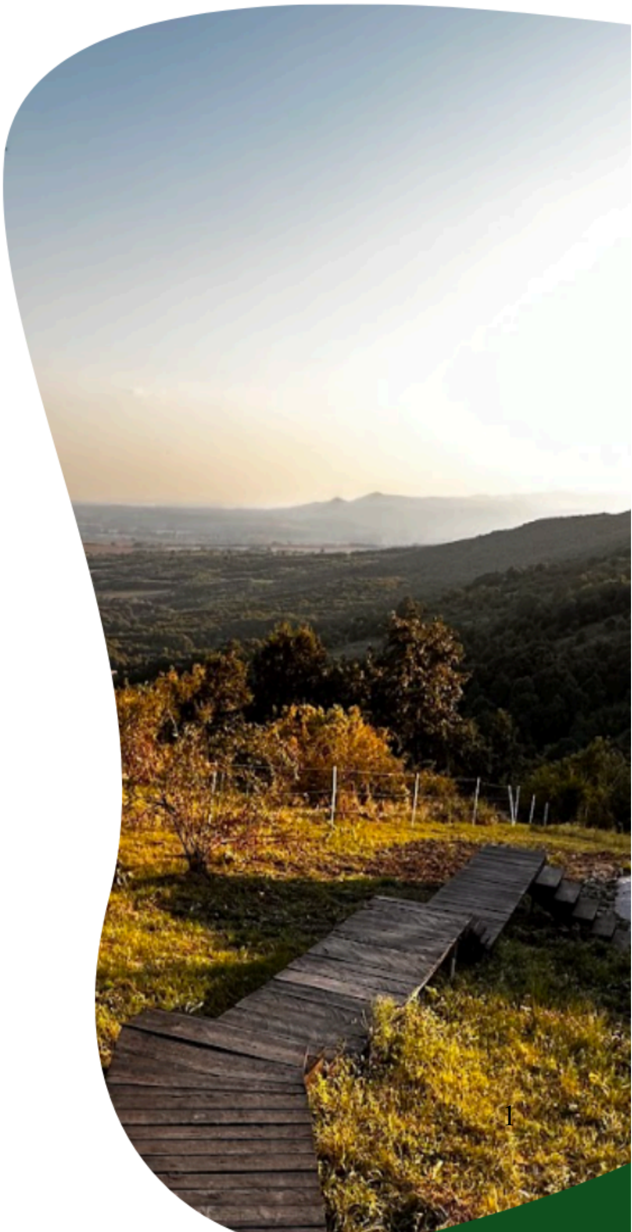
ENHANCE CALL

Financial Support for Third Parties

Final Report Part A (Public)

J-VERSE: JackDaw Validation in Real Spatial Environments



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Executive Summary

J-VERSE was a six-month ENHANCE project implemented by Catalink Limited to validate the usability, reliability and practical added value of the PoliRuralPlus JackDaw GeoAI chatbot in real territorial contexts. The project examined JackDaw from two complementary perspectives. First, it assessed how non-specialist and professional users interacted with its map-based conversational interface. Second, it compared environmental information returned by JackDaw with external meteorological data and locally collected IoT measurements.

Three validation use cases were implemented. The first focused on stakeholder usability and interaction across land-use, environmental and rural-urban questions. The second compared JackDaw meteorological outputs with Open-Meteo data. The third used temperature and humidity measurements from two adapted PATROLIoT devices to examine how broader-area JackDaw and Open-Meteo information related to local microclimatic conditions in Nicosia and Limassol.

The stakeholder validation involved 35 participants across seven stakeholder categories. Together, they completed 132 feedback forms, including 32 final questionnaires. Female participation reached 48.6%, and participants from four Cypriot districts were represented. Most users had only basic or no previous experience with geospatial tools, making the evaluation particularly relevant to the project's objective of improving access to territorial information for non-specialists. The stakeholder validation approach and results are documented in D2.1.

The usability results were mixed but clear. JackDaw was considered easy to use and fast, receiving mean scores of 4.16/5 for ease of use and 3.53/5 for answer clarity. However, usefulness, perceived accuracy, willingness to recommend and intention to use the tool in real life remained below the neutral midpoint. On the final-questionnaire item used to assess helpfulness, 56% of respondents provided a positive rating and 32% were neutral. The project therefore reports the helpfulness target as partially achieved rather than fully achieved.

For the technical validation, J-VERSE developed a FastAPI backend and a project-specific Knowledge Graph hosted in GraphDB. JackDaw outputs obtained through controlled prompts, Open-Meteo observations and PATROLIoT measurements were transformed into a common RDF/OWL representation. This enabled observations to be linked to their source, location, time and measurement type and supported reusable SPARQL comparisons and semantic classifications. The technical implementation and comparisons are documented in D3.1 and D4.1, while the consolidated findings, lessons learned and recommendations are presented in D5.1.

The environmental validation produced a nuanced result. Controlled JackDaw values and Open-Meteo frequently followed similar broad-area temperature patterns. The IoT devices captured additional local variations associated with sensor placement, buildings, vegetation and micro-environmental exposure. However, direct conversational answers were not always consistent with either the controlled JackDaw outputs or the reference calculations. For example, a direct answer returned 10 hot-and-dry summer days for both Nicosia and Limassol, whereas the Knowledge Graph produced 19 and 5 days from the controlled JackDaw records and 20 and 7 from Open-Meteo. This demonstrates a consistency issue between some controlled outputs and conversational answers. Detailed examination of JackDaw's internal processing was outside the scope of J-VERSE. The project therefore did not attempt to attribute the observed differences to retrieval, aggregation, spatial interpretation or response generation.

The project produced two PoliRuralPlus blog posts, five social-media posts and a news article. A scientific paper was also accepted for presentation at the KGCSW-SETN 2026 Workshop. The planned podcast was not produced; consequently, the overall dissemination KPI was partially achieved. These activities and their implementation against the proposal are documented in D1.2.

Overall, J-VERSE demonstrated that JackDaw provides an accessible and responsive interface for territorial exploration, but that its value depends strongly on data coverage, spatial-context handling, transparency and answer reliability. The project produced a reusable validation methodology, structured stakeholder evidence, technical comparison workflows, pilot datasets and concrete recommendations for the future development of JackDaw and related GeoAI systems.

1. Project Overview

Context and Rationale

GeoAI chatbots can lower the technical barrier to territorial and environmental information by allowing users to ask questions in natural language rather than operating specialised GIS software. However, an accessible interface does not automatically guarantee that the returned information is complete, spatially appropriate or numerically reliable.
J-VERSE was designed to examine JackDaw under real stakeholder and environmental conditions. The project combined stakeholder-based user evaluation with technical comparisons against independent environmental data sources. This allowed the project to assess not only whether users found JackDaw easy to operate, but also whether selected environmental outputs were consistent with independently collected data.
J-VERSE implemented a practical validation of JackDaw in complementary Cypriot urban and suburban contexts, covering land use, environmental conditions and rural–urban patterns.

Alignment with the ENHANCE Call

J-VERSE addressed the ENHANCE objective of applying, testing and improving JackDaw through six project objectives:
O1: Apply JackDaw in real European territorial contexts and assess its support for evidence-informed planning, research and stakeholder engagement.
O2: Produce structured validation feedback on usability, reliability and added value.
O3: Enable diverse stakeholders to access and interpret territorial information without specialised GIS expertise.
O4: Contribute to capacity building through introductory training and practical guidance.
O5: Disseminate the validation approach and results through the PoliRuralPlus platform and wider channels.
O6: Document a replicable validation methodology and recommendations for JackDaw's wider use.
These objectives linked practical JackDaw use with stakeholder feedback, technical validation and wider dissemination.

Use Cases

The validation was organised around three complementary use cases.

1. **General usability and stakeholder interaction** examined how users selected areas, formulated territorial questions, interpreted responses and assessed clarity, trust and usefulness.
2. **Meteorological API validation** compared JackDaw temperature and humidity outputs with Open-Meteo data for Nicosia and Limassol, including numerical values, trends, seasonal aggregates and comparative questions.
3. **IoT-based microclimate validation** compared JackDaw and Open-Meteo with local PATROLIoT measurements collected during field deployments in the two pilot areas.

Target Users and Stakeholders

The intended audiences included citizens, researchers, private-sector actors, agriculture stakeholders, NGOs, local and public-sector actors and operational environmental or civil-protection users.
The final evaluation sample included seven stakeholder categories. Civil-protection, forestry and emergency-response participation was lower than originally intended, while representation from the private sector, citizens and researchers was stronger.

Role of JackDaw

JackDaw was the primary PoliRuralPlus technology evaluated in the project. It was used through:

- its map-based conversational interface during stakeholder evaluation;
- its API during controlled technical data collection;
- repeated historical and environmental questions;
- geographically constrained prompts using WKT spatial context.

J-VERSE did not retrain or alter JackDaw. Its role was to exercise, observe and validate the system and report structured findings to PoliRuralPlus.

Supporting detail:
D2.1 documents the stakeholder validation instruments and results.
D3.1 documents the API and meteorological validation.
D4.1 documents the IoT deployments and three-source comparison.
D5.1 consolidates the validation findings, KPI assessment, lessons learned and final recommendations.

2. Progress Against Objectives and Work Plan

Overall Implementation

The project progressed from setup and validation design to stakeholder testing, technical integration, environmental pilots and final synthesis. Project coordination, quality assurance and risk procedures were defined in D1.1. Validation instruments and the guided user environment were completed under D2.1. The API and Knowledge Graph workflow was delivered in D3.1, followed by the IoT deployments and final three-source comparison in D4.1. The project concluded with the documentation of dissemination and communication activities in D1.2 and the consolidation of the overall validation findings, KPI assessment, lessons learned and recommendations in D5.1.

The planned work was therefore substantially completed, although several activities required operational adaptation because of JackDaw data availability, variable availability, pilot timing and stakeholder recruitment.

Deliverable status

Deliverable	Planned timing	Status	Main result
D1.1 Project Handbook & Quality Assurance Plan	M2	Achieved	Governance, roles, pilot setup, risks, QA and reporting procedures
D2.1 Validation Instruments, Technical Toolkit and Usability Summary	M4	Achieved	Validation methodology, guidance, consent, stakeholder sessions, 132 responses and usability findings
D3.1 Meteorological API Integration, Validation Dataset and Comparative Results	M5	Achieved	J-VERSE architecture, KG, Open-Meteo integration and 2025 historical comparison
D4.1 IoT Deployment and JackDaw Comparison Report	M6	Achieved	PATROLIoT deployment, datasets, backend extensions and IoT comparison
D1.2 Dissemination Report	M6	Achieved	Public outputs, outreach evidence and metrics
D5.1 Final Validation Report	M6	Achieved	Consolidated validation, lessons, KPIs and recommendations

Milestone Achievement

Milestone	Outcome and supporting evidence	Status
MS1 (end of M1): JackDaw pilot workspace configured (D1.1).	Configuration defined in D1.1, Section 7. Implementation is evidenced by the operational validation environment and toolkit in D2.1, API and Knowledge Graph workflow in D3.1, and IoT pilot setup in D4.1.	Achieved
MS2 (end of M3): General usability validation with at least 30 users completed; interim usability summary available (D2.1).	Thirty-five participants completed at least one scenario, exceeding the target of 30. Methods and results are documented in D2.1.	Achieved
MS3 (end of M5): Meteo API and IoT-based validation datasets and comparisons finalised; stakeholder pilot completed (D3.1, D4.1).	The JackDaw/Open-Meteo dataset and comparisons are reported in D3.1, the Nicosia and Limassol IoT datasets and comparisons in D4.1, and the completed stakeholder validation in D2.1.	Achieved

Milestone	Outcome and supporting evidence	Status
MS4 (end of M6): All dissemination outputs delivered, online feedback form submitted, and Final Validation Report completed (D1.2, D5.1).	D1.2 documents two blog posts, five social-media posts, a published news article and an accepted conference paper. D5.1 provides the Final Validation Report, while the completed feedback form, the PoliRuralPlus Technical Validation Questionnaire, is reproduced in the Annexes to this Final Report. The planned podcast was not produced.	Partially Achieved

The milestone descriptions associate MS2 with D2.1 and MS3 with D4.1, while the proposal work plan schedules these deliverables for M4 and M6 respectively. The assessment therefore uses the completion evidence provided by the deliverables linked to each milestone.

MS1–MS3 were achieved. MS4 was partially achieved solely because the planned podcast was not produced, as explained under Deviations and Corrective Actions.

Progress Against Objectives and KPIs

Objective / KPI	Target	Actual result	Status
Female participation	≥40%	48.6%	Achieved
Cypriot regions represented	≥3	Four districts	Achieved
Integrated environmental sources	≥2	JackDaw, Open-Meteo and IoT	Achieved
Territorial themes	≥3	Land use, environmental conditions, rural–urban patterns	Achieved
Completed validations	≥30	35 participants completed at least one scenario; 32 final questionnaires	Achieved
Stakeholder categories	≥4	Seven categories	Achieved
Guided testing sessions	≥2	One onsite and one online session	Achieved
Participants finding the tool helpful	≥70%	56% positive and 32% neutral	Partially Achieved
Weather API cross-check	≥1 source	Open-Meteo	Achieved
IoT pilot areas	2	Nicosia and Limassol	Achieved
IoT validation scenarios	≥2	Two location-based scenarios, one per pilot area	Achieved
IoT deployment instances	≥4	Four device-location instances: IoT-NIC-1/2 and IoT-LIM-1/2	Achieved
Blog posts	≥2	Two published	Achieved
Social-media posts	≥5	Five published	Achieved

News article	≥1	One published	Achieved
Conference paper/white paper	≥1	One accepted workshop paper	Achieved
Podcast	≥1	Not produced	Not Achieved
Replication guidance	Required	Included in D5.1 and supported by D2.1–D4.1	Achieved
Official PoliRuralPlus feedback form	Required	Completed in the Annexes to this Final Report	Achieved

A complete assessment of all project objectives, expected results and KPIs, together with the supporting evidence, is provided in Section 6.5 of D5.1.

Deviations and corrective actions

The KPI wording referred to at least four IoT devices, while the operational plan in D1.1 specified two physical PATROLIoT devices deployed sequentially. The devices were redeployed between Nicosia and Limassol, generating four distinct device-location deployment instances and two validation scenarios. This implementation provided the intended measurement and geographical coverage without requiring simultaneous deployment.

The Limassol pilot was implemented in a lower-density suburban setting rather than the initially anticipated rural setting. The selected area still provided a contrasting environmental context to urban Nicosia, including greater vegetation coverage and coastal influence, and therefore preserved the intended comparative value of the two pilots.

The IoT reporting interval was changed from the indicative five-to-ten-minute interval to approximately 30 minutes. This aligned the sensor measurements with the temporal availability of the Open-Meteo observations and enabled consistent common time buckets across sources, without adversely affecting the planned analyses.

The Nicosia deployment was repeated in June because JackDaw provided insufficient data during the initial March campaign. JackDaw humidity was also unavailable during the earlier Limassol campaign, restricting that comparison mainly to temperature. Repeating the Nicosia campaign provided sufficient data and enabled comparison of both temperature and humidity within the project timeframe, while the Limassol limitation was documented in the results.

The overall participation and stakeholder-diversity targets were achieved, but civil-protection, forestry and emergency-response stakeholders were less strongly represented than initially planned. Recruitment was widened through public, professional, research and SILVANUS networks. This increased overall participation and diversity, although the final sample contained stronger representation from the private sector, citizens and researchers.

The helpfulness target was partially achieved: 56% of respondents provided a positive rating on the relevant final-questionnaire item, compared with the 70% target, while a further 32% were neutral. The shortfall was associated primarily with limitations in data coverage and answer reliability rather than ease of interaction. These findings informed the recommendations provided in D5.1.

The project's dissemination KPI commitments (Grant Agreement Technical Description, Section 2.3, KPI-6 – Dissemination and Outreach Activities) included, among other outputs, “at least 1 podcast with an already known podcaster presenting the project and its outcomes.” This specific output was not produced. The podcaster identified during the proposal phase and subsequently approached by the project team was ultimately unable to participate in a recording within the project timeframe. Given the limited time remaining to identify and secure an equivalent podcaster, effort during the final project period was prioritised towards completing the other dissemination outputs, technical activities, scientific publication and final reporting.

The project nevertheless completed the planned blog posts and social-media posts, prepared a news article that was subsequently published on the PoliRuralPlus website, and produced an accepted conference paper, “J-VERSE: A Knowledge Graph-Backed Framework for Validating Controlled GeoAI Chatbot Outputs”, for the KGCSW-SETN 2026 Workshop, presenting the project's methodology, validation framework and results. The paper fulfils the conference or white-paper element already foreseen under KPI-6 and does not replace the separate podcast target, but it provides a durable and citable scientific dissemination output. Consequently, four of the five dissemination-output categories were completed, and the overall dissemination KPI was partially achieved. The deviation had no impact on the project’s technical implementation, overall timeline or budget.

The proposal anticipated submission of the official PoliRuralPlus feedback through an online form. During implementation, the requested feedback was instead incorporated into the Annexes to the final reporting template provided by PoliRuralPlus. This change affected only the reporting format and had no impact on the project activities or results.

The stakeholder activities were implemented through a combination of onsite, online and self-paced participation, reducing the event-related expenditure originally anticipated. As the sessions were held at Catalink’s premises or online, the corresponding budget allocation was not used.

Supporting detail:
Full objective and KPI definitions are provided in the approved project proposal.
The consolidated KPI assessment is provided in D5.1, Section 6.5.
Stakeholder-validation evidence is provided in D2.1.
Technical-validation evidence is provided in D3.1 and D4.1.
Dissemination evidence and deviations are provided in D1.2.

3. Solution Developed and Technical Results

J-VERSE Validation Toolkit

J-VERSE produced a working pilot toolkit that connected JackDaw, Open-Meteo and PATROLIoT temperature and humidity measurements through a common backend and semantic data layer.

The system consisted of:

- controlled JackDaw API interaction;
- Open-Meteo historical and current-data retrieval;
- ingestion of PATROLIoT temperature and humidity measurements;
- a FastAPI backend with validation and comparison endpoints;
- RDF transformation using RDFLib;
- a project-specific OWL ontology;
- GraphDB storage;
- SPARQL comparison and enrichment queries;
- a guided validation environment supporting participant onboarding, validation scenarios and feedback collection; and
- a validation dashboard presenting the historical, pilot and stakeholder-validation results.

The architecture enabled heterogeneous outputs to be represented consistently while preserving their source, geographic area, timestamp and measurement type.

Integration with JackDaw

JackDaw was accessed through a REST API using OAuth 2.0 client credentials. Controlled prompts requested numeric temperature and humidity values in a predictable response format and included a WKT geometry defining the geographic context. JackDaw's map-based conversational interface was also used during the stakeholder validation and for repeated questions examining response consistency, spatial sensitivity and historical-data availability.

The controlled protocol was necessary because JackDaw's normal free-text responses were not always directly machine-readable. The original prompts and responses were retained for traceability.

Technical Maturity

The resulting system should be described as a validated pilot prototype. It was exercised through:

- historical API validation using selected periods in 2025;
- short field campaigns across the Nicosia and Limassol pilot locations;
- two guided stakeholder sessions;
- open self-paced stakeholder participation;
- repeated controlled and conversational questions; and
- three complementary use cases.

The selected technologies and modular architecture support future extension and scaling; however, formal scalability, production-load and long-term availability testing were outside the scope of the project.

Main Technical Findings

The controlled JackDaw and Open-Meteo values generally followed similar broad-area temperature trends. During the IoT campaigns, the local sensors captured additional microclimatic variation related to buildings, vegetation, shading, solar exposure and local heat retention.

The comparison therefore showed that broad-area environmental services and point-level sensors should not be treated as equivalent. A difference between an IoT observation and a regional estimate may represent genuine local variation rather than an error.

The project also identified inconsistencies between some conversational answers and the results derived from controlled JackDaw values. The most visible example concerned hot-and-dry summer days:

Source / method	Nicosia	Limassol
Controlled JackDaw values analysed in J-VERSE	19	5
Open-Meteo values analysed in J-VERSE	20	7
Direct conversational answer	10	10

A further conversational answer incorrectly identified Limassol rather than Nicosia as the city with the higher average maximum summer temperature, although both structured datasets supported Nicosia.

These results show that usable structured values under controlled prompting do not always lead to an equivalent correct answer through open-ended conversation. Detailed examination of JackDaw's internal retrieval and response-generation processes was outside the scope of J-VERSE. The project therefore did not attempt to establish the precise internal cause.

The IoT evaluation showed close temporal agreement between JackDaw and Open-Meteo, while the local sensors frequently recorded higher temperatures during particular periods, especially at night and early morning in Nicosia. JackDaw humidity was unavailable during the Limassol pilot, limiting the completeness of the comparison. The conversational evaluation also returned the same or very similar responses for nearby coordinates and showed limited historical-data availability for some queries, indicating that the interface primarily represented broader-area conditions rather than local microclimatic variation.

These technical findings were consistent with the stakeholder evaluation: users generally found JackDaw easy to use, fast and clear, but its perceived usefulness, accuracy and trustworthiness were constrained by incomplete or insufficiently localised data and by uncertainty about the reliability of some answers. Together, the findings indicate that an accessible interface needs to be supported by adequate data coverage, clear provenance and reliable spatial and aggregation behaviour.

Access to Results

The principal J-VERSE results and technical resources are available as follows:

Resource[1]	Access and description
J-VERSE project page	Available at https://catalink.eu/research-development/j-verse/. It presents the project scope, implementation approach and main results, together with links to the principal J-VERSE resources.
Guided validation environment	Available at https://jverse.catalink.eu. It includes the introductory material and embedded validation walkthrough.
J-VERSE validation dashboard	Available at https://j-verse-dashboard.catalink.eu. It consolidates the historical, pilot and stakeholder-validation results, including an interactive live comparison.
API documentation	Available at https://jverseapi.catalink.eu/docs. The documentation is publicly reachable, while protected API operations require authorisation.
Pilot validation datasets	Per-pilot datasets combining PATROLIoT, JackDaw and Open-Meteo observations in common 30-minute time buckets. The datasets shared with PoliRuralPlus contain coordinates rounded to two decimal places.
Public project deliverables	The deliverables approved for public release document the stakeholder, technical and consolidated validation activities and findings.
Scientific paper	An accepted conference paper presenting the Knowledge Graph-backed validation approach and principal technical findings.

Supporting detail:
The guided validation environment and stakeholder process are documented in D2.1.
The complete architecture, ontology, data-ingestion process and API validation are documented in D3.1, Sections 2–6.
The backend endpoints, IoT configuration, pilot datasets, field deployments and three-source analyses are documented in D4.1, Sections 2–5.
The consolidated findings and validation dashboard are documented in D5.1, Sections 4–6.
Public dissemination outputs are documented in D1.2.

[1] Any publication of the relevant public deliverables and pilot datasets through Zenodo will be coordinated with PoliRuralPlus. Any deposition of an appropriate version of the scientific paper will be subject to the applicable publisher and self-archiving conditions.

4. Integration and Contribution to PoliRuralPlus

J-VERSE directly integrated with the JackDaw API provided through the PoliRuralPlus technical ecosystem. The project used JackDaw as the principal technology under validation and produced structured evidence about its usability, environmental output quality, spatial behaviour and limitations.

J-VERSE integration focused specifically on JackDaw. Other PoliRuralPlus tools, including the Advisor, RAG/GeoRAG, Vulture, data cubes and centrality-analysis tools, were outside the scope of the project.

The principal contributions to PoliRuralPlus were:

- structured stakeholder feedback and usability evidence;
- evidence from stakeholder use of JackDaw's map-based conversational interface;
- controlled API and historical comparisons;
- IoT-based environmental validation;
- a reusable semantic integration and validation workflow;
- an interactive dashboard consolidating the validation results;
- identification of data-coverage and spatial-context issues;
- recommendations concerning provenance, uncertainty and spatial resolution; and
- public dissemination and an accepted scientific conference paper.

The project also provided practical feedback during implementation. Historical Cyprus data became available following interaction with the JackDaw team, and humidity support was available during the later Nicosia campaign.

The Knowledge Graph was project-specific and it is not currently merged into a shared PoliRuralPlus knowledge base.

PATROLIoT, originally developed in SILVANUS, was reused and adapted as the local environmental source. SILVANUS networks also supported stakeholder recruitment, creating a concrete synergy with a previous European project.

Supporting detail: Technical interoperability is documented in D3.1 and D4.1. Stakeholder and ecosystem feedback is documented in D2.1. Public dissemination and communication activities are documented in D1.2. Consolidated contributions, lessons learned and recommendations are documented in D5.1.

5. Stakeholder Engagement and User Involvement

The stakeholder evaluation combined one onsite session, one online session and open self-paced participation. Users followed a nine-stage environment including project introduction, consent, three validation scenarios, free exploration and final feedback. The complete activity generally required 15-30 minutes.

Thirty-five participants completed at least one scenario. Together, they generated 132 feedback forms, including 32 final questionnaires. Seven stakeholder categories were represented, including the private sector, general public, research, NGOs, agriculture, students and the public sector.

The results showed a consistent distinction between interaction quality and content value. Users considered JackDaw simple, quick and generally clear. However, answer usefulness, perceived accuracy, trust and willingness to adopt it were more limited.

The most common issues concerned missing datasets, generic responses, persistence of an earlier selected area, inability to compare two selected locations, excessive clarification prompts and occasional inaccurate environmental figures. Users requested clearer information about available data, easier control of the map-selection box, chat history and map- or GIS-compatible outputs.

The evaluation also produced useful user journeys. A non-expert user retrieved land-use and protected-area information without GIS software. An agriculture-sector participant converted crop-suitability and sowing decisions into natural-language questions. Another participant used JackDaw to explore transport accessibility around Utrecht. These demonstrate scenario-based decision and communication support, although the project did not verify that a formal operational or policy decision was taken based on the answers.

Overall, the project provides evidence of strong usability and accessibility, while lower perceived usefulness, trust and answer reliability indicate that further improvement is needed before JackDaw can be relied upon for real-world decision support.

Supporting detail:
Full participant demographics, per-scenario results, correlations, subgroup analyses, qualitative comments and validation instruments are available in D2.1, Sections 5–6 and its appendices.
Consolidated usability findings and user journeys are provided in D5.1, Sections 2–3.

6. GDPR and Data Protection

This chapter describes how personal data relating to the validation participants and questionnaire respondents were collected, processed and archived in compliance with the General Data Protection Regulation (EU) 2016/679 (GDPR). It also explains the protective measures applied to the IoT deployment-location data. All relevant participant consents were obtained and are securely stored internally.

Legal basis and overall approach

The collection, processing and storage of personal data in connection with the J-VERSE validation activities complied with Regulation (EU) 2016/679 (GDPR)[2] and with the ethical and data-protection requirements of the PoliRuralPlus project[3] and the Enhance Call. The lawful basis for processing the personal data collected from participants through the validation activities was their consent, pursuant to Article 6(1)(a) of the GDPR. Data protection was considered during the design of the validation methodology and technical toolkit ("data protection by design"), particularly in relation to participant consent, questionnaire responses and IoT deployment-location data.

Workshop and testing participants

Before taking part in any validation activity, participants were provided with a dedicated information and consent form embedded as a mandatory step of the guided validation flow. Participation took place through an organised onsite session at Catalink's premises, an organised online session, or independently through the self-paced validation environment hosted at jverse.catalink.eu. The form explained the purpose of J-VERSE, the information to be collected and its intended use, participants' rights, including the right to withdraw and request deletion of their data, and a contact point for data-related requests. Consent was requested separately for (i) participation and processing of personal data for research and validation purposes, and (ii) the optional use of photographs or recordings for dissemination purposes. Participation was entirely voluntary. The validation process, forms and individual steps are documented in D2.1, including the appendices.

Data from 35 participants were retained for analysis. The consent form collected participants' email addresses, while each participant was assigned a unique User ID that was used in all subsequent forms to link their profile and responses without including their email address. The participant-profile information collected was limited to gender, stakeholder category, level of experience with geospatial or map-based tools, and current location, in accordance with the data-minimisation principle. No user-side behavioural data, such as click streams, selected-area coordinates, time-on-task or conversational histories, were collected from participants' JackDaw sessions.

IoT sensor field data

The IoT devices deployed for the microclimate validation in the Nicosia and Limassol pilots collected environmental readings, specifically temperature and humidity, which do not constitute personal data. However, the precise deployment coordinates were treated as sensitive location information. Coordinates included in the datasets shared with PoliRuralPlus and reported in D4.1 were rounded to two decimal places to protect the privacy of the deployment locations. The exact coordinates are retained internally and may be shared confidentially with PoliRuralPlus or authorised reviewers if required for verification.

[2] https://eur-lex.europa.eu/eli/reg/2016/679/oj/eng

[3] https://www.poliruralplus.eu/

Survey and questionnaire respondents

Questionnaire and scenario-feedback responses that were collected during the validation sessions were analysed primarily in aggregated form, in order to identify general usability patterns and validation findings rather than to evaluate individual participants. Where individual comments are reproduced in project deliverables, email addresses and other information that could identify the respondent are not included.

Storage, Access and Confirmation of Consent

Personal data collected within the project, including consent records, participant-profile information and questionnaire responses, are stored internally in access-controlled systems and are accessible only to authorised Catalink personnel. Valid consent was obtained before data collection, and the corresponding consent records are securely retained. Personal data will be retained, in accordance with the Grant Agreement and Catalink Limited's data retention policy, for five years from the payment of the final balance. At the end of this period, email addresses and the information linking them to participant User IDs will be deleted, while the remaining anonymised research data may be retained. Further information on storage, access controls and retention is provided in the GDPR and Data Protection section of Part B (Confidential) of the Final Report.

7. Communication, Dissemination and Visibility

The dissemination and communication outputs implemented during the project are summarised below:

Output	Achievement
Blog posts	2
Social-media posts	5
News article/press release	1
Conference contribution/white paper	1 accepted
Podcast	Not produced

The two blog posts covered the technical and user-centred dimensions of the project:

- *J-VERSE: Using Knowledge Graphs to Validate JackDaw Against Weather APIs and IoT Data*;
- *Putting JackDaw to the Test*.

Five LinkedIn posts communicated the project launch, participant recruitment, technical blog, user-validation blog and scientific-paper acceptance. The dedicated account generated 729 impressions, reached 355 members and recorded 41 clicks, 25 reactions, five reposts and a 9.7% engagement rate.

A news article presenting the overall J-VERSE approach and principal stakeholder and technical validation findings to a wider audience was submitted to PoliRuralPlus for publication on 31 July 2026 and subsequently published on its website.

A scientific paper entitled *J-VERSE: A Knowledge Graph-Backed Framework for Validating Controlled GeoAI Chatbot Outputs* was accepted for the KGCSW-SETN 2026 Workshop, with presentation scheduled for September 2026.

As explained in Section 2, the planned podcast was not produced because the podcaster identified during the proposal phase was ultimately unavailable within the project timeframe. This deviation did not affect the remaining dissemination outputs: J-VERSE completed the other four planned categories of dissemination output, providing complementary coverage through the PoliRuralPlus website, social media, a wider-public news article and scientific dissemination.

Version 2.0 visibility updates

In response to the initial administrative and visibility comments received, all relevant project dissemination channels, public-facing resources, reports and deliverables were reviewed and, where necessary, updated to ensure consistent and appropriate visibility of PoliRuralPlus and the official EU funding acknowledgement across project outputs. The following actions were completed or initiated:

- A dedicated J-VERSE page was published on the Catalink website, presenting the project scope, implementation approach and main results: https://catalink.eu/research-development/j-verse/.
- The guided validation environment was updated to display the J-VERSE, Catalink and PoliRuralPlus logos, together with the EU funding graphic, funding acknowledgement and disclaimer: https://jverse.catalink.eu/.
- The results dashboard was updated with the dedicated J-VERSE project-page link and corrected project-logo colour, and was confirmed to display the relevant EU funding statement and disclaimer: https://j-verse-dashboard.catalink.eu/.
- The public API documentation was updated with the relevant project and EU visibility elements: https://jverseapi.catalink.eu/docs.
- The relevant LinkedIn posts were reviewed and supplemented with the required funding acknowledgement and visibility information. Where previously published visual material could not be edited, the required information was incorporated into the editable post text or added through an associated comment, as appropriate.
- The visibility elements in Deliverables D1.1, D1.2, D2.1, D3.1, D4.1 and D5.1 were reviewed and updated.

- The J-VERSE news article has been published on the PoliRuralPlus website. Updated visual materials for the news article and the second blog post, as well as refined funding and disclaimer wording for the news article, were prepared and will be submitted to PoliRuralPlus for consideration together with this Version 2.0 Final Report.

Supporting detail:
Revised Deliverable D1.2 documents the dissemination activities, public links, updated screenshots, visibility review and supporting material. The completed and proposed visibility updates are also summarised in this Version 2.0 Final Report.

8. Impact Assessment

Technical Impact

J-VERSE delivered an operational pilot framework for evaluating GeoAI outputs using stakeholder evidence, external APIs and local IoT observations. It demonstrated how controlled JackDaw results could be preserved, aligned and compared within a common semantic structure. The resulting workflow and validation dashboard also provide a practical reference for extending and presenting similar comparative evaluations in other contexts.
The Knowledge Graph's contribution was to make source mappings, spatial and temporal context, provenance and semantic classifications explicit and reusable across the integrated streams.

Social and Inclusion Impact

The project involved a diverse and gender-balanced participant group and focused predominantly on users with limited geospatial experience. After brief guidance, users could select an area, formulate spatial questions and interpret responses without GIS software.
This represents a meaningful contribution to digital and spatial inclusion. However, the impact remains limited by the small sample size and uneven representation of operational public-authority and emergency-response groups.

Economic Impact

No direct revenue, commercial adoption or quantified cost reduction was measured. Potential future economic value lies in:

- reusable GeoAI validation services;
- semantic environmental-data integration;
- microclimate-aware planning tools;
- future research and innovation projects; and
- consulting or technical-integration activities.

These are exploitation opportunities rather than achieved economic impacts.

Environmental Impact

The project showed the importance of combining broader-area meteorological information with local observations. IoT measurements captured local variations beyond the spatial resolution represented by the broader-area JackDaw and Open-Meteo observations.
Potential environmental applications include heat-risk monitoring, climate-resilient planning, agriculture, green-infrastructure assessment and wildfire preparedness. No direct environmental intervention or quantified environmental improvement occurred during the project.

Policy and Decision-Support Impact

J-VERSE demonstrated JackDaw's potential to support exploration of land use, environmental conditions and rural–urban relations. Individual user journeys also included agriculture and transport-accessibility questions, illustrating possible applications beyond the predefined themes. The project did not document a formal policy or operational decision taken directly on the basis of JackDaw output.

The achieved impact should therefore be described as evidence of decision-support potential and limitations, rather than confirmed policy change.

New European Bauhaus Principles

Sustainability was addressed through environmental monitoring, the reuse of existing data and IoT infrastructure, and a replicable validation approach. No direct resource-saving or footprint analysis was performed.
Inclusion was strongly represented through gender balance, stakeholder diversity, natural-language interaction, non-specialist participation and consent-based engagement and privacy-conscious data handling.
Aesthetics and quality of experience were addressed indirectly through usability and interface feedback. Users rated ease of use and clarity positively but requested improvements to map controls, answer rendering and spatial-selection management.

9. Challenges, Risks and Lessons Learned

The most significant technical challenge was the uneven availability of JackDaw data across locations, variables and time periods. This affected the initial Nicosia campaign, access to historical data and the availability of humidity observations during the Limassol pilot.

A related challenge concerned the distinction between broader-area and local environmental information. JackDaw and Open-Meteo represented broader-area weather patterns, while the IoT devices captured additional microclimatic effects. Differences between these sources could therefore reflect their different spatial scales rather than measurement errors.

The project also identified differences between some direct conversational answers and results derived from controlled JackDaw outputs. Detailed examination of JackDaw's internal retrieval, aggregation and response-generation processes was outside the scope of J-VERSE and the interfaces used in its validation. The project could therefore document these differences but did not attempt to attribute them to a specific internal component or process.

These technical observations were consistent with the stakeholder findings. Users generally found JackDaw easy to use, fast and clear, while their willingness to recommend or adopt it was influenced more strongly by data coverage, perceived accuracy and usefulness than by ease of interaction alone.

Although the overall participation and diversity targets were achieved, several stakeholder categories included only a small number of participants, and operational stakeholders were less strongly represented. This limited the extent to which conclusions could be drawn for individual stakeholder groups.

Mitigation measures included repeating the Nicosia campaign, using Open-Meteo as an accessible external reference, aligning observations in common UTC time buckets, documenting unavailable variables and widening stakeholder-recruitment channels.

The principal lessons are:

1. controlled data access and conversational answers should be validated separately;
2. provenance and spatial resolution should be clearly communicated;
3. data availability should be visible when users formulate queries;
4. multi-location comparisons require explicit orchestration;
5. local IoT observations add value in microclimate-sensitive contexts;
6. system limitations should be communicated transparently;
7. comparative pilots should align collection periods and document sensor placement; and
8. future validation should strengthen representation within stakeholder categories, particularly among operational stakeholders.

Supporting detail:
Technical challenges and limitations are analysed in D3.1 and D4.1.
Stakeholder-related challenges and lessons are documented in D2.1.
The consolidated lessons learned and recommendations are provided in D5.1.

10. Sustainability, Replicability and Next Steps

J-VERSE produced several reusable assets: the validation methodology, guided stakeholder environment, questionnaires, FastAPI backend, semantic data model, comparison workflows, pilot datasets, prompts, SPARQL logic, validation dashboard and public communication materials.

The methodology can be replicated in another region by combining:

- access to JackDaw;
- a relevant external meteorological API;
- local IoT observations (where microclimate-level or three-source validation is intended);
- pilot locations selected to represent the intended territorial and environmental contexts;
- stakeholder-validation instruments;
- common temporal and spatial alignment; and
- documented comparison questions.

Before replication, future projects should verify JackDaw data coverage for the target geography and period. They should also determine whether the intended use requires broader-area information or local observations. The use of an openly licensed, key-free reference API such as Open-Meteo can further reduce the technical and procurement barriers to replication.

The selected technologies and modular architecture support extension to additional areas, sources, variables and semantic conditions. Formal large-scale performance and operational-scalability testing were outside the scope of J-VERSE.

The guided validation environment and dashboard support continued access to the validation approach and results. To support their long-term accessibility and reuse, the potential deposition of relevant public deliverables and pilot datasets in Zenodo will be coordinated with PoliRuralPlus. Deposition of an appropriate version of the scientific paper will also be subject to the applicable publisher and self-archiving conditions.

Potential next steps include:

- expanding the question set and number of locations;
- comparing paraphrased and repeated conversational questions;
- aligning future pilots within comparable seasonal periods;
- adding clearer provenance and uncertainty information;
- integrating additional local environmental sources;
- involving larger and more balanced samples across stakeholder categories, particularly operational stakeholders; and
- continuing collaboration with PoliRuralPlus and the JackDaw technical team.

Conclusions

J-VERSE completed a multi-layered validation of JackDaw through stakeholder interaction, meteorological API comparison and IoT field data.

The project's strongest positive result was accessibility. JackDaw enabled users with limited GIS experience to interact with spatial information through a clear and responsive interface. The strongest limitation was that ease of use did not consistently translate into perceived reliability, usefulness or readiness for real-life adoption.

The technical validation showed that controlled JackDaw outputs and Open-Meteo often followed similar broad-area environmental patterns, while IoT devices contributed additional local detail. It also identified cases in which direct conversational answers differed from results derived from controlled outputs.

Most project objectives and KPIs were achieved. The consolidated assessment in D5.1 records 19 of the 21 assessed expected-result and KPI entries as achieved and two as partially achieved. The participation, diversity, territorial-theme, weather-API and IoT-validation targets were achieved. The helpfulness target and overall dissemination KPI were partially achieved, with the podcast representing the only dissemination-output category not produced.

The strategic value of J-VERSE lies in the combination of user and technical validation. The project demonstrated that assessing a GeoAI chatbot requires more than checking whether it returns an answer. Evaluation must also consider the source and spatial scale of the data, consistency between controlled and conversational behaviour, user confidence, transparency and practical relevance.

The project therefore provides PoliRuralPlus with structured evidence, pilot datasets, a reusable validation methodology, an interactive results dashboard and concrete recommendations that can support the future development and broader validation of JackDaw.

Annexes

PoliRuralPlus Technical Validation Questionnaire

Validation of PoliRuralPlus Technical Ecosystem Concepts, Tools & Components.

Questions can be given as simple statements or sentences where suitable. It is not necessary to provide a comprehensive text. Where the question is irrelevant to the project, state **N/A**.

The technologies covered under this questionnaire include:

- Jackdaw GeoAI chatbot
- PoliRuralPlus Advisor
- RAG/GeoRAG
- Vulture
- Data harmonization tools and pipelines
- Data publishing concept

Participation in Webinars (initial Training Sessions)

1. Which PoliRuralPlus technical sessions did members of your project attend or review recordings of? Indicate: Attended live / Watched recording / Not reviewed. **Watched recordings:** Most technical education videos available through the PoliRuralPlus website. **Attended live:** An introductory one-to-one online meeting with the JackDaw developers at the beginning of the project.
2. Which sessions were most relevant to your project? Most relevant were: How to publish data on the hub, How to write new services for Jackdaw, and How to run Jackdaw locally

Awareness and Understanding of the PoliRuralPlus Ecosystem

3. Were you aware of the Jackdaw ecosystem and related tools before participating in the cascade funding activities in PoliRuralPlus? **No**
4. Which ecosystem components are you familiar with **Only JackDaw**
5. Briefly describe how you understand the purpose of the Jackdaw ecosystem within PoliRuralPlus. **JackDaw provides a map-linked conversational interface through which users can select an area and ask natural-language questions about territorial and spatial information. Its purpose is to make geographic data more accessible to policymakers, practitioners, researchers, businesses and citizens who may not have specialist GIS expertise.**

Actual Testing or Validation

6. Did your project test or experiment with any ecosystem technologies? **Yes. J-VERSE tested JackDaw through stakeholder evaluation, controlled API interaction, historical meteorological comparisons and two IoT-supported pilot campaigns.**
7. Which components were actively validated in your project work? **The JackDaw GeoAI chatbot was the only PoliRuralPlus component actively validated.**
8. Describe how the technologies were tested (internal testing, integration, stakeholder demos, pilot studies, evaluation exercises). **JackDaw was tested through: i) one onsite and one online guided stakeholder session; ii) independent, self-paced user evaluation; iii) three territorial scenarios**

covering land use, environmental conditions and rural–urban patterns; iv) controlled API requests using defined prompts and WKT geometries; v) comparison with Open-Meteo historical and live observations; vi) comparison with PATROLIoT temperature and humidity measurements; vii) repeated conversational questions examining consistency, spatial sensitivity and historical-data availability.

Technical Implementation

9. Did you implement or configure any of the technologies provided in the form of services, custom plugins/services, local deployment, RAG/GeoRAG pipelines, data harmonization workflows, data cubes, pipelines, or data publishing? **J-VERSE configured API-based access to JackDaw and implemented an external data-harmonisation and validation workflow.**
10. If yes, describe the technical architecture used (local deployment, cloud deployment, integration with existing systems, API-based integration). **J-VERSE used an on-premises architecture hosted on Catalink's servers, combined with API-based integration of external services. JackDaw and Open-Meteo were accessed through APIs, while PATROLIoT devices transmitted local temperature and humidity measurements to a FastAPI backend. The backend validated and normalised the observations, transformed them into RDF and stored in a GraphDB Knowledge Graph. The common semantic model represented the source, location, timestamp and environmental values of each observation. SPARQL queries and semantic-enrichment rules supported cross-source comparison and higher-level classifications.**
11. Did you develop new services or extensions? If yes, describe. **Yes. J-VERSE developed the following components as part of a separate validation toolkit rather than as extensions integrated into JackDaw: i) services for collecting controlled JackDaw and Open-Meteo observations; ii) endpoints for ingesting raw and aggregated measurements; iii) comparison endpoints for historical, pilot and live data; iv) an IoT-ingestion workflow; v) a project-specific ontology and Knowledge Graph; vi) semantic-enrichment and SPARQL comparison logic; vii) a nine-stage web-based stakeholder-validation environment; and viii) a validation dashboard presenting the historical, pilot and stakeholder results. These components interacted with JackDaw through its available interfaces and did not modify its internal implementation.**

Use Cases and Policy Applications

12. In which domain did you apply Jackdaw ecosystem technologies (e.g., rural planning, agriculture, land management, climate monitoring, policy analysis, community participation, state your own sector as you see fit)? **J-VERSE applied JackDaw to territorial and rural–urban planning, land-use exploration, environmental and climate information, agriculture-related questions, stakeholder participation and GeoAI reliability and usability evaluation.**
13. Did the tools support policy intelligence or decision-making processes? **To a limited and exploratory extent. JackDaw supported participants in accessing information relevant to territorial, agricultural and transport-related questions, but the project did not document or verify a formal policy or operational decision based on its outputs.**
14. Did you use any of the technologies provided to analyse policy scenarios? **No. J-VERSE did not use the provided technologies to conduct formal policy-scenario analysis.**
15. Did you use any of the provided concepts for collaborative planning or stakeholder interaction? **Yes. JackDaw was used in guided and self-directed stakeholder activities, allowing participants to select geographic areas, ask territorial questions and assess the answers.**
16. Did you experiment with RAG or GeoRAG approaches for knowledge retrieval? **No. J-VERSE did not experiment with RAG or GeoRAG approaches.**

Data and Knowledge Integration

17. Did your project publish any datasets? **No. No public dataset had been deposited at the time of reporting. J-VERSE produced per-pilot Excel datasets combining PATROLIoT, JackDaw and Open-Meteo observations in common 30-minute time buckets. The datasets shared with PoliRuralPlus contain coordinates rounded to two decimal places to protect the privacy of the deployment locations. Any potential public deposition of the datasets in Zenodo will be coordinated with PoliRuralPlus.**
18. Did you perform data harmonization to make datasets compatible with the ecosystem? **Yes. JackDaw, Open-Meteo and PATROLIoT used different data structures and collection mechanisms. J-VERSE mapped their observations into a common RDF/OWL model and aligned them using shared spatial context and 30-minute temporal buckets.**
19. Did you create or use centrality datasets for rural network analysis? **No. J-VERSE did not create or use centrality datasets for rural-network analysis.**
20. Did you use the data cube or centrality measures approaches to process spatial or temporal data? **No. J-VERSE used common temporal buckets to align observations but did not apply the PoliRuralPlus data-cube or centrality-measures approaches.**

Evaluation and Feedback

21. What aspects of the technologies worked well? **JackDaw was generally easy to use, fast and clear. Its controlled meteorological outputs also showed broad consistency with Open-Meteo within the evaluated scope.**
22. What limitations or challenges did you encounter? **The main limitations concerned uneven data availability, inconsistencies in some aggregated and multi-location answers, spatial-context handling and limited historical or variable coverage.**
23. Did stakeholders or users provide feedback during testing? Summarize key insights. **Yes. Users valued the accessible interface but reported lower trust and usefulness when data were missing or insufficiently localised. They requested clearer data availability, provenance, map controls and chat history.**

Evidence of Validation

24. Provide evidence *if available* (screenshots, demo videos, reports, evaluation results, prototypes, repositories – you may paste text or images here, supply links for documents or videos or web resources). **Evidence is provided in D2.1–D5.1, the guided environment at https://jverse.catalink.eu, the dashboard at https://j-verse-dashboard.catalink.eu and the API documentation at https://jverseapi.catalink.eu/docs.**

Future Potential

25. Would you consider continuing to use technologies like the PoliRuralPlus ecosystem after the project? (yes, no, why/why not) **Yes. JackDaw has potential for further validation and territorial-information applications, particularly if data coverage and conversational reliability continue to improve.**
26. Which of the components you have used or assessed have the highest potential for further exploitation? **JackDaw, particularly its conversational interface and API-based integration capabilities, has the highest potential for further exploitation.**

27. What improvements would make the ecosystem more useful? **Broader data coverage, clearer provenance and availability information, more reliable aggregated and multi-location answers, improved spatial-context handling and integration of local environmental data.**

Instructions for Using the PoliRuralPlus Technical Validation Questionnaire

*This questionnaire is designed as a **common reporting framework** for validating the PoliRuralPlus technical ecosystem (e.g. JackDaw, RAG/GeoRAG, Vulture, data tools).*

How to use this questionnaire

- *This questionnaire should be treated as a **final synthesis tool**, not as the primary data collection instrument.*
- *Each project is expected to **design its own tailored sub-surveys or feedback methods** (e.g. stakeholder questionnaires, workshop feedback forms, interviews) based on the relevance of specific technologies and use cases.*
- *These project-specific surveys should be **adapted to the target stakeholder groups** (e.g. policymakers, technical users, domain experts, citizens).*

Relationship between sub-surveys and this questionnaire

- *The questions in this document should serve as a **reference framework** when designing your own surveys.*
- *Not all questions need to be asked directly to stakeholders; projects should:*
    - *Select relevant topics*
    - *Simplify or rephrase questions as needed*
    - *Focus on aspects that stakeholders can realistically assess (e.g. usability, usefulness, relevance)*
- *After collecting input from stakeholders and internal project activities, projects must:*
    - *Aggregate and interpret the collected data*
    - *Reflect the results in this questionnaire*
    - *Provide concise, evidence-based answers*

Evidence and validation

- *Where possible, responses should be supported by:*
    - *stakeholder feedback*
    - *testing results*
    - *demonstrations or pilot activities*
- *Projects are encouraged to include **links or references to supporting materials** (e.g. reports, screenshots, videos)*

Key principle

The goal is to ensure that:

- *stakeholder insights and testing results are **systematically captured**, and*
- *project experiences are **consistently reported across all Enhance projects**, enabling comparison and learning at the programme level.*