COMUNIDAD

D2.1
Requirements for infrastructure

Connecting Europe and Latin America
Transforming Today's Data into
Tomorrow's Solutions

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Project Summary

The COMUNIDAD project, led by Lesprojekt, utilises Copernicus satellite data and the European Global Navigation Satellite System (EGNSS), along with Artificial Intelligence (AI), Big Data technologies and numerical modelling to transfer technologies and know-how to Latin America. The COMUNIDAD project focuses on improving agricultural and forestry management in Chile and Colombia through infrastructure development and a basic platform for creating applications that enhance precision, efficiency, and sustainability. The South American region benefits from this initiative by contributing to its socio-economic growth. Technological advancements are expected to lead significantly to practical applications due to the open-source approach in development. Lesprojekt, the project coordinator, draws on its expertise in technology applications in agriculture and forestry to guide the consortium. The project provides actionable insights by employing advanced techniques to incorporate Copernicus services, EGNSS and other spatial datasets. These insights help stakeholders, including farmers, advisors, policymakers, and land managers, make informed decisions that support sustainable practices. Essential data on crop health, land use, and forestry conservation are provided, enhancing land management practices and boosting agricultural productivity.

In the COMUNIDAD project, experiences and knowledge are transferred through developing and using technological components, infrastructure, and training materials. The COMUNIDAD project aims to transform agricultural and forestry management in South America through technological innovation and international collaboration based on experiences and know-how from European partners and based on international cooperation with partners from Latin America. The integration of cutting-edge technologies with strategic data analysis is set to improve different domains and promote environmental sustainability in the region.

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Copyright Statement

Executive Summary

The deliverable summarises the Infrastructure and Platform design requirements where functionalities are interlinked. Requirements were derived during discussions with developers and pilot partners to reflect the general functionalities of the COMUNIDAD architecture and the planned pilots' activities. An initial discussion about target users and the COMUNIDAD architecture components was described. The Infrastructure should support the planned pilot activities through data supply and processing capabilities.
The pilot activities realised in the pilot countries cover integrating remote sensing optical and radar data to estimate snow/no-snow climatology in the Aysén region in Chile and different aspects of coffee production and land management in the Caldas region in Colombia.

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Introduction

The deliverable describes the requirements associated with two primary components of the COMUNIDAD architecture – the Infrastructure and the Platform. Requirements for both elements are interlinked together. Task 2.1 has collected requirements from the general architecture perspective and the pilots' activities points of view. Several discussions were organised to collect general descriptions of pilots' activities and planned use cases to derive requirements for the Infrastructure linked to the use cases. The general requirement structure includes an identification, a description, and several categories for sorting requirements. The collected list of requirements is intended to be regularly updated during the design and development process of the COMUNIDAD architecture in WP2 and WP5. An initial discussion about potential target users was conducted in the context of the overall architecture components.

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1. Method of requirements collection

In software engineering, it is mandatory to describe a system which will be developed, among other things, from the point of usability and its impact. The most common method of defining a system's usability is through use cases. A use case scenario includes how a user will interact with the system and the expected behaviour. Each use case was linked with several requirements separated into a typical collection. Use cases and requirements were defined based on the planned functionality described in the project proposal and based on the discussion with pilot partners. We conducted several meetings with the pilot partners and formed use cases describing their needs. In a general pilot description document, pilot partners described high-level planned activities in pilots and individual use cases. Pilot requirements were derived from these general pilot descriptions, and pilot partners were consulted again if they reflected their need for activities in use cases.

2. COMUNIDAD infrastructure and platform general purpose and target users

The initially proposed COMUNIDAD architecture consists of two main components - Infrastructure and Platform. The Infrastructure is represented by the Remote Sensing Data Processing Platform (RSDPS), responsible for downloading satellite imagery, processing storage, and publishing it using standardised services. The primary data storage is represented by a relation database management system with a spatial extension, allowing the storage of vector and raster spatial data necessary for analysis and visualisations. Most of the infrastructure components are expected to have no graphical user interface, and the important part will be the utilisation of standardised interfaces and commonly used formats in the GIS domain. The Infrastructure should integrate existing data sources or provide links to existing data hubs (e.g., open data portals, national geoportals).

The Platform is represented by different application layer components for data processing and analyses and by the publication layer components for visualisation and presentation (e.g. some content management systems). The Platform is planned as the environment to deploy user applications, providing expected functionalities or addressing defined use cases' needs.

The structure of target users is very complex, including the general public, experts in

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different domains, application developers, students, decision-makers, etc. The access of various types of users to the COMUNIDAD architecture can be summarised in Table 1. Table 1 presents the expected utilisation of different parts of the architecture by various kinds of users.

Infrastructure can be divided into several components like the spatial database or the Remote Sensing Data Processing Platform, which can be described as the "Infrastructure component". Some components will provide an API to get data or methods, which is defined as an "Infrastructure API." The Platform will provide different services like analytical, catalogue, and publication, which can be defined as "Platform services." Different types of applications will be deployed on the Platform to solve different use cases and tasks, these can be defined as "Platform application". The Platform will contain web pages, blogs, tutorials, visualisations, maps, etc., described as "Platform content."

The types of target users are characterised by the expected access to the COMUNIDAD architecture and tasks where the Architecture can support users. We have identified the following list of types of target users:

- **GIS expert** – the GIS expert can be characterised as an advanced user who can prepare spatial datasets to be integrated into the Infrastructure, work with services provided by the Infrastructure, use services provided by the Platform, and develop and use applications on the Platform. The COMUNIDAD Architecture should support the need to publish and use datasets and to provide further analysis and presentation of results.
- **Domain expert** – the domain expert is an expert from any of the expected domains (e.g. hydrology, soil science, urban planning, environment, agriculture, forestry, land management, climatology) where the Architecture can be utilised from the perspective of dataset providing and Platform applications utilisation.
- **Developer** – the developer is an advanced user who could contribute to developing individual components and final applications for different types of users.
- **Decision maker** – a decision maker is a type of high-level user who should receive analysis results, maps and explanatory visualisations to support the decision-making process based on qualified information.
- **Farmer/Forester** – farmers, coffee growers and foresters are basic-level users who will work with applications and their outputs regularly, which should fulfil

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defined tasks on a defined level of accessibility and usability of applications.

- **Student** - students are potential future users of different types who have already used the Architecture during their education. Incorporating Architecture into the learning process can reduce the learning curve in the future.
- **General public** – the general public is expected to profit from the final products of applications and published content with maps and analysis results.

Table 1 - Overview of user access to COMUNIDAD architecture components

	Infrastructure component	Infrastructure API	Platform services	Platform application	Platform content
GIS expert	X	X	X	X	X
Domains experts		X	X	X	X
Developer	X	X	X	X	
Decision maker				X	X
Farmer / Forester				X	X
Student		X	X	X	X
General public					X

3. Use cases for requirements definition

The COMUNIDAD project proposal described initial ideas for Infrastructure and the Platform and pilots in Colombia and Chile. The initial definitions of the Infrastructure and the Platform were used to define the use cases for requirements. The original pilots' ideas were extended during task T2.1 in the initial pilots' descriptions and proposals for individual use cases. These descriptions were used as starting descriptions for pilot requirement collections in tasks T4.1 and T4.4.

The original pilot descriptions were extended during task T2.1 and contain more specific individual use cases.

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3.1 Colombian pilot

Small-scale farmers predominantly carry out coffee farming in Colombia, each owning an average of 1.6 hectares of land. The Coffea Arabica species, particularly low-growing varieties, is the primary crop, cultivated at high densities of up to 10,000 plants per hectare. Coffee thrives at 1,100 to 2,000 meters on rugged terrain with steep slopes.

Challenges arise from seasonal rains during harvest, poor infrastructure, and limited farm internet connectivity. Volatile coffee prices, consumer preferences, and limited adoption of technology among small farmers threaten economic sustainability. These factors, combined with climate change and extreme weather events, necessitate localised studies and effective risk management strategies.

Developing disaster risk models is difficult due to Colombia's insufficient and unreliable climate data. Remote sensing technology offers potential solutions by providing spatially extensive and frequent rainfall estimates, aiding adaptation and disaster management strategies. Addressing these challenges is critical for sustainability and competitiveness in the Colombian coffee sector.

The pilot will be divided into individual use cases focusing on particular aspects.

A. Mapping site-level in Coffee crops using microtopography with RTK GNSS

This use case will focus on improving agricultural efficiency in Colombia's coffee-growing regions by utilising RTK GNSS to produce precise topographic maps.

B. Risk Management, Landslides and Fires Risk

This use case will aim to integrate Copernicus data with local insights to address landslide and fire risks in Colombia.

C. Hydrological Balance for Evaluation of the Impacts on Coffee Production

This use case will focus on assessing the hydrological balance and its impact on coffee production by integrating satellite data, meteorological information, and hydrological models.

D. Environmental Footprint of Coffee Production

This use case will focus on assessing and minimising the environmental footprint of coffee production by integrating satellite data and advanced data analytics.

E. Vegetation and Deforestation Index in Coffee Crops

This use case will focus on monitoring the health of coffee crops and identifying deforestation activities in coffee-growing regions by developing a Vegetation and Deforestation Index.

F. AI-Driven Detection and Monitoring in Colombian Coffee Plantations

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This section outlines the integration of AI to enhance coffee plantation monitoring, focusing on crop health and identifying potential areas for sustainable development.

3.2 Chilean pilot

The Chilean pilot will integrate remote sensing optical and radar data to estimate snow/no-snow climatology. Seasonal snow composites will be created using Copernicus data at various spatial resolutions, with snow cover identified through the Normalized Difference Snow Index (NDSI). Cloud-cover gaps will be resolved using stochastic algorithms for accurate estimates. A System Dynamics approach will connect snow cover to economic sectors like agriculture and forestry, identifying feedback loops and evaluating policies through Dynamic Performance Management.
The pilot will focus on forest management, particularly native forest restoration and addressing stress on natural areas. Agroclimatic data will support improved crop management, and insights into snow cover quality will influence water supply, productive activities, and new small-scale hydrogenation projects. Collaboration with local institutions like FIA and CONAF will aid technology transfer and deployment opportunities.
The pilot will be divided into several use cases to focus on particular tasks.

A. Campos de Hielo Norte

This use case will implement a comprehensive system for monitoring glacier calving in the Campo de Hielo Norte region of Aysén, Chile. The system will aim to provide both real-time and historical data on glacier dynamics. The system will employ a snow cover algorithm to enhance the monitoring capabilities.

B. Land Use Planning for Agricultural and Forestry Practices in Aysén Region

Using satellite technology, the use case will focus on implementing a land-use planning system and optimising agricultural and forestry practices in the Aysén region.

C. Forest Fire Prevention and Management in the Aysen region, Chile

This use case will implement a comprehensive system for preventing and managing forest fires in the Aysén Region in the Chilean Patagonia, emphasising identifying high-risk areas to prevent the spread of large-scale fires.

4. Requirement structure

Each use case (described in Annex A) has the following structure: the state of the user followed by a description of what the user wants to do with the system (i.e., expected

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behaviour). However, a use case is usually conducted by several actions performed by the system. Thus, each action must be described separately into a requirement. The structure of the description can be generalised when the requirement is described, e.g., a process, or it can be very detailed in describing a specific type of dataset to be processed.

Each requirement has several attributes:

- **ID** – unique identifier of the requirement
- **Requirement description** - The description of the requirement. It is a statement about what the system has to fulfil. It can also be provided as a user story to simplify its implementation.
- **Rationale** - The rationale is the reason behind the requirement. It explains the essential requirement and how it contributes to the system's purpose.
- **Type** - It specifies the type of the requirement. The requirement exists in two forms: functional and non-functional. These requirements are based on the definition by Robertson & Robertson, 2006[1].
    - **Functional (F)** - Requirements are the product's fundamental or essential subject matter. They describe what the product has to do or its processing actions. They include a description of the action provided to the user or other participants from a view of the system.
    - **Non-Functional (NF)** - Requirements are the functions' properties. These specifications are as important as the functional specifications for the product's success. They include a description of the system's related needs, which are not actions but may benefit users too, e.g., maximal response latency for user's requests, open-source platform.
- **Priority** – The priority defines the importance of a requirement. The priority depends highly on the specific domain of the application. The priority of requirements is based on the definition by Bradner, 1997[2]. Priority is divided into:
    - **MUST** - Priority means that the definition is an absolute requirement of the requirement.
    - **SHOULD** - Priority means valid reasons exist to ignore a particular item in

[1] Suzanne Robertson and James Robertson. 2006. Mastering the Requirements Process (2nd Edition). Addison-Wesley Professional.

[2] Bradner, Scott. (1997). Key words for use in RFCs to Indicate Requirement Levels.

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particular circumstances. Still, the full implications must be understood and carefully weighed before choosing a different course.
    - **COULD** - Priority means that an item is truly optional.
- **Category** - The category aggregates the requirements into coherent sets. The following set of categories can be used:
    - **General** – a general requirement of the whole COMUNIDAD architecture.
    - **Infrastructure** – a requirement directly related to the infrastructure common for different functionalities.
    - **Platform** - requirement directly on the COMUNIDAD Platform common for different functionalities.
    - **Chilean pilot** – requirement is focused on functionalities necessary for the pilot activities in Chile.
    - **Colombian pilot** - requirement is focused on functionalities needed for the pilot activities in Colombia.
- **Horizontal category** - The horizontal category aggregates the requirements into coherent sets. The following set of categories can be used:
    - **Interoperability** (INTER): the ability to make individual parts of the system and the currently available systems work together
    - **Usability** (USE): ease of use and learnability of the system
    - **Security** (SEC): something that gives or assures safety and prevents abuse
    - **Legal** (LEG): using data and knowledge and COMUNIDAD components according to rules and regulations
    - **Openness** (OPEN): the ability and willingness to provide data openly, using well-defined catalogues and open access

5. Requirements reflection process

Requirements collected during task 2.1 by technical partners and defined by pilot partners are essential requirements for designing and implementing the Infrastructure and the initial COMUNIDAD Platform. The list of requirements is still being determined; it will be reviewed during the design task 2.2 and development task 2.3, and the status of individual requirements will be evaluated. The pilots' requirements are extended in detail during the T4.1 resp. T4.4 from the perspective of activities in pilots' individual use cases. The feasibility category will extend the requirement attributes. The requirement's feasibility will reflect the COMUNIDAD architecture's design and development process. It

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will be categorised as “fulfilled, feasible, non-feasible, or refused.”

Conclusion

This deliverable presents a comprehensive set of requirements collected during Task 2.1, which provides a detailed description of the expected functionality of the COMUNIDAD architecture. It covers a high-level overview and thoroughly examines the various pilot projects involved. From a general standpoint, the deliverable outlines the core functionalities, performance benchmarks, and key architectural components essential for successfully implementing the COMUNIDAD platform. From the pilots’ activities perspective, the document details specific requirements tailored to each pilot's unique objectives and activities. It includes the functionalities needed, integration points with the COMUNIDAD architecture, and the expected outcomes for each pilot project. This ensures that the architecture supports the practical, real-world applications and challenges the pilots face, providing a robust framework that fulfils the implementation requirements.

This deliverable is a critical blueprint for developing and implementing the COMUNIDAD architecture, ensuring it effectively meets broad and specific requirements.

Each requirement has several attributes that describe the content and categories. The list of requirements is provided as an appendix to the document, and the set will be maintained as a live online document in the COMUNIDAD shared folder.

Annex A

The following table contains all requirements collected during task T2.1. It includes requirements defined by technical and pilot partners with the main focus on the general functionality of the Infrastructure and Platform and specific functions by pilots.

Requirements are sorted into categories: infrastructure, platform, and individual pilots. Requirements provided by both pilots were added directly to infrastructure or platform categories.

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ID	Requirement Description	Rationale	Type	Priority	Category	Horizontal categories
Req_01	The infrastructure must run on the open-source operating system.	A user wants to use a system that is utilising open-source projects, e.g., an operating system.	non-functional (NF)	must	infrastructure	Openness (OPEN)
Req_02	The infrastructure must allow the deployment of servlet-based web applications.	A user wants to deploy a server-based web application to the infrastructure.	functional (F)	must	infrastructure	Interoperability (INTER)
Req_03	The infrastructure must provide services for user and role management.	An admin user wants to be able to manage other users and their roles within the infrastructure.	functional (F)	must	infrastructure	Usability (USE)
Req_04	The infrastructure must provide access to the components via a reverse proxy.	A user must not have direct access to the application's components but must access them via a reverse proxy.	functional (F)	must	infrastructure	Security (SEC)
Req_05	The infrastructure must be able to store spatial data in a robust and scalable open-source database system.	The infrastructure will be designed as a package to be installed in separate instances in pilot countries.	functional (F)	must	infrastructure	Security (SEC)
Req_06	The infrastructure must provide spatial data in commonly used standards.	To reach as high a level of interoperability as possible and be accessed by different typical applications.	functional (F)	must	infrastructure	Openness (OPEN)
Req_07	The infrastructure must provide data storage that is publicly available for external users.	Services provided by the Infrastructure should be available for other users or applications outside the COMUNIDAD components.	functional (F)	must	infrastructure	Openness (OPEN)
Req_08	The infrastructure must process vector and raster data, transforming and projecting spatial data.	Infrastructure will integrate local, regional or national data sets of different types from pilot countries where different national CRSs are used.	functional (F)	must	infrastructure	Usability (USE)
Req_09	The infrastructure must automatically download satellite images periodically.	The data archive on the Infrastructure should be kept up-to-date.	functional (F)	must	infrastructure	Usability (USE)
Req_10	The infrastructure must download up to date and historical satellite images on demand.	The archive should contain historical data where needed for calculations.	functional (F)	must	infrastructure	Usability (USE)
Req_11	The infrastructure must store downloaded images into the data storage.	Downloaded images should be stored directly on the Infrastructure so they can be used for analysis.	functional (F)	must	infrastructure	Usability (USE)
Req_12	The infrastructure must provide satellite images in various coordinate reference systems (CRS).	It is expected to combine data from the archive with local datasets from pilot countries; thus, images and results should be available in national CRS.	functional (F)	must	infrastructure	Usability (USE)
Req_13	Infrastructure will download selected Sentinel-1 data for the defined area of interest.	The Sentinel-1 scene is necessary for processing and generating more products.	functional (F)	should	infrastructure	Usability (USE)
Req_14	Sentinel 2 scenes are downloaded every day when available for defined areas.	Sentinel 2 scene is necessary for further processing and generating further products.	functional (F)	must	infrastructure	Usability (USE)
Req_15	The infrastructure must make atmospheric corrections of Sentinel-2 images and provide the result to other components.	Satellite images will be processed directly on the Infrastructure, and the corrections should be provided directly.	functional (F)	must	infrastructure	Usability (USE)
Req_16	The infrastructure must allow to set attributes, i.g., area of interest, period, season, for downloading satellite images.	Different attributes should parametrise data download.	functional (F)	must	infrastructure	Usability (USE)
Req_17	The infrastructure must provide a search of satellite images according to the following filter attributes - ID of the scene, time span, maximum cloud coverage.	The amount of data in the archive will limit the direct searching of the particular data. Thus, a search and filtering mechanism will be necessary.	functional (F)	must	infrastructure	Usability (USE)
Req_18	The infrastructure must provide the satellite images along with its all bands, atmospheric corrections, indexes, and RGB scenes.	The images will be used in different analysis types and produce deviates. Thus, the entire content of the data will be used.	functional (F)	must	infrastructure	Usability (USE)
Req_19	The infrastructure must provide overview statistics of processing the satellite images, including the number of images covering areas of interest on selected days and the average percentage of cloud coverage.	The overall statistics of images are necessary for any decision on the quality of input data for analysis. When only a few images are available for any long-term analysis, the reliability of the result is lower.	functional (F)	must	infrastructure	Usability (USE)
Req_20	The infrastructure must provide a set of tools for unsupervised and supervised classifications of satellite images.	Satellite images will be processed directly on the Infrastructure, and the classifications should be provided directly.	functional (F)	must	infrastructure	Usability (USE)
Req_21	The infrastructure must automatically download defined datasets from Copernicus Climatic Service.	Climatic data will utilised for further processing in pilot application.	functional (F)	must	infrastructure	Usability (USE)
Req_22	Infrastructure will download Sentinel data for the defined area of interest.	The sentinel-2 scene is necessary for processing and generating more products.	functional (F)	must	Chile pilot	Interoperability (INTER)
Req_23	Infrastructure will produce the Normalised Difference Snow Index (NDSI) in the defined areas of interest.	NDSI is necessary for further analysis of snow coverage in the pilot region.	functional (F)	must	Chile pilot	Interoperability (INTER)
Req_24	Infrastructure should provide tools for the calculation of missing data in NDSI due to cloud cover.	Cloud coverage is blocking the snow coverage analysis; a method to interpolate missing data will be used.	functional (F)	should	Chile pilot	Interoperability (INTER)
Req_25	Infrastructure will integrate datasets representing economic activities in pilot areas.	Further data integration and processing will provide risk management analysis for the defined pilot region.	functional (F)	should	Chile pilot	Openness (OPEN)

Req_26	Infrastructure will integrate climatic data used for calculations of agroclimatic factors of the defined area of interest.	Different analyses will use agroclimatic factors and data provided by Copernicus Climatic services will be needed.	functional (F)	should	Chile pilot	Openness (OPEN)
Req_27	Infrastructure should provide datasets used in agricultural planning, resource management, and risk mitigation.	Local and regional socioeconomic data will be used in different cases to calculate further analysis.	functional (F)	should	Chile pilot	Openness (OPEN)
Req_28	Infrastructure should integrate local weather station datasets provided by Dirección Meteorológica de Chile.	Local meteorological services will provide different datasets to be used in analyses.	functional (F)	should	Chile pilot	Openness (OPEN)
Req_29	Infrastructure should integrate datasets of historical glacier movements in the selected area.	Historical datasets are important for any assessments of changes.	functional (F)	should	Chile pilot	Openness (OPEN)
Req_30	Infrastructure should integrate datasets for land cover and land use in the defined area of interest.	Local datasets about LULC will be used in further analyses.	functional (F)	should	Chile pilot	Openness (OPEN)
Req_31	Infrastructure will integrate and publish local, regional or national datasets for defined areas of interests	Data sets from different sources will be used for analysis and visualisation mashups.	functional (F)	must	Colombia pilot	Openness (OPEN)
Req_32	Infrastructure must integrate climate data from global providers, e.g. Copernicus Climate Change Services, for the defined area of interest.	Climatic data will be used for different analyses in pilot regions.	functional (F)	must	Colombia pilot	Interoperability (INTER)
Req_33	Infrastructure must integrate weather forecasts from different providers for the defined area of interest.	To conduct complex weather analysis, the infrastructure must be able to integrate various weather forecast providers.	functional (F)	must	Colombia pilot	Interoperability (INTER)
Req_34	Infrastructure must contain an application for receiving tracking data from the coffee harvest - packages or labourers.	A farmer wants to be able to monitor the coffee harvesting process and track packages or labourers on a field.	functional (F)	must	Colombia pilot	Interoperability (INTER)
Req_35	Infrastructure must integrate local hydrological and soil maps to calculate hydrological balance.	Hydrological balance analysis will be calculated for selected plots and pilot localities.	functional (F)	must	Colombia pilot	Interoperability (INTER)
Req_36	Infrastructure must calculate different types of indexes for the defined area of interest.	Different types of analyses will incorporate indexes calculated from satellite data.	functional (F)	must	Colombia pilot	Usability (USE)
Req_37	API interface for surface and subsurface water content	A function for a layer classifying the plant moisture comfort will be provided.	functional (F)	should	Colombia pilot	Openness (OPEN)
Req_38	Local precipitation forecast for pilot localities will be integrated from different meteorological services.	Input data for plant moisture comfort calculations	functional (F)	should	Colombia pilot	Usability (USE)
Req_39	Infrastructure should store datasets about the year of coffee plot renewal. And update the dataset yearly.	Information on the age of different parts of the coffee plot is important for planning renewal works.	functional (F)	should	Colombia pilot	Usability (USE)
Req_40	Infrastructure should provide a data snapshot for offline usage during field works.	Infrastructure should provide a data snapshot for offline usage during field works.	functional (F)	should	Colombia pilot	Usability (USE)
Req_41	Infrastructure should be able to integrate measured data from RTK GNSS and provide maps of plots based on measured data.	Local GNSS measurements will be used to map coffee plots in the pilot region.	functional (F)	should	Colombia pilot	Usability (USE)
Req_42	Platform should integrate tools for geospatial analyses.	Defined analyses will be calculated on the Infrastructure and propagated to the Platform.	functional (F)	should	Colombia pilot	Usability (USE)
Req_43	Infrastructure should integrate historical datasets to validate analysis results.	A time-series of results will be built based on available historical datasets.	functional (F)	should	Colombia pilot	Usability (USE)
Req_44	Platform should integrate an alerting mechanism for announcing the results of analysis to defined channels.	Users want to be warned if a violation happens for defined conditions in the area of interest.	functional (F)	should	Colombia pilot	Openness (OPEN)
Req_45	The system could provide a responsive layout of its web interface optimized for touch-screen corresponding to the device in use.	A logged user wants to be able to use a mobile device without compromising the smaller screen size.	functional (F)	could	platform	Usability (USE)
Req_46	Main map window for the HUB supports CRS defined by the national grid of pilot countries - Chile, Colombia	The map window should be able to visualise maps in the national grids of Chile or Colombia without further transformations.	functional (F)	must	platform	Usability (USE)
Req_47	The system must allow users to create an account requiring them to insert the following information - email as a login, full name, and password.	A non-existing user must be able to create an account.	functional (F)	must	platform	Security (SEC)
Req_48	The system must generate a verification link to verify the correctness of the inserted email address while registration process.	A non-existing user must be informed by email about creating a new account to prevent abuse of the user's email address.	functional (F)	must	platform	Security (SEC)
Req_49	The system must verify the newly created account and redirect the user to the login page.	A non-existing user must be redirected to the system's login page after opening the received verification link in the email.	functional (F)	must	platform	Security (SEC)
Req_50	The system must allow users to log in to the system via its credentials, i.g., email address and password.	An existing user must be able to log in with credentials to the system.	functional (F)	must	platform	Security (SEC)
Req_51	The system must redirect the logged user to the system’s homepage after the successful authorisation.	The defined homepage is the first page to appear after successfully authorising an existing user.	functional (F)	must	platform	Security (SEC)
Req_52	The system must inform a user by an alert if its authorisation credentials are wrong.	An existing user should be notified if something goes wrong in the login process.	functional (F)	must	platform	Security (SEC)
Req_53	The system must allow OAuth authorisation (IETF 6749) for all interoperating components.	logged user, I require seamless interaction/switching among other interoperating components.	functional (F)	must	platform	Security (SEC)

Req_54	The system must allow OAuth (IETF 6749) authorisation in the QGIS Desktop	As a logged user, I require the authentisation with the QGIS Desktop application.	functional (F)	must	platform	Security (SEC)
Req_55	The system must reject access to other services if the required permission is not granted.	As a logged user, I must be rejected from accessing services if an required permission is not granted.	functional (F)	must	platform	Security (SEC)
Req_56	The system must list all existing users and allow their modification.	As an admin user, I must be able to modify user's information.	functional (F)	must	platform	Usability (USE)
Req_57	The system must show all connected services to which access can be granted to other users.	As an admin user, I must be able to modify permissions to access interoperating components for all users.	functional (F)	must	platform	Interoperability (INTER)
Req_58	The system must be able to change its language depending on the following options - English, Czech, Spanish.	As a logged user, I must be able to change the language of the graphical user interface (GUI).	functional (F)	must	platform	Usability (USE)
Req_59	The system must save the user's modified setting to the user's profile.	A logged user must be able to use the changed settings for the following login sessions.	functional (F)	must	platform	Usability (USE)
Req_60	The system must provide a web view displaying a predefined base map layer (e.g., OpenStreetMap).	A logged user must be able to display a view containing a base map (e.g., OpenStreetMap).	functional (F)	must	platform	Usability (USE)
Req_61	The system must provide an option to choose and switch a base map layer, e.g., to an orthophoto map.	A logged user must be able to switch the map to another base map (e.g., an orthophoto map).	functional (F)	must	platform	Usability (USE)
Req_62	The system must provide zoom in and out in the base map.	A logged user must be able to perform the actions by zooming in and out on the map.	functional (F)	must	platform	Usability (USE)
Req_63	The system must import a new data source from an online web service via a URL link in the following formats - Web Map Service (WMS), Web Map Tile Service (WMTS), Web Feature Service (WFS), Keyhole Markup Language (KML), Grand Pacific Exchange (GPX), Geo JavaScript Object Notation (GeoJSON), ArcGIS Map, GeoSPARQL.	A logged user must be able to add data from various online sources.	functional (F)	must	platform	Usability (USE)
Req_64	The system must import a new data source from the user's file system as a file or an archive in the following formats - KML, GPX, GeoJSON, ShapeFile, Raster Image, and Raster Time Series.	A logged user must be able to import data from the file system in various file formats.	functional (F)	must	platform	Usability (USE)
Req_65	The system must list and import all available (i.e., publicly avaliable or with a granted permission) layers from persistent storage (i.e., data catalogue).	A logged user must be able to see all layers from the system's persistent storage to import.	functional (F)	must	platform	Usability (USE)
Req_66	The system must display a progress bar/wheel to inform its users when a new layer is imported.	A logged user must be visually informed about the progress of importing a new layer.	functional (F)	must	platform	Usability (USE)
Req_67	The system must display the newly imported layer above the base map and list it in the layer manager of the view map.	A logged user must fully see the imported layer above all existing layers in the view map.	functional (F)	must	platform	Usability (USE)
Req_68	The system must provide ordering of all layers if they overlay.	A logged user must be able to adjust the ordering of each layer within the stack of layers.	functional (F)	must	platform	Usability (USE)
Req_69	The system must allow adjusting general visual parameters of each layer, e.g., opacity.	A logged user must be able to adjust each layer's parameters (e.g., opacity) to change the visual appearance within the stack of layers.	functional (F)	must	platform	Usability (USE)
Req_70	The system must persist one or multiple layers imported by the user into the data system's catalogue along with the layer's metadata, including access rights (e.g., visibility of the data source to other users).	A logged user must be able to save the current state of the layers as a map composition or separately as each data source into the persistent storage (e.g., data catalogue) along with its metadata.	functional (F)	must	platform	Usability (USE)
Req_71	The system must allow export of the current map composition with the user's defined parameters as a PNG image.	A logged user must be able to download the current state of the map composition as a PNG image.	functional (F)	must	platform	Usability (USE)
Req_72	The system must provide parameters to adjust the final image to export.	A logged user must be able to define the exported PNG image's final visual appearance (e.g., dimensions, DPI).	functional (F)	must	platform	Usability (USE)
Req_73	The system must provide a tool that measures the distance between two points selected by the user.	A logged user must be able to measure the distance between two points on the map layers.	functional (F)	must	platform	Usability (USE)
Req_74	The system must provide a tool that measures the area of a polygon created by the user.	A logged user must be able to measure the area of a polygon upon the map layers.	functional (F)	must	platform	Usability (USE)
Req_75	The system must provide an HTML editor and related modules to be able to compose an HTML page by a user.	As a logged user, I must be able to create a webpage that includes HTML elements and a map view of the map composition.	functional (F)	must	platform	Usability (USE)
Req_76	The system must host and publish a web page created by the user on the internet.	A logged user must be able to publish the HTML page as a web application or a static web page for a public audience.	functional (F)	must	platform	Usability (USE)
Req_77	The system must allow users to login into the system via its credentials using a plugin in QGIS Desktop and initiate an authentication process by OAuth (IETF 6749).	An existing user must be able to log in to the platform using the QGIS Desktop application.	functional (F)	must	platform	Interoperability (INTER)
Req_78	The system must inform a user by notification through the QGIS plugin if the user's authorisation credentials are wrong.	An existing user must be informed if something gets wrong during the authorisation process.	functional (F)	must	platform	Interoperability (INTER)

Req_79	The QGIS plugin must display a list of map compositions and individual layers from the data catalogue stored by the user and the ones publicly shared by others.	A logged user in the QGIS Desktop must be able to display all map compositions and individual layers from the data catalogue.	functional (F)	must	platform	Interoperability (INTER)
Req_80	The QGIS plugin must load and display the map composition or the layer selected by the user in the QGIS Desktop application.	A logged user in the QGIS Desktop must be able to import and display the selected map composition or layer in the QGIS main view content.	functional (F)	must	platform	Usability (USE)
Req_81	The QGIS plugin must persist one or more layers or a map composition created by the user into the data catalogue along with the layer's metadata, including access rights (e.g., visibility of the data source to other users).	A logged user in the QGIS Desktop must be able to persist one or more layers created in the QGIS into the platform's data catalogue.	functional (F)	must	platform	Interoperability (INTER)
Req_82	The system must allow users to create new empty layers along with its specific metadata, including access rights (e.g., visibility of the data source to other users), as well as deleting the created layers.	A logged user must be able to create a new empty layer and define its metadata, which will be available for drawing.	functional (F)	must	platform	Usability (USE)
Req_83	The system must allow users to use a set of tools to draw a point, a polygon, a line, or a circle as a feature onto the selected layer.	A logged user must be able to use drawing tools to create new features on the selected layer in the map view.	functional (F)	must	platform	Usability (USE)
Req_84	The system must show all drawn features in the map view positioned in the correct coordinates and on the scale.	A logged user must see all drawn features in the map view in correct coordination and align with the base map.	functional (F)	must	platform	Usability (USE)
Req_85	The system must show a list of all drawn features in the layer with their attributes and enable its modification.	A logged user must see all drawn features as a list with an option of modifying them.	functional (F)	must	platform	Usability (USE)
Req_86	The system must persist created layers within drawn features into the data catalogue along with the layer's metadata.	A logged user must be able to persist the layer with the drawn features into the platform's data catalogue.	functional (F)	must	platform	Usability (USE)
Req_87	The system must provide a list of external analyses that can be performed for a specific area.	A logged user must be able to use external analysis to provide additional information about the area.	functional (F)	must	platform	Interoperability (INTER)
Req_88	The system must perform the selected analysis for the feature or an area selected by the user and visualise the results in the map view.	A logged user must be able to perform the selected external analysis for a specific area or a location defined by a feature.	functional (F)	must	platform	Usability (USE)
Req_89	The system should store metadata of the newly imported layer in the browser's local storage. As well as the source file if the data source is from the user's file system.	A logged user wants to keep the imported layers within the browser to prevent loss if the browser's tab crashes.	functional (F)	should	platform	Usability (USE)
Req_90	The system should keep the state of work when the user refreshes the web application.	A logged user wants to keep the current working settings of all layers within the browser in case of a browser's tab refresh or a crash.	functional (F)	should	platform	Usability (USE)
Req_91	The system should provide an integration to a running SensLog instance as a data source via its Web Public Application Interface (Web API).	A logged user wants to be able to add a SensLog running instance as a new data source.	functional (F)	should	platform	Interoperability (INTER)
Req_92	The system should authorise the user's access to the SensLog by OAuth (IETF 6749).	A logged user wants authorisation to access the SensLog instance without additional authentication.	functional (F)	should	platform	Security (SEC)
Req_93	The system should load all authorised units alone with their metadata from the SensLog instance as a new layer in the layer manager.	A logged user wants to see all permitted units from the SensLog as a new layer in the map view.	functional (F)	should	platform	Usability (USE)
Req_94	The system should reload all units every time the web-page is refreshed by the user.	A logged user wants to keep the monitoring units up to date.	functional (F)	should	platform	Usability (USE)
Req_95	The system should display all units as a layer in the map view, where each unit is a clickable element with a label, as well as an interactive list displaying all units, including detailed descriptions.	A logged user wants to be able to interact with each monitoring unit by pressing the unit's icon in the map view or by an expandable list of the unit's items.	functional (F)	should	platform	Usability (USE)
Req_96	The system should provide detailed information on the selected unit, i.e., a list of connected sensors, the status, and keep all selected units highlighted.	A logged user wants to see all information about each unit and have visual information on all selected monitoring units.	functional (F)	should	platform	Usability (USE)
Req_97	The system should show a graph with raw measured values of the selected sensor in a predefined time interval (e.g., 1 week backwards from its last observation).	A logged user wants to see the raw measured values of sensors as a graph.	functional (F)	should	platform	Usability (USE)
Req_98	The system should filter sensors of the same kind among all units.	A logged user wants to display all sensors of the same kind.	functional (F)	should	platform	Usability (USE)
Req_99	The system should display values of multiple sensors of the same kind in the same graph at the same selected time interval (if the data is available).	A logged user wants to visualise values from multiple sensors in the same graph.	functional (F)	should	platform	Usability (USE)
Req_100	The system should adjust the time interval according to predefined intervals, e.g., one day, one month, or to a custom interval from-to a specific date-time for all displaying sensors.	A logged user wants to adjust the interval of displaying values in the graph.	functional (F)	should	platform	Usability (USE)