanders, part of the consortium, and from the Flanders Environment Agency (VMM).

From the SMAT personnel:

- **Interviewee #1** Biological laboratory manager: responsible for overseeing and managing the operations of the biological laboratory, ensures the accurate and efficient execution of chlorophyll measurements, and implements quality control measures,

- **Interviewee #2** Instrumentation technician: responsible for the technical maintenance, electronic analysis, and data management of water quality and current measurement instruments. This role also includes conducting sampling and measurements during field campaigns,
- **Interviewee #3** Water treatment plant manager: in charge of the potabilization process at the lagoon water treatment plant, this role is responsible for ensuring the safe and efficient production of drinking water.

From the De Watergroep and the VMM personnel

- **Interviewee #1** Water quality analyst (VMM): the role involves the assessment and analysis of water quality parameters to monitor and evaluate the environmental condition of water bodies, mainly with remote sensing applications,
- **Interviewee #2** Water quality analyst (VMM): same as above,
- **Interviewee #3** Quality production manager (De Watergroep): overseeing the production side of operations, this role is responsible for managing a network of 60 water production facilities and 160 storage centres. The manager ensures the efficient and reliable production of high-quality water, implementing rigorous quality control measures at each stage of the production process,
- **Interviewee #4** Hydrologist (De Watergroep): expert in studying the distribution, movement, and quality of water in various environments, including rivers, lakes, groundwater, and watersheds. She analyzes data related to precipitation, evaporation, runoff, and water storage to assess water resources and manage water systems effectively,
- **Interviewee #5** Sampling coordinator (De Watergroep): as the responsible individual for sampling activities, this role ensures the proper planning, execution, and documentation of sample collection processes.

2.1.3 PUC3 - Satellite Journalism

The involved personnel are from the consortium partner Deutsche Welle (DW):

- **Interviewee #1** Journalist and editor for Turkish section: the role encompasses the responsibilities of a journalist specializing in the Turkish section, responsible for gathering, researching, and reporting news stories, through various media channels, such as articles, videos, or multimedia presentations,
- **Interviewee #2** Investigation unit: part of an investigative team dedicated to identifying and examining compelling cases that warrant public reporting. By utilizing available data (e.g., satellite images), they gather evidence and verify information to uncover hidden truths and bring important matters to the attention of the public,
- **Interviewee #3** Data team: responsible for managing and analysing vast amount of data. In this context, ensuring data quality, integrity, and accessibility plays a crucial role.

2.1.4 PUC4 - Land Border Monitoring

The involved personnel are from different groups. One group of interviewees is from the consortium partner European Union Satellite Centre (SatCen), one group is from the Cyprus Police, and one group is from the Ministry of the Interior of the Republic of Lithuania.

For security reasons, the personnel details are not disclosed.

From the SatCen personnel:

- **Interviewee(s)** Member(s) of the Image Analysis Team: the primary responsibility is to analyse and interpret imagery data for the purpose of monitoring and securing land borders.

From the Cyprus Police personnel:

- **Interviewee(s)** Member(s) of the Law Enforcement Agency: Expert in border security surveillance and criminality analysis near border sections.

From the Ministry of the Interior of the Republic of Lithuania personnel:

- **Interviewee(s)** Member(s) of the Law Enforcement Agency: Expert in border security surveillance and specialist of the National Coordination Center.

2.2 Survey methodology

The survey was carried out through several live video calls, each lasting approximately one hour, involving distinct groups of participants: PUC2 with SMAT, PUC2 with De Watergroep and VMM, PUC3, and PUC4. The survey sessions were led by the task leader, accompanied by the corresponding PUC leader to ensure a comprehensive understanding of the specific PUC context. In each meeting, only the specific PUC was presented to each group. In the case of PUC1, due to language requirements, the survey was conducted entirely by the PUC leader, and the responses were subsequently compiled and shared with the task leader in written format.

The methodology implemented across all PUCs was consistent, ensuring uniformity and reliability in the data collection process. A carefully designed scheme was employed to inform and engage the interviewees, creating awareness about the project and the specific objectives of the interviews. By providing clear explanations of the project's goals and the intended outcomes, the interviewees were able to gain a comprehensive understanding of the significance of their participation.

The survey methodology aimed to establish a comfortable environment that would enable the interviewees to provide authentic feedback and responses. This involved employing an informal approach during the interviews, fostering an atmosphere that encouraged open and honest discussions. The emphasis was placed on creating a safe and inclusive space where individuals felt empowered to express themselves and share their perspectives freely. Through this informal approach, the survey methodology promoted active participation and engagement from all interviewees, and it facilitated meaningful dialogue, allowing for the exploration of diverse viewpoints and the elicitation of valuable insights. The emphasis on encouraging authentic responses ensured that the collected feedback accurately represented the interviewees' thoughts, experiences, and suggestions.

The survey methodology incorporated an agenda that guided the interview process and ensured consistency across all PUCs. The agenda consisted of the following key components:

1. **Introduction**: the session began with an introduction to explain the meeting's purpose and the expectations, and to set a positive and welcoming tone for the interviewees. This provided an opportunity to establish a comfortable environment for open discussion.
2. **CALLISTO brief presentation**: a concise presentation was delivered to provide an overview of the CALLISTO project, its objectives, and the anticipated outcomes. This presentation served to familiarize the interviewees with the project's context and highlight its relevance to their respective domains.
3. **PUC specific presentation**: a dedicated presentation was conducted by the PUC leader for each specific PUC (each PUC leader was present only with the corresponding PUC interviewee group). This presentation explained the details of the use case, its objectives, and the potential role of the interviewee within the PUC, as a possible CALLISTO platform's user. This ensured that the interviewees had a clear understanding of the specific context and scope of their involvement. In

instances where the PUC results were not yet available (PUC2 and PUC4), a simulation of the expected results was presented, to offer a clear understanding of the anticipated outcomes and demonstrate the type of results that could be achieved through the CALLISTO platform.

4. **Survey - open questions**: the core of the survey involved a series of open-ended questions designed to encourage voluntary responses from all participants. These questions aimed to gather diverse perspectives, insights, and suggestions related to the project's goals, requirements, and potential challenges. This open format enabled interviewees to express their thoughts freely and provide valuable input.
5. **Comments and closing**: the session concluded with an opportunity for interviewees to share any additional comments, thoughts, or questions they may have had. The closing segment involved expressing gratitude to the interviewees for their participation and reiterating the importance of their contributions to the project.

The interview process was accompanied by informative slides, providing visual support, videos, live demo and images of the platform, and enhancing the understanding of key concepts and information discussed during the session. The following presents a comprehensive list of the survey questions designed for this specific task. These questions aim to provide a comprehensive understanding of stakeholder opinions, experiences, and suggestions, contributing to a holistic analysis of the project's impact and effectiveness. The order respects the order in which they have been asked.

2.3 Survey content

The following presents a comprehensive list of the survey questions designed for this specific task. These questions aim to provide an understanding of stakeholder opinions, experiences, and suggestions, contributing to a holistic analysis of the project's impact and effectiveness. The arrangement of the questions in the table reflects the sequential order in which they were posed during the survey.

Table 1: Questions of the stakeholder engagement survey.

Topic	Questions
Round of presentations: role and affiliation	
General information	Do you already know the Copernicus Programme? Do you use it and how do you use it at the current moment?
CALLISTO introduction	Do you know the CALLISTO project and its outcomes? Do you know the four PUCs of CALLISTO?
CALLISTO brief presentation *PUC specific presentation (only to the corresponding PUC interviewee group)*	
PUC-related	**PUC1 - CAP Monitoring** Does CALLISTO enhance the regularity and the scalability of inspections and checks? Does CALLISTO support the decision-making process to adopt appropriate follow-up actions? Does CALLISTO increase: 1/ accuracy evidence-based decision making for the control of CAP, 2/ reduction of inspection costs and complexity and, 3/ transparency between the Paying Agency and the farmer?

	PUC2 - Water Quality Assessment Does CALLISTO help in providing water quality information from satellite images? Is the water quality information accurate/reliable? Is the obtained information useful for the purpose of managing the water treatment plant? Does CALLISTO help in comparing water quality information from different sources? Does CALLISTO help to identify the factors to forecast the development of algae blooms, and to identify a predictive algorithm? Does CALLISTO provide the necessary time to implement the necessary correct actions at the production site? Does CALLISTO help to explore the usability of satellite images as an early warning tool for surface water pollution events? Is CALLISTO a predictive tool?
	PUC3 - Satellite Journalism Does CALLISTO support journalists to monitor specific situations and developments without the need for external experts to retrieve and interpret the data? Does CALLISTO help in coping with the identified barriers: 1/ knowledge/interpretation, 2/ skills, 3/ resources (time and hardware)? Can be CALLISTO considered an easy-to-use EO tool for collect insights and knowledge? Does CALLISTO platform look intuitive and easy to use? Does CALLISTO help to gather benefits of both approaches "sensor journalism " (data gathered from citizens and social media) and "satellite journalism " in an effective way?
	PUC4 - Land Border Monitoring Does CALLISTO support the end users (image analysts) delivery of EO-based satellite border surveillance? Does CALLISTO improve the current workflows and services of the Copernicus Security Services portfolio by delivering additional value? Does CALLISTO provide an integrated solution, that works seamlessly with end users workflows and tools? Does CALLISTO workflow/platform look intuitive and easy to use?

	Overall, does CALLISTO accomplish its target to support evaluating the land border changes?
Relevance of the outcomes	How much do the project outcomes or deliverables are relevant and can support your specific needs? If not, in what ways would the outcomes be satisfactory for your activity?
Potential benefits	From your perspective, what potential benefits do you see in using a platform like this? How do you think it could add value to your activity, organization or industry? On the contrary, what specific challenges and pain points do you see in using this platform?
Market and users' need assessment	Do you believe there is a need for a platform like CALLISTO? What specific challenges or pain points do you think this platform could address for the users or in the market?
Platform's attractiveness	Would your organization be interested in using a platform like this one? If yes, what are the key factors that would influence your decision to adopt this platform? If not, what are the limitations that you identify and that prevent you in adopting the platform?
Competitive landscape	As per your knowledge, are there any existing platforms or solutions in the market that offer similar functionalities? If yes, how do you think our platform compares to existing alternatives in terms of features and capabilities? If not, do you see potential applications for this platform in the market?
Potential users and stakeholders	Who do you think would be the primary users or stakeholders of this platform? Are there any specific user groups or industries that you believe would benefit the most from using this platform?
Feedback and suggestions	Do you have any specific feedback or suggestions on how we can enhance the platform and to make it more attractive for your needs? Are there any additional features or functionalities that you think should be considered?
Project involvement	How would you like to be involved in the project? Are there any specific areas where you would like to contribute your expertise or resources?

3 Stakeholder Perspectives

This chapter presents an analysis of the answers and feedback received from stakeholders during the survey. It provides valuable insights into stakeholder perspectives, satisfaction levels, and suggestions related to the CALLISTO project. The feedback gathered from stakeholders plays a crucial role in understanding their needs, identifying potential improvements, and evaluating the overall effectiveness and relevance of the project's outcomes.

3.1 Business Requirements

This deliverable presents a comprehensive analysis of stakeholder engagement activities conducted for the CALLISTO project, aimed at gathering feedback from key stakeholders. The insights obtained from the stakeholder survey are instrumental in understanding the specific needs and expectations of the target users. In conjunction with the stakeholder feedback, this document also recalls the definition of business requirements presented in the *D2.2 - Detailed pilot use cases and user requirements*, which focuses on non-functional aspects and addresses the quality, performance, reliability, and industrial and communication needs of the CALLISTO platform. By combining the stakeholder feedback with the identified business requirements, a holistic understanding of the project's objectives and the alignment with stakeholder interests can be achieved. This integrated approach ensures that the project's outcomes are not only technologically sound but also market-attractive, meeting the needs of end-users and driving potential adoption beyond the project's duration.

For the elicitation of the final business requirements of the CALLISTO platform, a clear methodology was applied as explained in D2.2.

The overall process of defining the business requirements of the CALLISTO platform was based on well-established standards. One of the main standards that were adopted is ISO/IEC 25010 [1], which constitutes the de facto standard for software quality evaluation and modelling. For the context of this project, we focused on the following factors inspired by ISO/IEC 25010:

- **Performance efficiency**. The performance relative to the amount of resources used under stated conditions. Capacity is considered a property of Performance efficiency, according to ISO 25010[i].
- **Reliability**. The degree to which a system or component performs specified functions under specified conditions for a specified period.
- **Compatibility**. The degree to which two or more systems or components can exchange information and/or perform their required functions while sharing the same hardware or software environment.
- **Maintainability**. The degree of effectiveness and efficiency with which the product can be modified.
- **Availability**. Express the ratio of the available system time to the total working time.
- **Security**. The degree of protection of information and data so that unauthorized persons or systems cannot read or modify them, and authorized persons or systems are not denied access to them.
- **Usability**. The degree to which the product has attributes that enable it to be understood, learned, used and attractive to the user, when used under specified conditions.

The above description is important since it facilitates the understanding of the business requirements, and it also provides evidence that the definition of the final business requirements is based on a solid basis.

After the completion of the selection process, a comprehensive compilation of business requirements has been finalized and is now accessible in the document D2.2.

3.2 Stakeholder Feedback and Satisfaction

The feedback received from stakeholders proved to be highly insightful and valuable, providing a wealth of information and perspectives. Each PUC group, based on their unique field of activity and expertise, shared specific and contextually relevant answers, enriching the overall understanding of the project's impact.

In the following, the list of the most relevant outcomes for each PUC is provided as an overview. The final recap highlights the key findings and noteworthy insights expressed by the stakeholders.

3.2.1 PUC1 - CAP Monitoring

From CAPO interview the major outcomes are:

- **Utilization of street-level images**: the user found the platform highly useful for checks and inspections, with street-level images being particularly valuable in their assessments and monitoring activities. However, they noted that street-view images can sometimes be obstructed by obstacles like trees, which may limit their visibility and effectiveness.
- **Provision of evidence for follow-up actions**: the platform provides valuable evidence that can justify the need for follow-up actions based on the observed conditions and discrepancies.
- **Cost and complexity reduction**: he emphasized that the platform helps reducing costs and complexity, specifically in terms of inspection costs per parcel. This efficiency contributes to streamlined monitoring processes.
- **Increased transparency in decision-making**: the storage and accessibility of data provided by the platform increase transparency, as farmers and other stakeholders have access to the same information, enhancing accountability and understanding of decisions.
- **Integration with existing tools and avoidance of overlap**: the stakeholder highlighted the importance of integrating the platform with existing tools and processes to avoid duplication of efforts and ensure efficient utilization of resources. Some internal tools are already in use, and minimizing overlap is essential.
- **Value in post-harvest inspections**: the platform proves particularly beneficial for inspections conducted after the crop has been harvested, especially in cases where subsequent grazing by animals may occur.
- **Field inspection navigation and agricultural roads and paths**: the stakeholder expressed the need for navigation features specifically designed for field inspections to facilitate efficient on-site assessments, and suggested including agricultural roads and paths on the map for improved navigation and better contextual understanding during field inspections.
- **Potential users**: the interviewee identified farmers as potential users, who can benefit from accessing and reviewing information pertaining to their parcels through the CALLISTO platform, as they can directly access and engage with the platform to ensure compliance, address any discrepancies, and optimize their agricultural practices based on the available information.

3.2.2 PUC2 - Water Quality Assessment

From SMAT interview the major outcomes are:

- **Accuracy and reliability of measurements**: the major stress was about the capacity to determine for the CALLISTO's outcomes the accuracy and reliability of the measurements (related to algae or other materials content). The importance of having high quality measurements data directly impacts their ability to effectively manage their systems.

- **Usefulness if data is accurate**: stakeholders highlighted that if the data provided by CALLISTO is accurate, it would greatly support their facility management activities.
- **Potential for predictive algorithms**: the users expressed interest in the possibility of developing predictive algorithms based on the data gathered, which could provide valuable insights for proactive decision-making.
- **Particularly useful for unmonitored basins**: it was identified the significance of CALLISTO's satellite imagery particularly in areas where monitoring is challenging or not currently possible.
- **Algae early expansion detection**: the stakeholders recognized that satellite imagery could provide advanced notice of algae or pollutant expansion in certain areas, offering valuable insights for planning and decision-making.
- **Satellite weaknesses in relation to climate, weather, and clouds**: users pointed out the challenges associated with optical and multispectral satellite images (Sentinel-2), as light seasonal variations and weather conditions, which can impact the effectiveness of the monitoring tool.
- **Resolution of measurements**: stakeholders acknowledged that the resolution of measurements, particularly for chemical parameters, is suitable as they exhibit similarity within a few meters.
- **Need for customization and evolution**: Stakeholders emphasized the importance of adopting CALLISTO for specific clients and considering future enhancements to meet evolving needs and requirements.
- **Importance of social network information**: a special highlight was for the value of incorporating information from social networks, as it can provide insights into pollution events and discharges into rivers.
- **Potential users**: the interviewees identified water service providers, municipalities, as well as all water-related economic activities as key users. The ability to prevent and predict critical events is crucial in managing water resources effectively. Also, the energy sector, environmental control agencies, and the tourism sector can be beneficial of the CALLISTO's services.

From De Watergroep the major outcomes are:

- **Validation of satellite images**: the stakeholders stressed the fundamental condition of validating satellite water quality analyses with in-situ sampling, to ensure the accuracy and reliability of the collected data before adopting the platform for decision-making purposes.
- **Valuable insights on unmonitored basins**: the users recognized the value of CALLISTO in providing valuable insights and information for unmonitored basins, where traditional monitoring may be challenging or unavailable.
- **Inclusion of additional parameters**: it was suggested incorporating additional parameters into the analysis to enhance the comprehensiveness of water quality assessments.
- **Temporal resolution concerns**: the temporal resolution of satellite data collection was highlighted as a potential challenge that needs to be addressed to ensure timely and up-to-date information. The Sentinel-2 data revisit time might not be sufficient to timely detect fast-occurring events.
- **Tracking lake conditions and pollutant threshold notification**: stakeholders emphasized the importance of utilizing satellite images to track the historical conditions of lakes and generate threshold notifications for pollutants. This feature would enable users to monitor and respond to water quality issues promptly.
- **Integration with other tools**: users expressed the need to integrate the CALLISTO platform with other relevant tools and services, enabling seamless data sharing and collaboration across different platforms and systems.

- **Learning and training material for platform operators**: Stakeholders identified the need for comprehensive learning and training materials to support operators in effectively utilizing and navigating the CALLISTO platform.
- **Potential Users**: the interviewees identified drinking water service providers and municipalities but also users and tourists who utilise water for recreative purposes (swimmers), as it helps to predict and prevent issues such as toxicity caused by algae and ensure a safe swimming environment.

3.2.3 PUC3 - Satellite Journalism

From DW the major outcomes are:

- **Validation of data with ground control**: users stressed the need to validate the satellite images or the atmospheric analyses with ground control data to ensure accuracy and reliability in their journalistic investigations.
- **Data download feature**: it was expressed the desire to have the ability to download data directly from the platform for further analysis and utilization in their journalistic work.
- **Inclusion of additional social networks**: stakeholders suggested expanding the platform's coverage to include social networks from regions such as Russia and China to enhance the breadth and depth of social media data analysis.
- **Automatic updates and alert notifications**: it was identified the importance of automatic updates for atmospheric quality predictions and suggested the implementation of an automatic alert notification system to provide timely information for journalistic reporting.
- **Tutorial and manual for operators**: the users emphasized the need for comprehensive tutorials and manuals to support platform operators in effectively utilizing the features and functionalities of the CALLISTO platform.
- **Initial investigative analyses tool**: CALLISTO was recognised as a valuable tool for conducting initial investigative analyses, providing them with essential insights to complement their journalistic work. They acknowledged the platform's potential in supporting their research and enabling them to seek additional expertise when necessary.
- **Lowering barriers to access**: stakeholders appreciated the fact that CALLISTO lowers barriers to entry by not requiring special hardware, as only an internet connection is needed to access and utilize the platform's features.
- **Ease of interpretation with social media**: also, they highlighted that social media data, which is incorporated into the platform, is more easily interpretable compared to satellite images. This accessibility enhances the platform's usability for journalistic reporting and analysis.
- **Open-source and freeware**: in the end, stakeholders expressed a preference for open-source and freeware platforms, indicating their reluctance to pay for access to such services.

3.2.4 PUC4 - Land Border Monitoring

Disclaimer: the allegations are the responsibility of their authors and do not necessarily reflect the views or the official position of SatCen.

From SatCen, Cyprus Police and Republic of Lithuania personnels, the major outcomes are:

- **Automatic change detection and notification system**: users highlighted the usefulness of the automatic change detection feature, particularly when accompanied by an automatic notification system. This feature allows them to identify potential changes and triggers further analyses using higher resolution data.

- **Integration of social network and crowdsourced information**: stakeholders expressed appreciation for the capability to incorporate social network and crowdsourced information into the platform. This additional data source enhances their analysis and provides valuable insights for border monitoring activities.
- **Need for additional social network data**: nevertheless, users expressed the desire for an expanded range of social network data, specifically from other geo-political contests. This broader coverage would provide a more comprehensive understanding of border activities and facilitate more robust analysis.
- **Combining overview from CALLISTO with high-resolution images**: they acknowledged that CALLISTO is beneficial in providing an overview of land border changes, which can be complemented by further analyses using high-resolution images.
- **Integration limitations with existing systems**: however, stakeholders mentioned that the current version of CALLISTO could not be fully integrated into their existing systems, as their systems predominantly rely on very high-resolution data.
- **Flexible change detection algorithm for different satellite image sources**: users emphasized the importance of a flexible change detection algorithm that can be adapted to different sources of satellite images, including different sensors. This flexibility would enable them to effectively utilise CALLISTO with various datasets for accurate change detection analysis.
- **Potential Users**: the interviewees identified as potential users the border control agencies and governments that require satellite image analyses for land border monitoring and management.

3.3 Iterative Improvement

The survey conducted as part of the stakeholder engagement process yielded valuable insights from users across all PUCs of the CALLISTO project. In analysing the survey responses, several key points emerged that were common to all PUCs. These common survey outcomes provide a comprehensive overview of the perspectives and suggestions shared by stakeholders, highlighting important aspects related to the data validation, dataset expansion, personalization with additional features, and the need for comprehensive manuals and training. By incorporating this feedback into the project's planning and decision-making processes, the team can continue to refine and enhance the platform, ensuring that it meets the diverse needs of stakeholders and maximizes its positive impact in various domains.

- **Usefulness and relevance**: the survey revealed that all users recognized the important value of the CALLISTO project and the significant outcomes it has achieved so far. The users acknowledged the project's relevance to their respective fields and expressed appreciation for the valuable insights provided by the platform,
- **Data validation**: a common point raised by stakeholders was the importance of data validation. Users emphasized the need for CALLISTO to validate the satellite and in-situ data collected and analysed by incorporating ground control data. Ensuring data accuracy and providing information about the level of accuracy are crucial for users to confidently utilize the data and determine if further analysis is required,
- **Expanding dataset**: many stakeholders expressed a strong interest in expanding the dataset. This included as example a desire for more social media data to be included in the analyses (mainly by PUC3 and PUC4), access to higher-resolution satellite images (all the PUCs), and the inclusion of additional parameters for water quality assessments (PUC2). Additionally, stakeholders in PUC1 highlighted the need for agricultural road information to be integrated into the maps,

- **Personalization with additional features**: users emphasized the importance of personalizing the platform with additional features that cater to their specific needs. Examples included a navigation system for field inspectors in PUC1, and automatic alarm notifications for PUC2, PUC3, and PUC4. Flexibility and adaptability were identified as key attributes of the platform to ensure its suitability for individual users,
- **Manual and training**: across all PUCs, users expressed the need for comprehensive training material to effectively utilize the platform and its tools. Stakeholders highlighted the importance of having user-friendly manuals and training resources to enhance their understanding and proficiency in using the platform.

4 Interaction activities

4.1 Strategy

The purpose of *Task 2.4: Requirements communication and knowledge transfer* is to ensure that requirements and knowledge are communicated to the development partners in an understandable and meaningful way. In addition, this task aims to ensure that requirements are kept up to date, taking into account changes in user scenarios, evaluation results and, of course, technical developments and constraints.

From the beginning of the project, several initiatives were taken to ensure good communication between users and development partners. The actions can be grouped into three categories:

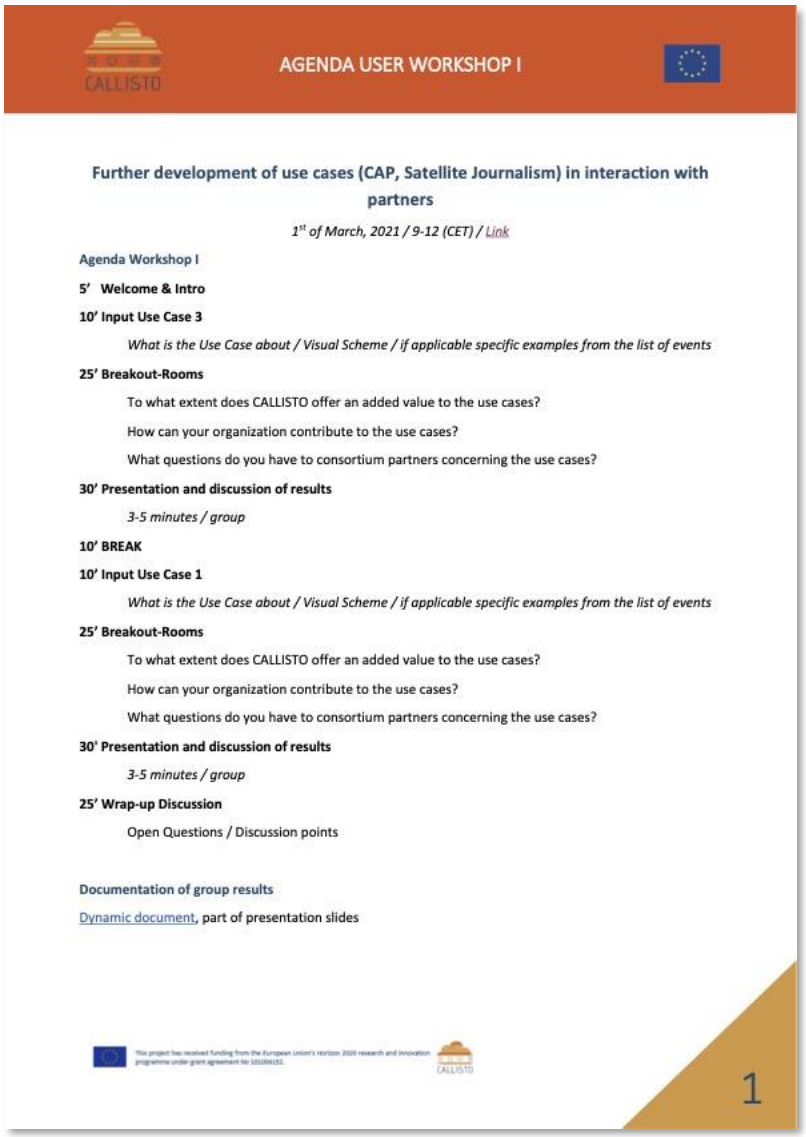
1. **Set up and establish a communication channel**: dedicated WP2 meetings were held early in the project. In year 2, a bi-weekly teleconference was established, which became the main exchange platform for the user partners. The bi-weekly meetings cover everything related to *WP2 Use case design and user requirements* and *WP8 Pilot implementation, evaluation and training*. The bi-weekly is designed as an open space where next steps, to-dos and responsibilities can be discussed, but also to express limitations and anticipated challenges.
   Although the bi-weekly teleconferences are aimed at user partners, all CALLISTO partners are invited to participate, especially the developing partners. This offer is often taken up: Sometimes developing partners have been asked to participate, e.g. when discussing user requirements, other times developing partners have asked to use the bi-weekly meeting to present their results and initiate discussions with the technical partners.
   In addition to the bi-weekly User Telco, a weekly Technical Telco has been established by the Technical Coordinator. Although focused on the development aspect of the project, it serves as another forum where bridges between users and development partners are easily built.
2. **Dedicated workshops**: several workshops have been organised to strengthen the exchange between users and development partners. These workshops did not have a common structure, but were planned and organised individually in accordance with the needs of the participants and the objectives of the project.
   Some of these workshops are described in 4.2 Actions and results, such as two user workshops at the very beginning of the project (see: User workshops (M3)), where all CALLISTO partners participated to discuss the four project use cases, user requirements sessions (see: User requirement sessions (M18-M20)) and workshops dedicated to individual technical developments, such as the SMAS tool (see: SMAS workshop) and CALLISTO platform workshops (see: CALLISTO platform user training).
3. **Bilateral exchange**: all users are encouraged to contact the development partners whenever clarification, brainstorming, etc. is needed. Equally, development partners are encouraged to do likewise.

4.2 Actions and results

The following sections present a selection of key activities that ensured communication and knowledge transfer between users and development partners. A more detailed description of the development of user requirements throughout the project can be found in 5.1.1 Development of user requirements and methodology.

4.2.1 User workshops (M3)

With the kick-off of the project in January 2021, WP2 started organising two remote user workshops with the aim of involving the whole consortium and devoting time to each and every PUC. As a result, two very engaging 3-hour user workshops were held on March 1st and 15th. These not only laid the groundwork for the respective PUCs, but also served as team-building and trust-building events.



AGENDA USER WORKSHOP I

Further development of use cases (CAP, Satellite Journalism) in interaction with partners

1st of March, 2021 / 9-12 (CET) / Link

Agenda Workshop I

5' Welcome & Intro

10' Input Use Case 3

What is the Use Case about / Visual Scheme / if applicable specific examples from the list of events

25' Breakout-Rooms

To what extent does CALLISTO offer an added value to the use cases?

How can your organization contribute to the use cases?

What questions do you have to consortium partners concerning the use cases?

30' Presentation and discussion of results

3-5 minutes / group

10' BREAK

10' Input Use Case 1

What is the Use Case about / Visual Scheme / if applicable specific examples from the list of events

25' Breakout-Rooms

To what extent does CALLISTO offer an added value to the use cases?

How can your organization contribute to the use cases?

What questions do you have to consortium partners concerning the use cases?

30' Presentation and discussion of results

3-5 minutes / group

25' Wrap-up Discussion

Open Questions / Discussion points

Documentation of group results

Dynamic document, part of presentation slides

1

Figure 1: Agenda of the 1st User Workshop on 1st of March, covering PUC1 CAP Monitoring and PUC3 Satellite Journalism.

4.2.2 User requirement sessions (M18-M20)

Prior to the completion of the first prototype, the user and development partners used the bi-weekly user meeting to discuss each individual user requirement with a focus on platform functionality. In successive meetings, the individual user requirements were discussed in terms of

- their feasibility,
- their estimated maturity,
- and their potential limitations.

The whole process resulted in an updated list of user requirements, a roadmap for development and evaluation, and improved communication between users and development partners.

4.2.3 Dedicated workshops and trainings

In the course of the project, users and development partners come together on different occasions and in different forms (bilateral telcos, demos, workshops, trainings, etc.) to discuss user needs and technical solutions. The following two sections describe two events that are considered good examples of how these exchanges took place.

4.2.3.1 SMAS workshop

During one of the bi-weekly user meetings, the functionalities of the SMAS tool were discussed. As all PUCs except PUC1 expressed interest in the tool, an additional meeting was organised to allow time and space for a detailed demonstration and discussion of the tool. Based on the results of this very constructive meeting, feedback was collected (Table 2) which was addressed by the SMAS developers at CERTH and then re-demonstrated to the users. This very iterative and streamlined process resulted in an updated development roadmap (Figure 2) and consequently a noticeable improvement of the tool. The SMAS tool is currently being evaluated by end users.

Table 2: Selection of requests and comments on the SMAS tool from user partners. Note: For ease of reading, this table shows an extract from the original table (only one example entry per PUC), which also includes the contact e-mails to ensure a quick exchange between the users and the developers.

PUC	Request / Comment
2	Download from Timeline: We are not able to use the JSON file that can be downloaded from the Timeline; is there the possibility to get a more easily usable format? Maybe a csv, to allow filters and queries?
3	In “On-the-fly-search”, clarify what locations the heatmap and the “Most Mentioned Locations” widget show. Are the locations embedded in the tweet metadata?
4	Selection Tweets from heatmap: The heatmap point should be clickable. When a user clicks in the specific heatmap area, it should pop up the aggregated number of tweets in that heatmap and (if feasible) each tweet as a short list.

Development Roadmap

ID	Date	Issue	Actions	Status
1	20/02/2023 - 08/03/23	Heatmap and timeline tweets are not associated in some way.	1. Add locations detected to each tweet in the timeline as text and when clicked the heatmap widget zooms in to the location. 2. Add an extra map layer with pins that on click they show the associated tweet	Deployed
2	09/03/23 - 17/03/23	Results cannot be filtered by selecting a social media platform.	1. Add a parameter to the REST API endpoints that filters posts by platform if it is set. 2. Fetch results based on platform when clicking a platform chip on the Total Posts widget.	Deployed
3	20/03/23 - 27/03/23	Selected locations in the filters reset every time Get Analytics is pressed	Fix the filters reset issue. *Add location suggestions when typing in the locations filter input adding more options than the ones provided from most mentioned location widget.	Deployed
4	28/03/23 - 31/03/23	Not all widgets are interactive	1. When clicking a phrase in word cloud widget add it to the keyword filter field. 2. When clicking to the Number of Posts per Day widget date switch the dates filter field to the selected date.	Deployed

Figure 2: Screenshot of shared document outlining the updated development roadmap.

4.2.3.2 CALLISTO platform user training

CS GROUP, as the technical lead in the development of the CALLISTO platform, initiated individual user training (T8.3) with all user partners to ensure sustainable integration of the PUCs in M27 to M29. CALLISTO user partners who are responsible to publish content (data or interfaces) on the CALLISTO platform, can use it to access different tools and means offered by the platform, such as the deployment of Virtual research environments (VREs), as well as to create dashboards for data analytics or to manage the notifications for their services. Specific training sessions has been regularly proposed to user partners, that use the CALLISTO platform. These sessions are meant to train them to the use of their added-value services through the platform. These sessions took the form of practical exercises workshop. At least three intensive one-hour workshops were held for each of the four PUCs to introduce the platform, transfer knowledge and address user requirements and other needs.

In addition, to support user partners in the use of the CALLISTO platform, online documentation (Figure 3 : CALLISTO portal documentation) has been made available through the web-portal (https://callisto.csgroup.space/tutorials), including tutorials with explanations of the platform's various tools, as well as examples of use.

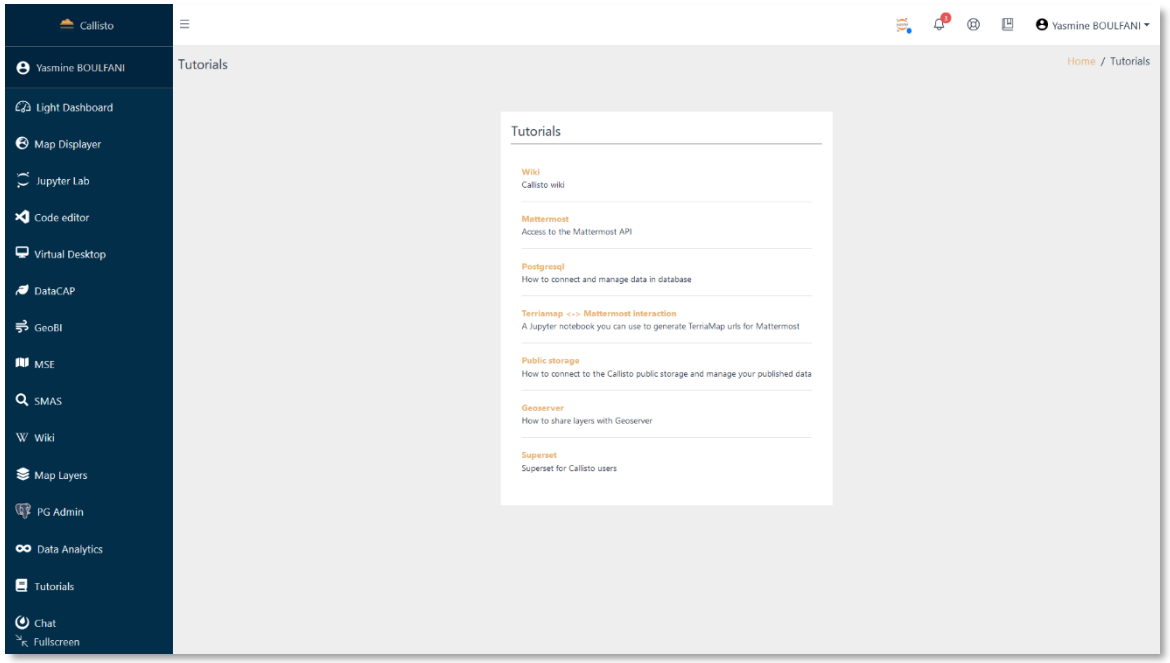


Figure 3 : CALLISTO portal documentation

Moreover, any authenticated CALLISTO user could contact the helpdesk via the web-portal chatroom via the Mattermost chat tool (Figure 4 : CALLISTO help via the live chat).

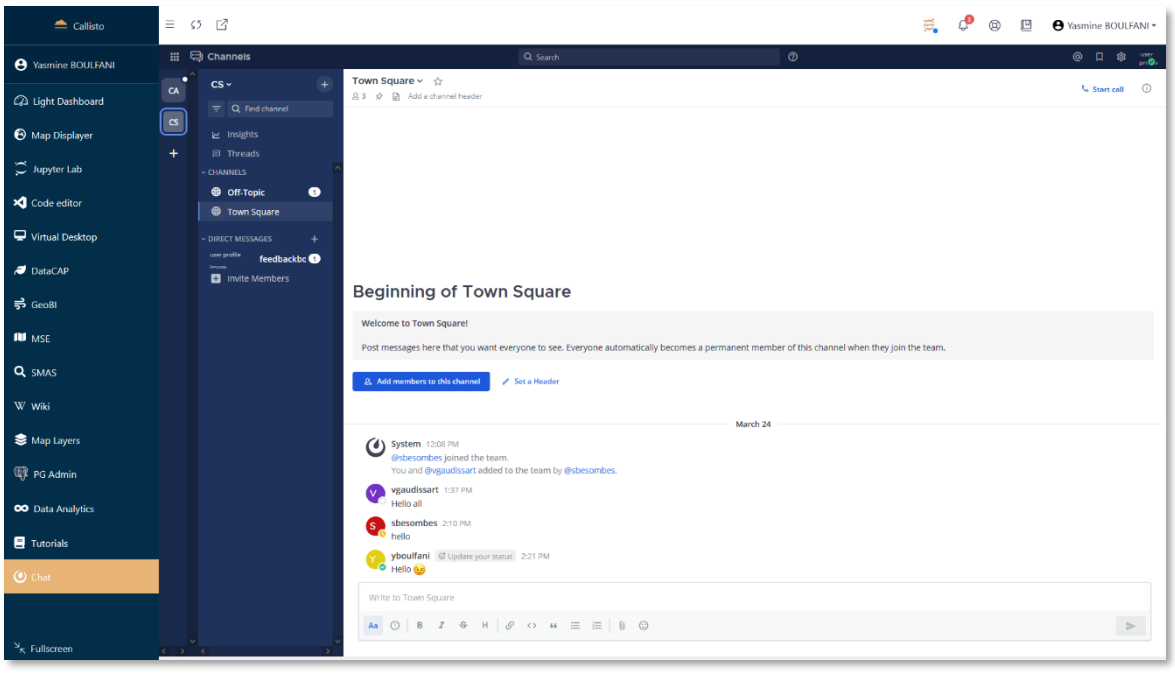


Figure 4 : CALLISTO help via the live chat

5 Requirements Communication

5.1 User requirements

5.1.1 Development of user requirements and methodology

One of the objectives of WP2 is the development and specification of user requirements. As outlined and presented in *D2.1 Pilot use case design and user requirements* and *D2.2 Detailed pilot use cases and user requirements*, this task is an iterative process that requires a certain degree of exchange between user and development partners.

5.1.1.1 Development 1st year

Initial feedback from the technical partners and further enquiries with (potential) end users led to a first version of the requirements in month 6 of the project. The user requirements were based on the initial requirements contributed by the PUC partners and validated in different ways, such as (1) extensive expertise on the four use cases within the consortium, (2) extensive market research, and (3) interviews, workshops, exchange sessions with potential end users and stakeholders. After a compilation of initial requirements based on the input of all PUC partners, synergies were found, discussed and merged into new requirements. This iterative process led to a dynamic evolution of the requirements and supported the PUC leaders in communicating their needs to each other. DW, as WP2 lead, created a collaborative spreadsheet tool for this purpose. The spreadsheet is filterable and allows the user to sort requirements by different values. Two important steps were taken during the process: First, a distinction was made between *PUC-specific* and *general requirements*. On the other hand, the user requirements have been mapped with Key Results (KR), as all of CALLISTO's key development work is linked to them. In total there are 22 different KRs.

This initial list of user requirements is shown in D2.1. The user requirements spreadsheet was made available and communicated not only to the user partners, but also to the technical partners via email and the project wiki. The main exchange platform for communicating the status of the requirements, apart from emails and bilateral exchanges, were the bi-weekly user and technical conference calls.

In the following months, the requirements were again discussed and validated in cooperation with the technical partners in order to refine the requirements and define coordinated prioritizations (T2.2 Specification of user requirements). This task has recently been completed in M30.

Prioritization followed the MoSCoW methodology[ii], a prioritization technique used in software development to reach a common understanding with the stakeholders of an application about the importance they place on the delivery of each requirement (introduced in D2.1). It has also been successfully applied to business requirements (see: 3.1 Business Requirements). It defines four priority categories, which are: must have, should have, could have, won't have.

In addition to the MoSCoW methodology, the timing of the demos influenced the prioritization of the implementation, with the use case specific requirements of PUC2 being implemented faster for the first demo and PUC3 for the second demo, and the remaining user requirements being implemented later until the final demo of the CALLISTO platform.

5.1.1.2 Development 2nd and 3rd year

In the course of the second project year, especially during a dedicated session at the plenary meeting in May 2022 and in the months leading up to the release of the first prototype (M23), the user requirements were

revised by all user partners in close exchange with the technical partners. The updated version can be found in *D2.2 Detailed pilot use cases and user requirements* following a standard classification:

- ID: the initials G and S indicate whether the requirement is general or specific. If more than one partner showed interest in a requirement, it is considered a general requirement.
- Name: The short name of the requirement.
- Description: a more detailed summary of the intent of the requirement.
- Key results: All requirements are mapped to CALLISTO's 22 different Key Results as defined in the proposal. KR22 Air quality geospatial business intelligence tool was introduced to the projects at a later stage and is therefore reflected for the first time in the list of user requirements.

The incorporation of user requirements into the final CALLISTO platform and systems is an iterative process that continued after the release of the second prototype (M28) and the second round of evaluation (M30). The up-to-date list of user requirements is further available on the project's wiki, hence, was made available not only to the user partner, but also to the development partners. The main exchange platform for communicating the status of the requirements, apart from emails and bilateral exchanges, continue to be the bi-weekly user and weekly technical conference calls.

5.2 Evaluation

In the multifaceted evaluation of CALLISTO functionalities, the evaluation of user requirements plays a crucial role. To date, two rounds of evaluation have taken place. The results are documented in *D8.1 Pilots implementation and 1st prototype evaluation report* and *D8.2. Pilots implementation and 2nd prototype evaluation report*.

In order to link the end-user requirements derived from the four PUCs with the technical developments, the user requirements have been mapped to the 22 technical Key Results (KR). Consequently, we evaluate both:

1. the contributions of the KRs to the PUCs;

2. the contributions of the KRs to the achievement of the user requirements within each KR.

Table 3 shows the contribution of the KRs to the PUCs as reported in D8.2. For the evaluation of user requirements, questionnaires were prepared covering all the generic and specific requirements already available for testing. For the 2nd round of evaluation, twelve out of 20 generic requirements were evaluated by end-users from all four use cases. For some of the PUC specific requirements almost all requirements could be evaluated (PUC3: 10 out of 11), for some only a few (PUC1: 4 out of 18; PUC2: 4 out of 11) and for one none (PUC4: 0 out of 18). The heterogeneity is related to the different technical focus. For the final evaluation it is expected that most general and specific user requirements can be evaluated, although some remain optional.

Table 3: Interactions between the CALLISTO KRs. The green colour corresponds to interactions that are already part of the evaluation, while the orange colour corresponds to interactions that should be evaluated in the third and final round of evaluation.

PUC	Description	Key Results																			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	17	18	19	20	21	22
1	CAP monitoring																					
2	Water quality																					

3	Journalism																					
4	Land borders security																					

5.3 Use cases

The following sections describe the four use cases addressed by CALLISTO, namely *PUC1 - Cap Monitoring*, *PUC2 - Water Quality Monitoring*, *PUC3 - Satellite Journalism* and *PUC4 - Land Border Monitoring*. Note: The sections are taken from D8.2, which was due in M30 and presents the current status of the PUCs.

5.3.1 PUC1 CAP Monitoring

PUC1 aims to enable the transition towards the exhaustive monitoring of the EU's CAP. The defined use case scenarios aim to facilitate this purpose through the utilisation of state-of-the-art AI DL models, generation of analysis-ready Space-to-Ground data, generation of annotations with data fusion and processing techniques, provision of a web platform for data visualisation and dispute resolution, assisting field inspectors with the capability for near real-time decision making and, ultimately, through the incorporation of all the corresponding technologies and tools in the current operating model of the PA of the member states.

The scenarios and services defined for PUC1 are:

- **Crop Classification**

  This is the main enabling process, through which the adoption of the CAP-provided guidelines for the cultivation of specific crop types is monitored. Development of Deep Neural Networks (DNN), acquisition and utilisation of Space-to-Ground data, and highly adapted operational scenarios will contribute to a set of relevant services, which will be of varying Technological Readiness Level (TRL), ranging from proof-of-concept to pre-operational. The areas of interest for crop classification will come both from Cyprus and the Netherlands.

- **Grassland Outlier Detection and Reconversion**

  The maintenance of permanent grasslands supports carbon sequestration and protection of biodiversity. Also, it is in line with requirements of the "EU Biodiversity Strategy 2030" and works as an incentive for farmers to adopt sustainable practices. Apart from detecting the non-compliant outliers, CALLISTO will also aid in the monitoring of reconversion for these cases. For this scenario in particular, the AoIs will be coming from the Netherlands, as it is the prevalent crop type and there is also very high coverage of street-level imagery to accommodate validation and extensive capacity for photo-interpretation.

The corresponding services that will be developed for the scenarios described above are as follows:

- **Product 1: Sentinel-based Deep Learning models for crop classification**

  CALLISTO will exploit Sentinel-1 and Sentinel-2 imagery for crop classification, building on top of the outputs of H2020 ENVISION.

- **Product 2: Smarter OTSC sampling**

  The smart sampling approach developed by NOA and CERTH will be enhanced so that on the spot checks (OTSCs) will become more effective. This will be achieved not only by the refinement of the Deep

Learning Crop Classification models, but also through the incorporation of the CALLISTO UAV in the operational frameworks of the paying agencies, and the planning around field inspections.

- **Product 3: UAV-based Tree Detection**

The CALLISTO UAV will be utilised to accommodate the need to count the total number of olive trees within a parcel for it to be considered as having the "olive trees" crop type. In addition, it will support the distinction of fallow lands by measuring the distance between trees and whether or not it is within a particular threshold for the characterisation.

- **Product 4: Crop Diversification**

Further to the crop type classification, the monitoring of crop diversification is also a requirement that is based on the total area of cultivation. This becomes a challenging task to solve with Sentinel data alone, and especially in countries like Cyprus, where the minimum allowed area for a parcel is quite small. CALLISTO will incorporate various data sources and photo-interpretation tools for this to be made possible.

- **Product 5: Enhanced Transparency and Process Simplification through Street-Level Images and Geo-tagged photos**

The CALLISTO UAV and the CALLISTO mobile application will synergistically contribute to the enhancement of the transparency of CAP control, as well as its simplification. This is also made possible with the DataCAP web interface that can greatly support desk OTSCs and dispute resolution.

- **Product 6: Deep Learning on Space-2-Ground Data Sources for Crop Classification**

CALLISTO is developing pipelines to acquire data from both the Space and Ground domains and apply the necessary pre-processing steps to match them into a single space-to-ground dataset. This will enable the application of Deep Learning on each domain and the application of fusion on multiple levels (e.g., early fusion, late fusion, decision fusion, etc.).

5.3.2 PUC2 Water Quality Monitoring

PUC2 is implemented in two different scenarios at two different sites:

- The water production centre (WPC) of the Blankaart is one of the largest surface water production centres of the Flemish water utility De Watergroep (Belgium) with a production of approximately 11 million m3 drinking water per year. The WPC has an octagonal reservoir that can buffer 3 million m3 water from the surface water sources. Overall, the residence time of the water in the reservoir is 100 days.
- The Po River Water Production Centre, managed by SMAT, accounts for about 20% of the water produced and distributed to the City of Turin, with a total production capacity of about 80 million m^3 per year. The WPC is supplied by two different sources. Water can be withdrawn directly from the Po River (the main water course in Northern Italy), or from a lagoon basin located approximately 7 km upstream the plant. Intake raw water is a mixture of the two sources, whose relative contribution depends on several factors including water availability, water quality, river pollution events. The lagoon is an artificial basin derived from an old gravel quarry that was retrained and transformed into a water reservoir of about 1.6 million m^3.

The basins represent an invaluable water reserve in case of droughts and assure a substantial improvement of raw water quality since sedimentation and natural purification processes reduce chemical and biological

pollutants. Moreover, the basin allows to avoid sudden variations in water quality and to optimise treatment processes with lower amounts of chemical reagents.

On the other hand, the retention time (about 7 days for SMAT lagoon and up to 100 days for De Blankaart), can give rise to a deteriorating water quality with algae blooms due to high nutrient contents of the source waters. This phenomenon takes place with ever more frequency due to increasing temperatures.

A deteriorating water quality requires adaptations in the purification and should thus be avoided. The early detection of a deteriorating water quality would allow for taking timely and effective proportional mitigating measures.

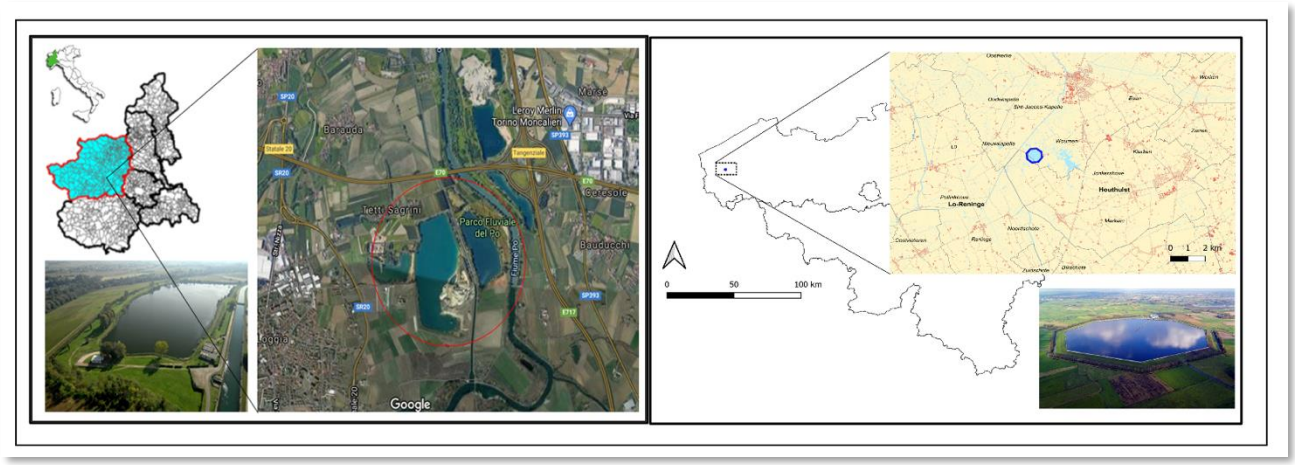


Figure 5: Water Production Centers of PUC2.

CALLISTO develops a methodology to quantify water quality variables with the use of in-situ and satellite remote sensing data sources, for a spatial overview of the water quality in the reservoir. In the scope of CALLISTO, we explore the usability of satellite images as an early warning tool for algae bloom events. Also, by performing correlation analysis with environmental factors and by integrating different data sources, we try to exploit CALLISTO tools for predictive purposes.

Moreover, the use of advanced algorithms for information extraction and innovative tools such as augmented reality to convey this information to the user will be tested on the CALLISTO platform. In addition, it will be verified if the CALLISTO approach can be used to evaluate the water quality of the nearby natural pond, which is one of the surface water sources for the reservoir.

Finally, a crowdsourcing module that collects in real-time citizen-generated data from social media platforms, provide additional information related to water quality in the area of interest by collecting and geotagging all available information potentially related to the use case. In this use case the Yser river, which is the other surface water source of the reservoir, will be the main topic of interest.

Specific products that will be developed in PUC2 are:

- Product 1: An automated processing data chain with near real-time validated and atmospheric corrected water reflectance products from Earth Observation missions. This processing data chain leads to novel and fine-tuned water quality products (Suspended Particulate Matter, Chlorophyll-a, phytoplankton groups);
- Product 2: An analysis ready dataset for future AI models and model training, validation and testing;
- Product 3: A tool to generate hyperspectral signals from multispectral ones obtained from satellites, using deep neural network techniques, with the aim to provide advanced water quality products

from Sentinel 2 images, to be also applicable to basins not monitored with an in-situ hyperspectral sensor;

- Product 4: A multi-correlation analysis for additional insights in the relation between algae blooms, satellite data and environmental data, leading to the extraction of causal relationships;
- Product 5: A tool that can foresee the evolution of algae bloom events throughout its life cycle, using insights taken from the multi-correlation analysis (Product 4) in combination with Product 1.

5.3.3 PUC3 Satellite Journalism

The main focus of *PUC3 - Satellite Journalism* lies in the investigation of AQ (Air Quality) for journalistic purposes. AQ has been a topic in media coverage for a long time, often related to single events, such as the Great Smog of London in 1952. But in light of the climate crisis and the European Green Deal initiatives, it enjoys increasing attention. Especially, since AQ affects us all with every breath we take. Luckily, AQ-related data is collected more intensively, which allows a more objective investigation. However, this data – namely retrieved from satellite imagery, ground stations and sensors – is not easily accessible and – most importantly – not easily understandable by non-experts such as journalists. A journalist working for a national or international outlet does not have the resources to constantly observe manually the AQ of a predefined AoI by themselves just hoping to find interesting data. On the contrary, any kind of (semi-)automated monitoring linked to a notification system is useful. The monitoring could be AQ-data-based or based on social media activities. Furthermore, if the user already knows what to investigate, it is of great value if the journalist has the option to easily access historic AQ data and trends.

The AQ user scenario aims to contribute to environmental journalism by providing a research tool that allows journalists to investigate and monitor AQ data from various sources. The main goal of the user scenario is to support three different but intertwined journalistic tasks:

Monitoring: Journalists will not simply observe AQ data in pure hope to find something. In contrast, they are interested in anything unusual and unexpected such as exceeding/deceeding thresholds (outliers) but also finding trends and patterns. Not only AQ data but also human observation can serve as a component of monitoring by systematically screening social media activities linked to AQ. Ideally, the CALLISTO services which can be used for monitoring, allow issuing notifications whenever a suspicious development related to AQ happens in a predefined AoI.

Investigation of AQ data: There can be several reasons for a journalist to start investigating AQ data. On the one hand, the monitoring systems might have issued a notification indicating an interesting development. On the other hand, the journalists might want to explore AQ data related to a specific event, such as environmental factors (forest fires, heatwaves, cold winters, etc) or human impact (constructions of facilities like airports, highways, and factories; catastrophes such as explosions; environmental-friendly decisions such as renaturation). The journalist can then use the CALLISTO systems to investigate all given data (e.g., CAMS data, national ground station data measuring AQ, sensor data, Social Media data). In the scope of analysing the data, data fusion and cross-referencing might take place.

Traditional journalistic research: The monitoring system and the investigation might show what is happening, e.g., AQ is surprisingly positive or bad in a certain AoI. To find an answer to why this is the case, traditional research is required, such as talking to experts, interviewing people on sight etc. In recent months, DW and DRAXIS have focused on AQ data in the Berlin area. For the next and final prototype, AQ will be studied in relation to forest fires in major European cities.

5.3.4 PUC4 Land Border Monitoring

The Land Border Monitoring aims to identify relevant changes in a certain AoI. CALLISTO exploits the Copernicus Big Data paradigm and the Land Border Monitoring (PUC4) introduces the tipping and cueing approach in IMINT Copernicus services, allowing Activity-Based Intelligence (ABI) to operate at scale, discovering patterns (i.e., events) in the dataset and bringing this information to Imagery Analysts for further consideration and analysis based in a change detection algorithm.

CALLISTO provides an innovative algorithm for Change Detection. Thus, the main expectation is that the CALLISTO platform will be able to process Sentinel data, perform accurate land change detection to infer relevant changes at borders, and deliver alerts through a communication channel to the analysts. Therefore, the main goal, using CALLISTO resources and capabilities, is to evaluate the land border changes, which were previously defined based, not only, in a spectral/thematic context but also in a geospatial context. As regards the spectral/thematic component, in general terms we are looking for a land cover change from a vegetated land to a cleared/impervious surface. In addition, burnt scars on forests or flooded areas near river-defined borders, might also be considered relevant if they are in the vicinity of the borderline. Therefore, the second important component that we define is the context/geospatial component, which refers mainly to the distance of an event from the borderline. Other data sources such as social network platform analysis will provide additional information in order to create potential awareness scenarios near EU external borders.

The Image Analyst will use the CALLISTO platform to submit an underlying task for change detection for a period. Thus, the service will be triggered at user request to complement an ongoing IMINT service or in case of a suspicious activity in an AoI, which needs to be monitored. The added value provided by CALLISTO will support the Image Analyst in the process of decision-making.

This use case provides several services that aim to contribute to evaluate the CALLISTO Platform in terms of outputs provided by the Change Detection algorithm (Relevant Land Changes: New buildings, new barriers (fences, walls), new roads and cart tracks, new runways/airports, new infrastructure in riverbanks (e.g.,piers), new bridges or constructions works near the EU external border, changes near Border Control Points and/or migrant camps, possible agglomeration of cars, trucks, buses etc. Non-relevant land changes: Snow cover alterations (snowfall or melting), agricultural crop stages (sowing, ripening, harvest etc.), forest leaf-off/-on conditions). The application of the proposed methodology to the current needs and expectations is evaluated from a user perspective. For this Use Case, three AOI have been defined for testing/evaluating the performance of the algorithm of change detection performance capabilities using as input satellite imagery as well as one AOI, as a simulated EU external border, for the applicability and performance of the UAV.

1 - External Border of Croatia with Bosnia Herzegovina (116km2) - Satellite Imagery

2 - External Border of Croatia with Bosnia Herzegovina (75km2) - Satellite Imagery

3 - External Border of Hungary with Serbia (117km2) - Satellite Imagery

4 – Simulated European Union External Border (4.81 km of border line) - UAV Imagery

5.4 Matching user scenarios with key results

In 5.2 Evaluation, it was outlined that mapping user requirements and PUCs with KR is one of the key strategies to ensure that user and technical goals are aligned and to evaluate the project results from the user perspective. For this reason, an exercise to closely monitor this mapping was introduced by the technical lead earlier this year. The exercise was to break down all the steps of each use case and provide relevant information about

- the agent (who is the end user),
- action (e.g. notification, login),
- mapped KR,
- CALLISTO tools (e.g. Map Displayer, SMAS),
- description of what the agent wants to do,
- partner for technical integration,
- integration status & data availability,
- delivery date, and
- comments.

All the information is collected in a dynamic spreadsheet that is shared with all development and user partners and is constantly revised to keep it up to date.

The following four subsections provide a table of PUC specific information. For ease of reading, the section *comments* are not shown in the tables. *Integration status & data availability* and delivery date are also omitted as these parameters change dynamically.

5.4.1 PUC1 CAP Monitoring

Table 4: Breakdown of the PUC1 use case mapping the KRs and the partner responsible for integrating.

Steps	Agent	Action	KR	Tool	Description	Partner for integration
1	Paying Agency User / Field Inspector	Login	KR19	CALLISTO Platform	A Paying Agency User / Field Inspector logs in to the CALLISTO platform.	CS
2	Paying Agency User / Field Inspector	Visualize LPIS data (Farmers' declarations)	KR01, KR02, KR19	CALLISTO Platform, Map Displayer	The User should be able to select the LPIS data and visualize them on the map. Each parcel will be a polygon that will be colour-coded based on the declared crop type.	NOA, CS
3	Paying Agency User / Field Inspector	Visualize AI model predictions.	KR01, KR02, KR03, KR10, KR19	CALLISTO Platform, Map Displayer	The User should be able to select the AI model predictions and visualize them on the map. Each parcel will be a polygon that will be colour-coded based on the predicted crop type.	NOA, CS
4	Paying Agency User / Field Inspector	Visualize agreements and disagreements	KR01, KR03, KR19	CALLISTO Platform, Map Displayer	Visualize the agreements and disagreements on the map - Green for strong agreements - Red for strong disagreements - Orange for low-confidence agreements/disagreements	NOA, CS

5	Paying Agency User / Field Inspector	Identify areas for on-the spot checks (OTSC).	KR01, KR02, KR03, KR07, KR12, KR14, KR19	CALLISTO Platform, Map Displayer	The User should be able to identify areas that are good candidates for OTSCs. These can be for example: - Areas with cases of lots of low-confidence decisions that should be further evaluated - Parcels that cannot be easily visited and should be captured by a UAV flight	CS, NOA, Fraunhoffer, InfAI, NURO
6	Paying Agency User / Field Inspector	Check availability of Street-Level Images (SLIs)	KR01, KR02, KR19	CALLISTO Platform, DataCAP, Map Displayer	See whether street-level images (SLIs) are available for any of the parcels with decisions of low confidence and the points from which they were taken. This can be possible through the DataCAP integrated application. As an alternative, if feasible, the map displayer should also accomodate this.	NOA, CS
7	Paying Agency User / Field Inspector	Check SLIs and their details	KR01, KR02, KR19	CALLISTO Platform, DataCAP, Map Displayer	Go to DataCAP and - find the parcel of interest - check SLIs (if available), along with the dates of acquisition and point of capture - take a decision through photo-interpretation (if possible) and/or resolve potential disputes - check graphs of vegetation indices for the parcel of interest	NOA, CS
8	Paying Agency User / Field Inspector	Check UAV images	KR01, KR02, KR09, KR19	CALLISTO Platform, MSE	Go to the MSE and check if UAV photos are available for the parcel(s) of interest. If possible, take a decision through photo-interpretation and/or resolve potential disputes.	CERTH, ACCELI, NOA, CS
9	Paying Agency User / Field Inspector	Have a flight path created for parcels of interest	KR10, KR11, KR19	CALLISTO Platform, UAV Path Planner	For cases where representative photos of many parcels are needed, the inspector can request the generation of a UAV flight path from the Path Planning tool.	CERTH, CS
10	UAV Pilot	Fly the UAV according to the flight path to collect images	KR11, KR18	CALLISTO UAV, UAV Path Planner	The UAV flies according to the generated flight path plan and acquires representative images from the parcels.	ACCELI, CERTH

11	Paying Agency User / Field Inspector	Download and install the CALLISTO mobile application	KR19, KR21	CALLISTO Platform, CALLISTO Mobile Application	The user should be able to download the CALLISTO mobile application. (This will be most probably done through downloading the .apk from the CALLISTO Platform. However, there is a discussion on the potential to do that through the Google Play Store.)	DRAXIS, CS
12	Paying Agency User / Field Inspector	Check UAV images and ancillary data on the CALLISTO mobile application.	KR01, KR19, KR21	CALLISTO Mobile Application, CALLISTO UAV, CALLISTO Platform	These images are sent near-real time to the CALLISTO mobile application (downloaded from the CALLISTO platform). The field inspector uses them for the decision making process, checking not only the UAV images on the CALLISTO mobile app, but also useful vegetation indices for the parcel in question.	DRAXIS, ACCELI, CS, NOA
13	Paying Agency User / Field Inspector	Perform field-visit OTSC	-	-	In case there is no strong-confidence decision, SLIs don't exist or cannot be used, and UAV images (if a flight took place) aren't sufficient, the field inspector then visits the parcel(s).	-

5.4.2 PUC2 Water Quality Monitoring

Table 5 Breakdown of the PUC2 use case mapping the KRs and the partner responsible for integrating scenario 2 by SMAT. A similar scenario will be evaluated for De Blankaart by De Watergroep.

Steps	Agent	Action	KR	Tool	Description	Partner for integration
1	CALLISTO platform	Alarm/Notification	KR04, KR16, KR19	Mattermost	An alarm related to an abnormal concentration of chlorophyll is sent by e-mail to SMAT operator.	RBINS, CS, SMAT
2	SMAT operator	Log in	KR19	Mattermost	The operator received the email and checks the appropriate channel (Mattermost) to check the Alarm.	CS
3	SMAT operator	Pushing Data/Visualization	KR04, KR16, KR19	CALLISTO Map display	The operator opens map displayer and sees the last acquired S-2 images that were processed (Rbins docker)	RBINS, CS
4	SMAT operator	Pushing data/Visualization	KR04, KR16, KR19	CALLISTO Map display	The operator can see that the chlorophyll concentration is above the threshold set by SMAT only in one part of the basin	RBINS, CS

5	SMAT operator	Pushing data/Visualization	KR04, KR16, KR19	CALLISTO Map display	The operator checks the sampling and online monitoring data on the same map to validate the alarm's results	SMAT, CS
6	SMAT operator	Evaluation	-	-	Chlorophyll concentrations derived from in-situ data are relatively low, whereas those obtained from satellite data show significantly higher values.	SMAT, RBINS
7	SMAT operator	Visualization	KR04, KR16, KR19	-	The operator wants to review historical events to determine whether this phenomenon has occurred previously.	SMAT, RBINS, CS
8	SMAT operator	Visualization	KR12, KR14, KR19	UI	In order to do that, the operator performs some queries in order to know which datasets are available on the platform and which is the highest clorophyll concentration in the performed monitoring campaigns.	SMAT, Fraunhofer, INfai, CS
9	SMAT operator	Evaluation	-	-	The operator notices that during past algae bloom events, there was an initial increase in chlorophyll concentration in a specific area of the basin, that later expanded throughout the entire basin. However, this surge in algae concentration was only detected by the online monitoring system 10 days after the initial increase.	-
10	SMAT operator	Visualization	KR08	CALLISTO Map display	The operator launches the forecasting module and sees that the algae bloom is supposed to expand in the whole basin, 5 days after.	CERTH, CS
11	SMAT operator	Decision	-	-	As a result, the operator decides to begin monitoring the event by collecting sample data using a boat.	-
12	SMAT operator	Visualization	KR07, KR20	3D app	They utilize a 3D application on their smartphone to identify the areas with the highest chlorophyll concentrations, allowing them to obtain samples from those specific locations.	NURO, RBINS, SMAT
13	SMAT operator	Use of external tool	-	-	Laboratory analysis are performed on the collected samples; results of	SMAT

					analyzed sample are made visible on the LIMS.	
14	CALLISTO platform	Visualization	KR04, KR16, KR19	CALLISTO Map display & Supersets	Laboratory Information Management System (LIMS) data “immediately” visible on the Callisto platform	SMAT, CS
15	SMAT operator	Evaluation	-	-	Now we can see that the laboratory analysis confirms the concentration seen from the S-2 processed data.	-
16	SMAT operator	Visualization		Supersets? or maybe Map displayer	In the dashboard, all this information is made available	SMAT, CS
17	SMAT operator	Triggering a service	-	Mattermost for the triggering part	A report is printed and sent to the plant manager that can take decisions on the basis of all available information.	N/A
18	SMAT operator	Evaluation	KR04		Since there is another basin nearby that is not monitored with the on-line monitoring system, thanks to the Callisto platform the operator can see that no algae is growing in the second basin, thus no action should be taken.	RBINS, CERTH, CS
19	CALLISTO platform	Visualization	KR13, KR17	SMAS	After the algae bloom, another event occurred in the lagoon basin. The SMAS application started to detect tweets speaking about some pollution that is visible in the Po river near to Pancalieri, about 20 km far from the SMAT intake. Through the SMAS application, we start reading tweets and we collect information about the possible contaminant.	CERTH, CS
20	SMAT operator	Decision	-	-	We decide, as precautionary, to close the water intake from the basin in order to protect it from the introduction of contaminant; we continue to monitor the Po river intake and when we start to detect anomalies in the a-specific monitored parameters, we close the Po intake and open again the lagoon intake, since the pollution event has passed.	-

5.4.3 PUC3 Satellite Journalism

Table 6: Breakdown of the PUC3 use case mapping the KRs and the partner responsible for integrating.

Steps	Agent	Action	KR	Tool	Description	Partner for integration
1	Journalist Eva	Configuration of SMAS notification	KR17, KR08	SMAS, Mattermost	Journalist defines keywords, locations, number of posts (thresholds)	CERTH, CS
2	Journalist Eva	Configuration of GeoBI notification	KR05, KR08, KR22	GeoBI, Mattermost	Journalist defines location and pollutants (thresholds)	Draxis, CS
3	Journalist Eva	Configuration of notification	KR19, KR08	Superset Dashboard	Journalist sets up Dashboard for observation of unexpected Air Quality (AQ) changes at any European location	CS, Draxis, CERTH
4	Callisto Platform	Notification	KR08	Mattermost	All journalists involved in the investigation receive a notification via email and by flagging the alert on the Callisto platform. They click on the provided link which opens either Dashboard, SMAS or GeoBI, depending on the notification's origin. All are embedded via the Callisto Platform interface.	CS, Draxis, CERTH
5	Journalist Eva	Dashboard analysis	KR19	Superset Dashboard	Journalist uses the dashboard to identify location, time and cause of the AQ alert.	CS, Draxis, CERTH
6	Social Media expert	Visualization / Analysis	KR17	SMAS	Social Media expert uses the different widgets of the SMAS tool to analyze where, when, and how often AQ-related Social Media posts were published.	CERTH
7	Social Media expert	Visualization / Analysis	KR17	SMAS	By using the tool's localization module, the Social Media expert discovers several tweets from local residents, expressing concern about the air quality and health problems that may be related to the pollution. She follows up on these posts to find a potential protagonist for her story.	CERTH

8	Social Media expert	Export	KR17	SMAS	Further, the Social Media expert downloads the relevant data, e.g. frequency of posts to potentially add to her story.	CERTH, DW
9	AQ expert	Visualization / Analysis	KR05, KR22	GeoBI	AQ expert uses the GeoBI tool to do an in-depth analysis of present, past, and forecast AQ in one of the pre-configured AoI.	Draxis
10	AQ expert	Export	KR05, KR22	GeoBI	AQ expert can export the data and visualizations to enhance the story	Draxis
11	AR expert	AR Analysis	KR07, KR20	Nuro AR App	AR expert uses the AR app to visually investigate the temporal and spatial variation of AQ at different atmospheric heights	Nuro
12	AR expert	Export	KR19, K20	Nuro AR Server	Downloads AR model via Mattermost	CS, Nuro
13	Data expert	Analysis	KR19	Map Displayer	Data expert uses the Map Displayer to do a visual AQ investigation by merging SMAS and GeoBI data.	CS, CERTH, Draxis
14	Data expert	Export	KR19	Map Displayer	Data expert creates storyboard	CS
15	Journalist Eva	Produces story	-	Web CMS	Journalist Eva uses the investigation results provided by the Social Media, Air Quality, AR and Data experts to produce a story.	DW

5.4.4 PUC4 Land Border Monitoring

Table 7: Breakdown of the PUC4 use case mapping the KRs and the partner responsible for integrating.

Steps	Agent	Action	KR	Tool	Description	Partner for integration
1	CALLISTO Platform	Alarm/Notification	KR13, KR17	SMAS Mattermost, Land Border application	Leveraging the SMAS platform, a SATCEN Imagery Analyst starts monitoring a specific area using indicators from social media posts. Essential data, in a CSV file, is dispatched via Mattermost, later visualized on MapDisplayer. An operator subsequently conducts a	CERTH, CS

					Location-Based Analysis (LBA) with the provided information.	
2	Imagery Analyst	Visualisation	KR19	Map Displayer Land Border application	The aforementioned social media indicator was referring to the recently initiated construction works for a new temporary accommodation centre for irregular migrants, close to the EU external border. The main objective is to detect any potential relevant change near the vicinity of the EU external border.	CS
3	Imagery Analyst	Data Processing / Data Analysis	KR06, KR14	Land Border application	Using an artificial intelligence model for detection of relevant changes and through the processing of several datasets of Sentinel 2 satellite images generates an alert for a detected relevant change in the AOI	CERTH, CS
4	Imagery Analyst	Data Request	KR01, KR15	Onda Dias	The IA (Imagery Analyst) requests other distributed index geo-referenced data sources from the CALLISTO platform using ONDA DIAS, in order to support the detection procedure. In case the requested data sources are not available, a new generated dataset could be created, using machine learning or deep learning methodologies, from historical datasets	CS
5	Imagery Analyst	Visualisation/Data Analysis	KR09, KR11, KR18	MSE	Due to the proximity (< 1km) of the detected change from the EU external border, the IA requests UAV imagery and video, actively searching for archive video records with the aim of supporting the decision and classification of the type and relevance of the detected change	CS, ACCELI
6	Imagery Analyst	Visualisation/Data Analysis	KR19	Map Displayer	The data acquired from the UAV confirms the change as a new construction site (initially detected from two pairs of Sentinel 2 satellite images from different periods) located less than 1km from the EU external border under monitoring	CS

7	Imagery Analyst	Visualisation	KR07, KR20	Land Border application	Due to the orography of the terrain and the type of detected change, 3D visualization of the acquired UAV dataset is applied, which will enhance the observation on the type of construction detected, providing a more comprehensive overview.	CERTH, CS, NURO

6 Conclusion

At the end of this very intensive user-driven WP, we are confident that we have successfully achieved the objectives of WP2. We have engaged with stakeholders and established business requirements, delivered a number of use cases and scenarios, developed user requirements and ensured that user requirements and general knowledge were communicated and transferred with and to all project partners.

Engaging with **stakeholders** through an interactive survey format provided valuable insights, including the importance of data validation, data set expansion, personalisation with additional features, and the need for comprehensive manuals and training in the context of CALLISTO. By incorporating this feedback into the project's planning and decision-making processes, the team can continue to refine and enhance the platform to ensure that it meets the diverse needs of stakeholders and maximises its positive impact in different areas.

User requirements were not only continuously updated and fed into the technical work packages, but there was also a more general continuous exchange and transfer of knowledge with the user and development partners. Where necessary, preliminary requirements were added, deleted or updated as an integral part of the ongoing iterative requirements specification process.

The **use case**s proved to be a solid basis for the current project pilots. All partners have been involved in this iterative process and a fruitful exchange has taken place between the user partners, who represent the future users, and the development partners, who know the potential and limitations of the available technologies.

Overall, the user partners are satisfied with the results of WP2. Considering the challenges of setting up the CALLISTO project, and of course WP2, in a remote environment, we feel that the communication between user and development partners has worked well, although we recognise that there is always room for improvement.

With WP2 officially closed with the submission of this deliverable, the work of the WPs will be considered and incorporated in the final months of the project. The partners are confident that CALLISTO is an attractive proposition that will add real value to the end users of the scenarios.

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