



Deliverable D2.3:

Preliminary catalogue of services, resources and functionalities

**Project Title: Towards a pan-European Research Infrastructure
for Excellent Citizen Science**

Project Acronym: RIECS-Concept

Contract N°. 101188210

Programme: Horizon Europe (HORIZON)

Topic: Research infrastructure concept development

HORIZON-INFRA-2024-DEV-01-01

Project start date: 01 January 2025

End date: 31 December 2027



Deliverable title	Preliminary catalogue of services, resources and functionalities
Deliverable number	D2.3
Deliverable version	1.0
Contractual date of delivery	30/06/2026
Actual date of delivery	30/06/2026
Nature of deliverable	R
Dissemination level	PU
Work Package	WP2 Feasibility research and conceptualization
Task(s)	T2.3 Sketch of the catalogue of services, resources, and functionalities
Partner(s) responsible(s)	IBE
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Description	Inventory with a preliminary list of services, resources and functionalities emerging from the evaluation of end users' requirements and gaps within the CS and RI landscapes. It will be a reliable source of top-tier resources and services to be considered by CS developers, RIs and stakeholders interested in implementing CS initiatives. This interim result specially helps to consolidate the common understanding of the RIECS concept, easing next steps.
Key words	citizen science; catalogue of services, resources and functionalities; RIECS; research infrastructure; user stories

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Version History

Version	Date	Comments
0.1	10/03/2026	First draft document and share table of contents with consortium partners
0.2	20/06/2026	First complete version
0.3	26/06/2026	Adapted contents to new versions of D2.2.
1.0	30/06/2026	Final document structure and contents revised

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This deliverable has been prepared in the framework of the RIECS-Concept project, grant agreement N° 101188210 under the HORIZON-INFRA-2024-DEV-01-01 topic.

AI use disclaimer

Parts of the analysis and drafting of this deliverable were carried out with the assistance of AI tools. The extraction and coding of statements used three independent large language models (Anthropic's Claude Sonnet 4.6, DeepSeek V4, and the European model Mistral Large) cross-checked against one another. AI was used as a co-analysers under human direction to support the labelling and clustering of user stories, the summarisation and coding of engagement notes, the consolidation and mapping of the technology and needs, and the drafting and editing of text - and not as an autonomous author. All AI-generated outputs (needs, themes, gaps, mappings, summaries and draft text) were reviewed and validated by the responsible consortium partners, who remain responsible for the content of this deliverable. No personal data was sent to external AI services, in line with the project's GDPR and data-management arrangements.

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Acronyms

CS, Citizen Science

RI, Research Infrastructure

RIECS, Research Infrastructure for Excellent Citizen Science

ESFRI, European Strategy Forum on Research Infrastructures

GA, Grant Agreement

WP, Work Package

KER, Key Exploitable Result

EOSC, European Open Science Cloud

AI, Artificial Intelligence

AAI, Authentication and Authorisation Infrastructure

FAIR, Findable, Accessible, Interoperable, Reusable

CARE / TRUST, data-governance principle sets

LLM, Large Language Model

KER, Key Exploitable Result

GDPR, General Data Protection Regulation

S / F / R, Service / Functionality / Resource

RI, Research Infrastructure

N## / GAP-### / RIECS-REQ, need / structural gap / D2.2 requirement



Executive summary

This deliverable presents the preliminary catalogue of the services, resources and functionalities that the Research Infrastructure for Excellent Citizen Science (RIECS) must provide in the future. As the first Key Exploitable Result (KER1) of RIECS-Concept, this catalogue is not simply a report but the project's first exploitable asset. It consolidates the citizen science community's demand into a common functional reference, specifying what RIECS must be able to do, that informs all subsequent design decisions. It serves as the shared foundation for the technical, organisational and strategic development of RIECS, enabling partners to work from a common understanding and supporting future implementation beyond the lifetime of the project. It takes the form of a demand-led functional specification: a structured statement of what RIECS shall be able to do, derived from the citizen science community's own co-design demand. For this reason, D2.3 is central to the project RIECS-Concept as a common reference for technical design, governance discussions, sustainability planning and future validation with the community. In practical terms, it is the bridge between the needs identified in the concept phase and the next steps towards a feasible, federated and ESFRI-compatible research infrastructure.

The catalogue is the end of a reproducible chain over one body of evidence during the first half of the project. It started in conversations and participatory sessions in 42 workshops, the online questionnaire and related engagements, resulting in 823 co-design user stories.

Using the same user stories as D2.2, here, three independent language models extracted 6,678 statements ["RIECS shall ..."], each a literal sentence traceable to its story. These were deduplicated into 1,980 catalogue entries typed as a Service, Functionality or Resource resulting in: 694 services, 1.111 functionalities and 174 resources). The catalogue entries were then consolidated into 151 named components and clustered across 29 component groups, organised on the seven RIECS layers, and finally cross-checked back against D2.1 and D2.2 so that the catalogue fits the 31 technical requirements.

As a result, seven layers integrate the proposed catalogued items, typed as a “service” (a standalone capability RIECS runs and offers as a unit, such as hosting, an identity service, or a project directory), a “functionality” (a specific feature *within* a service, e.g., filtering a dataset, exporting results, etc.) or a “resource” (an asset or material RIECS provides, for instance, datasets, a template or training materials).

The centre is the foundation and the federation contract (layers L0–L1: identity, FAIR data, quality, compliance, standards and APIs, an EOSC node) with 33 components in total. It is here where the field's structural gaps concentrate and where no single existing platform provides a shared solution; this is what RIECS must build and operate. The edge refers to federation-related participation, knowledge and community capabilities (layers L2–L4). With 103 components this carries most of the demand of federating capabilities to connect with existing platforms as peers. Additionally, L5 and L6 refer to key aspects of citizen science, governance and multidisciplinary, included by-design in RIECS-Concept and confirmed with stakeholders' inputs.



Table 1. The seven RIECS layers and their component groups

Layer	Component groups
L0: Foundation	Identity & EU-compliant services · Open data access & repositories · Data quality & validation · Data privacy & protection
L1: Interoperability & Federation	Interoperability & data standards · External system integration · Project discovery & outreach · European scale & deduplication · Search & filtering
L2: Participation & Workflow	Citizen data collection & integration · Usability & modular workflows · Project participation spaces · Accessibility & multilingual support · Multimedia & storytelling contribution · Participant communication & onboarding
L3: Knowledge, Analysis & Impact	Data reuse & export · Policy outputs & visualisation · Project showcasing & dashboards
L4: Community, Recognition & Capacity	Contribution feedback & retention · Community building · Collaboration & matchmaking · Guidance & methodological support · Training materials & courses · Methods, equipment & documentation · Expertise discovery & directories
L5: Governance of the RI	Governance & transparency · Funding & sustainability · AI transparency & ethics
L6: Cross-cutting	Multi-domain support (domain-neutrality)

The result presented in this document converges with the consortium's previous work, since its components address all 37 consortium-validated needs (N01–N37), all 10 structural gaps, and all 31 D2.2 technical requirements (18 functional, 7 non-functional, 4 compliance, 2 integration). Confidence is reported throughout (131 corroborated, 20 emerging components; a large single-source tail kept as a watch-list), and the limitations found, such as interpretive AI-assisted coding, uneven engagement and curated cross-references, are stated plainly.

As a result this is a first, preliminary version of a living catalogue. This document is the starting point for the next refinement phase where stakeholders will be asked to review, improve, endorse or reject its contents. For this purpose, the catalogue has an online version <https://concept.riecs.eu/catalogue> with a “Contribute/Validate” function, and this will remain open for wider community validation in the second phase of RIECS-Concept, until the end of 2027. It is the direct input for further community engagement (WP4) and the technical design of WP3.

The catalogue defines what RIECS must be: a connecting infrastructure that builds the shared centre, federates the edges, serves every domain equally, and is governed for European public interest values. That is the main message RIECS-Concept now carries towards the ESFRI roadmap.



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1. Introduction

1.1 Position in Work Package 2

D2.3, created under Task 2.3, completes the feasibility research and conceptualization process in WP2, resulting in the first Key Exploitable Result (KER1) of the RIECS-Concept project. It is delivered as a public document at month 18, alongside its interactive online web version, the RIECS catalogue: <https://concept.riecs.eu/catalogue/>

Publishing the catalogue now, at the end of the first phase of the concept stage (month 18), fills also a milestone that opens a second phase in which the catalogue can be iterated, validated and improved together with the community before WP3 will use it as input for the technical feasibility work. This means translating the catalogue components into possible architectural options, data and metadata models, integration pathways with existing platforms and research infrastructures, EOSC alignment routes, and preliminary decisions on what RIECS should build, federate, reuse or support through standards. In the longer term it is a step toward establishing RIECS as a sustainable, ESFRI-compatible European research infrastructure for excellent citizen science. This document specifies the concept that such an infrastructure would realise.

1.2 Scope of this deliverable

This deliverable comprises a catalogue of services, resources and functionalities. We present that catalogue as a functional specification: a structured statement of what the RIECS platform must be able to do, expressed throughout as "the RIECS shall provide ...". Each catalogued RIECS item is typed as a Service, a Functionality or a Resource, grouped into thematic component groups, and organised on a small number of RIECS layers.

What this deliverable deliberately does not do is decide which concrete technologies will implement each component. That question belongs to the technical roadmapping and design in WP3. As introduced earlier, the catalogue is preliminary and it is a first version, built to be revised as the stakeholder engagement and the technical design continue.

In the longer term it is a step toward establishing RIECS as a sustainable, ESFRI-compatible European research infrastructure for excellent citizen science. This document advances the concept the functional concept that such an infrastructure would realise. This is strategically relevant now because citizen science landscape is growing and increasingly fragmented. Platforms, tools, datasets and services often develop in isolation, with uneven standards, limited interoperability and short project-based lifecycles. This document shows a unique response to this situation resulting in what RIECS should provide to help existing and future initiatives connect, remain autonomous and become reusable at European scale.



1.3 Relationship to the other project deliverables

In WP2 the deliverables form a short chain:

- D2.1 characterises the challenges and the existing landscape (drawing on the literature and existing portals);
- D2.2 distils the user stories into technical requirements and maps them, for the first time, onto suitable and feasible technologies;
- and this deliverable, D2.3, presents the preliminary catalogue of the services, resources and functionalities that the platform must provide.

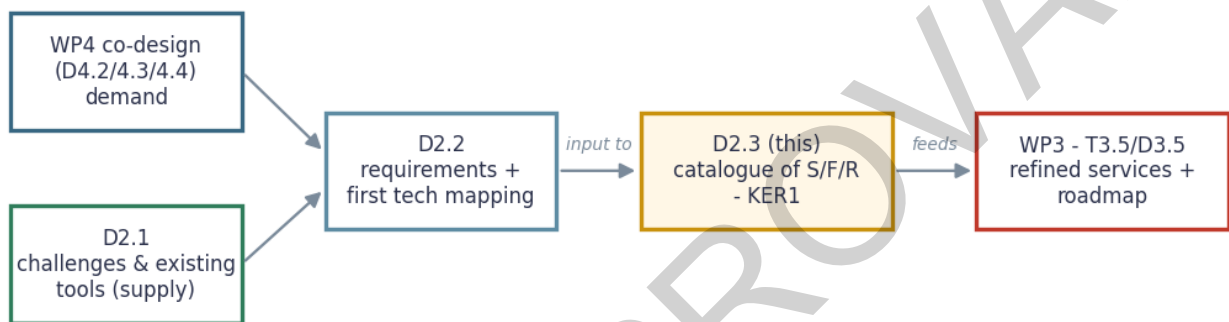


Figure 1. D2.3 in the project's deliverable chain.

The reciprocal relationship from the catalogue's side can be seen as follows:

- Upstream. The demand originates in the WP4 (D4.2, D4.3 and D4.4) and reaches this catalogue through the preparatory tasks of transcription, synthesis, clustering and labelling. The supply-side context comes from D2.1.
- D2.2 predecessor / continuation. The two are designed to be read together. While D2.2 distils the user stories into technical requirements and a first technology mapping, D2.3 continues from those same requirements to build the component catalogue. D2.3 is therefore the continuation of D2.2 and D2.2 is thus an input to D2.3. Their cross-check validation is external to both: each is checked against the 37 consortium-validated needs (N01–N37) originating from D4.2 and D4.3 and D2.2's requirements realise them and D2.3's components trace back to them
- Downstream. This catalogue is the direct input to the technical integration feasibility study (T3.5 / D3.5, KER2), which will update this catalogue and will turn components into design and technology choices. This document will be used for reference in the engagement activities during the second phase (WP5) too.



Table 2. Where this deliverable sits: its inputs, its predecessor D2.2 and its downstream results.

Relation	Deliverable(s)	What it contributes
Upstream (demand)	D4.2 / D4.3 / D4.4 (WP4 co-design)	The user stories: citizen, student and stakeholder demand/needs
Upstream (supply context)	D2.1	Challenges assessment and the existing-tools landscape
Predecessor (WP2)	D2.2 (MAU)	Technical requirements + first mapping to technologies, distilled from the user stories; D2.3 continues from these. Both meet the 37 needs
This deliverable	D2.3 (KER1)	The preliminary catalogue of services, resources and functionalities
Downstream	D3.5 (KER2)	Technical integration feasibility; refined catalogue and build/federate design
Downstream	D3.3 (KER3) / D3.4 (KER4)	Data model; implementation & sustainability roadmap

1.4 A dynamic catalogue open for validation

This document is a snapshot of a living and evolving idea and, as such, it exists in two forms from the same data: this fixed document (to be revised and updated when needed), and the interactive RIECS catalogue at <https://concept.riecs.eu/catalogue>, which is more easily navigable and continuously updated, durable and useful for wider validation to be carried out in the second phase. The catalogue is therefore evidence-led and expert-checked but open for community-based improvements.

For transparency, Table 3 records the catalogue's inputs and their validation status showing how each element is built on, and what is human-checked or machine-derived. What is then *produced* from these inputs is the subject of the Methodology and is shown at a glance in Figure 2. The principle, shared with D2.2, is that the document transparently details the provenance and the confidence of each input.

Table 3. Inputs and their validation status

Input	Source	Validation status
User stories - D4.2 (citizens & students)	WP4 co-design	Human-validated; the demand benchmark
User stories - D4.3 / D4.4 (stakeholders)	WP4 co-design	Accepted into the corpus; LLM-analysed; not separately human-validated
Demand evidence - the 37 needs (N01–N37)	D2.2	Human-validated (independent benchmark)
Demand evidence - technical requirements (RIECS-REQ)	D2.2	Taken from D2.2; referenced, not re-derived
Demand evidence - structural gaps (GAP-001...010)	D2.2	Taken from D2.2; referenced



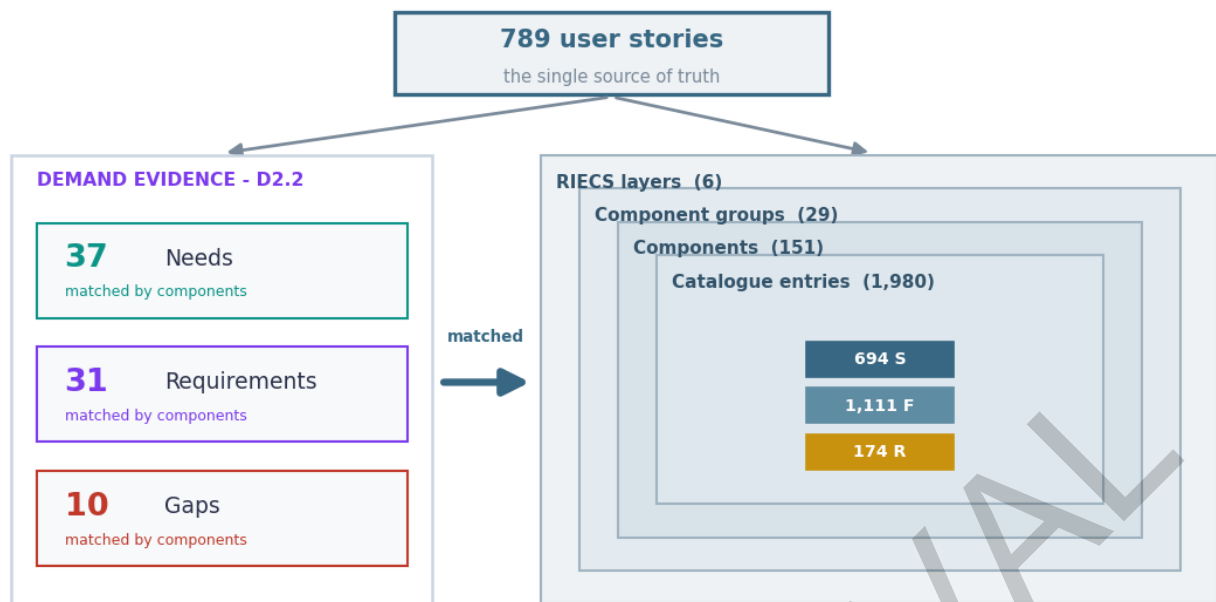


Figure 2. From user stories to the catalogue: every component matches the demand

2. Methodology

The catalogue is the result of a deliberately explicit, reproducible chain that turns community demands into a layered functional specification of resources, services and functionalities. It comprises the following tasks: the demand source i.e. the user stories; → multi-model extraction of atomic statements; → demand-pure deduplication into catalogue entries; → consolidation into named components; → a confidence weight; → the RIECS-catalogue layers; → typing into services, functionalities and resources; → addressing each component to the demand and the framework it serves; and → publication for further community validation,

Two preliminary remarks about technologies and the methodology followed:

- This catalogue is **independent of any existing tool** so no technology enters the demand-side analysis: statements are deduplicated on their own meaning, never against what some current platform already does. This design decision avoids favouritism and prejudging a solution, and it makes those components the community asks for but that no current platform provides survive into the catalogue instead of being silently absorbed. Existing technologies are already mapped and analysed in D2.2 so they are taken into account in the RIECS conceptualization and design process, but they do not constrain what RIECS should be at this point. This is important also because the technology landscape will keep changing over the coming years, while the demand the catalogue expresses is more stable.
- Using **three AI models** (DeepSeek V4, Claude Sonnet 4.6 and the European model Mistral Large) is a reliability measure mitigating the risk of having extraction results that are the model's artefact. The inclusion of a European model is pertinent for the data-sovereignty principle and strategic EU agendas.

The rest of this section walks the steps that matter most for reading the catalogue.

2.1 From conversations to a preliminary catalogue

The WP4 co-design conversations were transcribed, synthesised, clustered and labelled into user stories (D4.2–D4.4); those stories are the demand source for the pipeline described here, which continues ; and uses the same input as the requirement pipeline of D2.2. Of the 823 user stories collected through 36 workshops and a questionnaire (across D4.2, D4.3 and D4.4), 27 were excluded (not citizen science, not relevant for RIECS, too project-specific, duplicates, or without parseable content), leaving 796 in scope and valid for analysis. These valid stories are decomposed by the three models into statements, which are de-duplicated into 1,980 catalogue entries and then consolidated into 151 components. This attrition is shown in the funnel, Figure 3. These are statements of what the citizen science community actually asks a shared infrastructure to do - not an abstract wish-list.





Figure 3. From co-design demand to a functional specification.

Each user story is decomposed into atomic "*RIECS shall ...*" statements, and each statement is typed at the point of extraction as a Service, a Functionality or a Resource.

The lineage of every catalogue item is: *user story* → *statement* → *catalogue entry* → *component*.

Because each step preserves a link to the one before, every component in the catalogue can be traced back, to the specific stories behind it, and forward, from any story to where it landed.

2.2 Multi-model extraction and demand-pure deduplication

Statements are extracted by the three LLMs mentioned above, producing approximately 6,678 "shall" statements. Crucially, each statement is a real extracted sentence, not a model paraphrase, and remains attributable to its source story. The statements are then deduplicated on meaning alone, using sentence embeddings and agglomerative clustering at a conservative similarity threshold, with a manual audit for over-merges. They result into 1,980 catalogue entries.

A catalogue entry is still close to a single sentence; the raw per-catalogue-entry tags are too fine-grained to serve as the units of a specification. We therefore consolidate the 1,980 catalogue entries, by meaning, into 151 named components grouped into 29 component groups. Over-large buckets were split by reading the member catalogue entries and reassigning them by meaning; nothing is discarded in the process. The component is the unit of the catalogue: it is described, it carries its "shall" statement, it rolls up its services, functionalities and resources, and it traces down to its catalogue entries and the stories behind them.

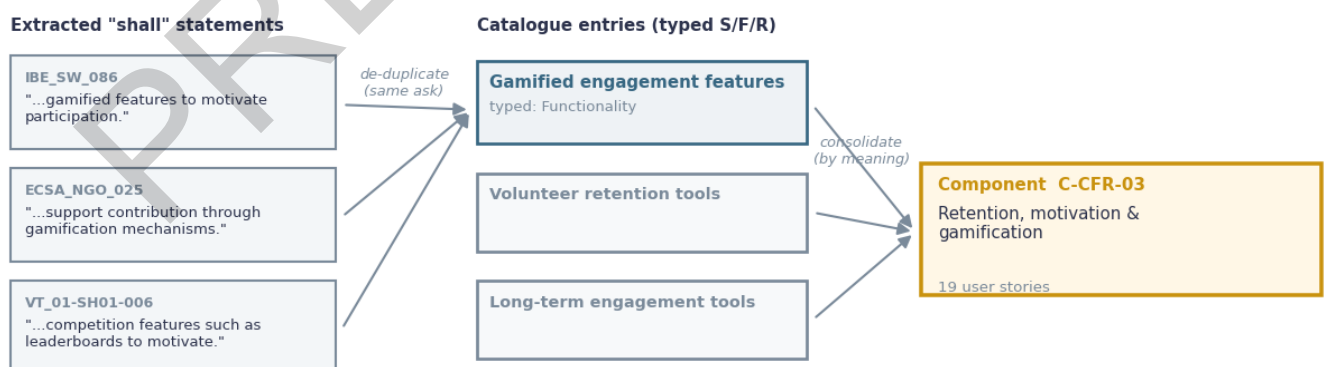


Figure 4. An example: many extracted statements about recognising contributors de-duplicate into one catalogue entry, which then consolidates with its sibling entries into component C-CFR-02.

They are not identical to the thematic structure of D2.2, but they derive from the same evidence base. D2.2 organises the 37 needs into nine thematic clusters and reports a set of higher-level cross-cutting concerns. D2.3 resolves that same demand into finer, nameable component groups arranged across seven functional layers. These layers were derived by organising the components according to the role they would play in a future research infrastructure: foundation, interoperability, participation, knowledge and impact, community and capacity, governance, and cross-cutting domain neutrality. The two structures are therefore continuous. Annex B traces each group back to the needs, so a reader arriving from D2.2's themes can follow where each lands.

✓ **L0 Foundation** · 4 groups · 17 components · RIECS builds & operates

The backbone RIECS builds and operates: identity, FAIR data, quality and compliance — where the structural gaps concentrate.

^ **L1 Interoperability & Federation** · 5 groups · 16 components · RIECS builds & operates

The federation contract: standards, APIs, federated discovery, and the EOSC / research-infrastructure node.

✓ **Interoperability & data standards** · 5 components

Standards, metadata and APIs that make citizen-science data FAIR and exchangeable.

^ **External system integration** · 5 components

Connecting the platform to external infrastructures (EOSC, Zenodo, OSF, institutional systems).

Open APIs & connectors (API-first integration)

corroborated

The platform shall expose open APIs, connectors and ingestion pipelines so external tools and data plug in (API-first).

● 3 services ● 5 functionalities ● 1 resources

9 catalogue entries · 13 stories · max 5 voices

External platform & data-source integration

corroborated

The platform shall integrate external platforms and data sources — connectivity, interlinking, multi-source aggregation.

● 9 functionalities ● 2 resources

11 catalogue entries · 25 stories · max 5 voices

Federated, non-centralised architecture

emerging

The platform shall run a federated, non-centralised architecture where projects and datasets federate rather than centralise.

● 2 services ● 1 functionalities

3 catalogue entries · 3 stories · max 1 voices

Figure 5. The catalogue's structure: RIECS layers to component groups to components, as shown on the RIECS platform (Catalogue · components).



2.3 Confidence

Each component carries a confidence label:

- **Corroborated:** A component is marked *corroborated* if it is corroborated by two or more independent stories (we find 131 of the 151);
- **Emerging:** for single-voice components (20).

This project assumes and understands that it is almost impossible to cover all the voices during the conceptualization process, and we witness that some arguments can be controversial. This way we keep corroboration as a confidence weight, not an inclusion filter. This lets the specification be transparent about how strongly each component is evidenced without losing the long tail of genuine but less-frequently-voiced demand. These elements are the material the project should revisit as more engagement data arrives from in-depth discussions with wider communities.

2.4 Mapping the catalogue with other outputs from the project

To make the catalogue useful and to connect it to the consortium's framework, every component is addressed to three things it serves:

- the **needs** (N01–N37) it helps realise - a direct link, since each component inherits the needs of its member catalogue entries;
- the **technical requirements** (the RIECS-REQ specification) it satisfies (from D2.2); and
- the **structural gaps** (GAP-001...010, from D2.1/D2.2) it helps to fill.

While the needs link is automatic (and reliable), the links to the D2.2 requirements and to the structural gaps were hand-curated: we read each of the 31 RIECS-REQ and 10 gaps against the 151 components of the catalogue and assigned each to the component (or components) it genuinely concerns. We chose a manual map because the automatic requirement-level crosswalk was too noisy to be trustworthy at this granularity (for example, it attached hosting gaps to the identity component). This mapping is documented in the convergence section below (11), and the full crosswalks are in Annexes C and D.

2.5 Traceability

Traceability is a property of every entry in the catalogue, in both directions: from any user story forward to the components it produced, and from any component backward to the stories and catalogue entries behind it.

Let's use a concrete example to show this: C-IDEN-01 component from the Foundation layer (L0):



C-IDEN-01 - Citizen-owned federated identity (AAI / SSO). "RIECS shall provide one citizen-owned, non-institutional identity, federated across platforms with single sign-on."
 Layer L0 · group Identity & EU-compliant services · 14 catalogue entries · 12 source stories
 · units 5 services / 8 functionalities / 1 resource · confidence: corroborated.

Integration with repositories & tools



C-ESI-04 · L1 · External system integration · emerging ?

The platform shall integrate with research repositories and tools (GitHub, Zenodo, OSF, institutional repositories, libraries).

7 catalogue entries · 4 user stories · max 1 independent voices

WHAT THIS COMPONENT ADDRESSES

NEEDS ?

N14 ×5

N08 ×2

REQUIREMENTS ?

RIECS-REQ-I-001

● Services (1)

R1323 · Best possible access across libraries

● Functionalities (6)

R0889 · Integrate research findings

R1234 · Interoperability with museum systems

R1237 · Integrate GitHub repositories

R1238 · Integration with Zenodo

R1239 · Integration with OSF

R1673 · integrate institutional library services

Supporting user stories (4) — traceability

CSZ_SG_008 · Citizens · D4.2

citizen interested in the scientific area I would like access to literature, often behind paywalls — I'd like to be temporarily granted the same rights as...

Figure 6. A component on the RIECS platform: its "shall" statement, its services/functionalities/resources and the stories behind it,.



Forward traceability (from stories to the catalogue). The component is built from asks. For example, a technology provider (story ECSA_ccc_003, D4.3) wrote "*I want to have lower social and institutional barriers for hardware builders to contribute to citizen science*"; a citizen scientist (0eAD_01_044, D4.2) asked to "*make my contributions in an easy-to-use, privacy-friendly, interoperable app*". Such statements were extracted into atomic, typed statements and deduplicated; the resulting catalogue entries that make up this component include:

- R0177 (Service) - "... a single trusted identity and login mechanism that is recognised across all participating citizen science platforms so contributors do not need separate accounts on each."
- R1687 (Resource) - "... integrate with external authentication providers or standards (e.g. OAuth, OpenID Connect) to enable unified sign-up/login."
- R0625 (Service) - "... a unique, persistent identifier for each participant that enables participation across multiple projects while protecting personal data."
- R1469 (Functionality) - "... act as a connector that gives users access to multiple existing CS spaces and platforms from a single login, without requiring them to adopt RIECS as a primary platform."

The last of these is worth noting: the community itself frames identity as a connector to existing platforms, not a reason to move to a new one, highlighting the federation stance voiced by the community.

Backward traceability (from the catalogue to the conversations). From the component one can read straight back to its 14 catalogue entries and to the 12 stories that produced them (navigable in the online explorer of this document). Every "shall" shown above is a real extracted sentence, attributable to a specific story; none is a paraphrase.

Addressing forward (what the component serves). The component is linked to the demand and the framework it answers:

- Needs: it contributes to N14 Interoperability and platform integration, N08 Open Science / FAIR / CARE compliance, N05 Shared data and metadata standards, and N03 Low-barrier participation.
- D2.2 requirement: it satisfies RIECS-REQ-N-001 (the RIECS shall implement a federated identity and access management).
- Structural gap: it helps fill GAP-001 (no common identity/AAI layer across citizen science platforms; participants need *separate accounts per project*).

Addressing backward (need/gap/requirement to components). The same links read backwards:

- The structural gap GAP-001 is addressed by three components, all in L0: C-IDEN-01 (federated identity), C-IDEN-02 (persistent login & profile) and C-IDEN-03 (identity & contribution portability). This is why the gap is described as a backbone the platform must build;
- the D2.2 requirement RIECS-REQ-N-001 is satisfied by C-IDEN-01 and C-IDEN-02;
- the need N14 (Interoperability and platform integration) is broader and is addressed by 42 components spanning several layers: from identity and FAIR storage in L0 (C-IDEN-01,



C-ODAR-01) to the interoperability standards and the EOSC federation of L1 (C-INTS-02, C-INTS-03).

These reverse links are the content of Annexes B (needs to components), C (gaps to components) and D (D2.2 requirements to components); the aggregate is the convergence reported in Section 11.

This example therefore illustrates the whole chain from community demand to catalogue entries to a named component, traceable in both directions and addressed both ways. Since it is in L0, It is also a clear instance of the architecture's missing backbone component that no single existing platform provides, and that RIECS must therefore build. The same structure holds for all 151 components; the layer sections that follow this one present them group by group.

PRE-APPROVAL



3. The RIECS Catalogue layered architecture

This section presents the catalogue's architecture with the seven layers and the units (Service, Functionality, Resource) it is made of. The detailed, layer-by-layer content is in the upcoming sections. The full registers are in the annexes.

3.1 The seven layers at a glance

Every component sits in one RIECS layers that covers the catalogue from the technical foundation upwards to governance:

- **L0: Foundation.** RIECS shall provide the trustworthy core every project stands on: identity, data, quality, compliance.
- **L1: Interoperability & Federation.** RIECS shall let platforms and the European cloud interoperate: standards, APIs, discovery, and an EOSC node.
- **L2: Participation & Workflow.** RIECS shall let people create projects, collect data and take part, accessibly.
- **L3: Knowledge, Analysis & Impact.** RIECS shall turn contributions into analysis, reuse, decisions and policy evidence.
- **L4: Community, Recognition & Capacity.** RIECS shall recognise contributors and build community, skills and connections.
- **L5: Governance of the RI.** RIECS shall govern the infrastructure: participatory governance, sustainability, ethics and AI accountability.
- **L6: Cross-cutting.** RIECS must provide multi-domain support for domain neutrality

The reading of this architecture is:

- Build the centre, federate the edges, The centre is L0 and L1, the backbone and the federation contract, with 33 of the 151 components. This represents what RIECS must build and operate itself, because this is precisely where the field's structural gaps concentrate and where no single existing platform provides a shared solution.
- The capable edge is L2–L4, the participation, knowledge and community layers. They include 103 components in total, much of which can be met by connecting to or federating capable existing or new platforms as peers rather than rebuilding them.
- In order to govern for sustainability, and serve every domain equally, we have L5 (governance, 14 components) and the Cross-cutting L6 (1 component) that span the whole architecture.

We suggest this reading as a design stance, informed by the evidence, not a measured fact. Whether a given edge component is ultimately met by federating a peer or by building is a decision for the technology mapping in the future (for instance, as part of D3.5), taken component by component; the catalogue's role is to say *what* is required, not to pre-empt that choice.





Figure 7. The RIECS layers and their component groups: L0–L5 plus the cross-cutting domain-neutrality property; the centre (L0–L1, build) and the edge (L2–L4, federate).

Table 4 also presents the layers to their component groups; Table 5 gives the per-layer figures.

Table 4. The seven layers and their 29 component groups

Layer	Component groups
L0: Foundation	Identity & EU-compliant services · Open data access & repositories · Data quality & validation · Data privacy & protection
L1: Interoperability & Federation	Interoperability & data standards · External system integration · Project discovery & outreach · European scale & deduplication · Search & filtering
L2: Participation & Workflow	Citizen data collection & integration · Usability & modular workflows · Project participation spaces · Accessibility & multilingual support · Multimedia & storytelling contribution · Participant communication & onboarding
L3: Knowledge, Analysis & Impact	Data reuse & export · Policy outputs & visualisation · Project showcasing & dashboards
L4: Community, Recognition & Capacity	Contribution feedback & retention · Community building · Collaboration & matchmaking · Guidance & methodological support · Training materials & courses · Methods, equipment & documentation · Expertise discovery & directories
L5: Governance of the RI	Governance & transparency · Funding & sustainability · AI transparency & ethics
L6: Cross-cutting	Multi-domain support (domain-neutrality)

Table 5. Master rollup by RIECS layer

Layer	Groups	Components	Catalogue entries	Services (S) / Functionalities (F)/ Resources (R))
L0 : Foundation	4	17	187	78 / 103 / 6
L1 : Interoperability & Federation	5	16	222	58 / 152 / 12
L2 : Participation & Workflow	6	29	356	107 / 229 / 20
L3 : Knowledge, Analysis & Impact	3	19	237	63 / 162 / 12
L4 : Community, Recognition & Capacity	7	55	687	268 / 332 / 87
L5 : Governance of the RI	3	14	142	52 / 64 / 26
L6 : Cross-cutting (multi-domain support)	1	1	149	68 / 69 / 11
Total	29	151	1,980	694 / 1,111 / 174

3.2 The units of the catalogue: Service, Functionality, Resource

The catalogue is built from three unit types, assigned to each catalogue entry at extraction:

- a **Service** is a standalone capability RIECS runs and offers as a unit (for example, hosting, an identity service, a project directory);



- a **Functionality** is a specific feature *within* a service (for example, filtering a dataset, exporting results, giving feedback);
- a **Resource** is an asset or material RIECS provides or makes available (for example, a dataset, a template, a training guide).

Of the 1,980 catalogue entries, 694 are services, 1,111 are functionalities and 174 are resources (the remaining one is typed as an integration). Each component rolls up the services, functionalities and resources beneath it; the full per-component breakdown is navigable on the platform, and the deduplicated entry register in Annex A.

This distribution is informative. Functionalities dominate, while resources form the smallest category. This does not mean that RIECS will not host or curate materials. Many services, such as training, guidance, documentation, templates or methodological support, will require stable resources behind them. Rather, the distribution shows that stakeholder demand is mainly expressed as capabilities and actions: validating data, finding projects, accessing guidance, receiving feedback, exporting results or connecting with others. That is consistent with an enabling infrastructure that provides and curates key resources where needed, while also connecting users to external datasets, tools and platforms.

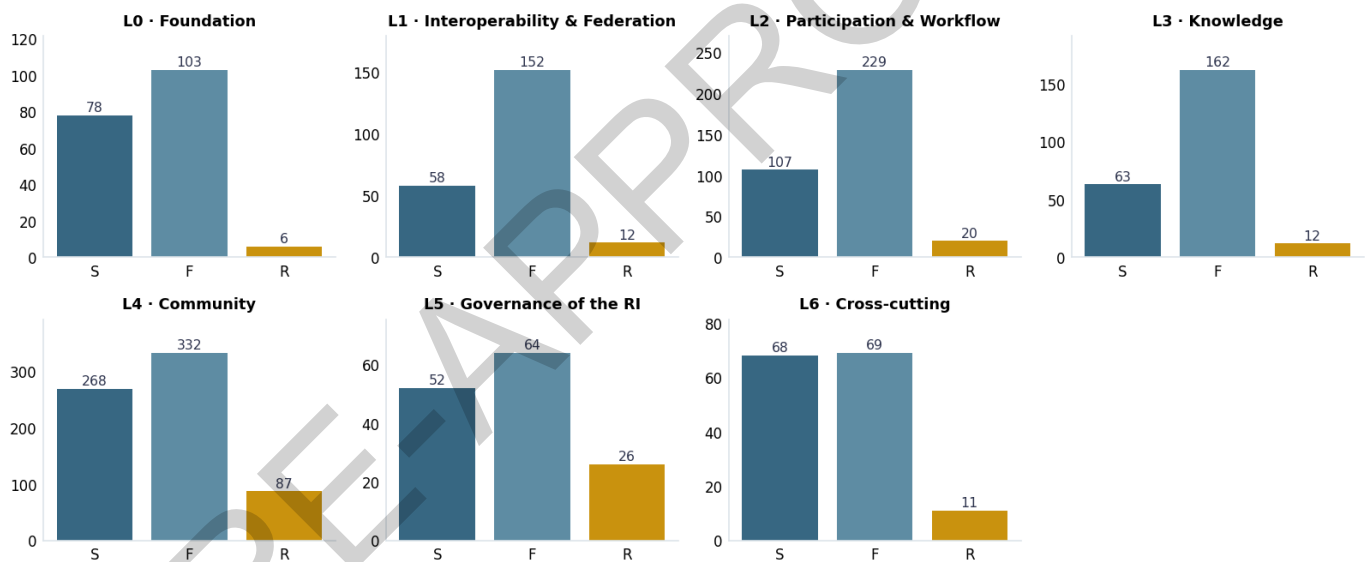


Figure 8. Per-layer composition: services, functionalities and resources in each of the seven layers.

4. Layer L0: Foundation

RIECS shall provide the trustworthy core every project stands on: identity, data, quality, compliance.

L0 is the backbone RIECS must build and operate with 17 components in 4 component groups: *Open data access & repositories*, *Data quality & validation*, *Data privacy & protection*, and *Identity & EU-compliant services*.

These groups are drawn from 187 catalogue entries and 219 source-story appearances. With L1 it forms the centre of the catalog architecture and the components here are where the field's structural gaps concentrate, and they are precisely the shared foundation that no individual platform provides today.

Four of the ten structural gaps land in this layer: the absence of a common identity layer (GAP-001), of a shared validation/quality service (GAP-004), of a sustainable hosting offer (GAP-005), and of resolved cross-border data-protection handling (GAP-009); a fifth, cross-project recognition (GAP-006), is seeded here through credential recognition and continued in L4.

4.1 Components

L0 component groups and components are presented in the tables below:

Open data access & repositories (2 components)	
<i>Sharing, storing and providing open, traceable access to citizen science datasets.</i>	
FAIR data storage & repositories (at scale)	C-ODAR-01
20 Services 14 Functionalities 1 Resource	
Provide trusted, long-term, scalable storage and repositories for citizen science data and project outputs.	
Needs N04, N01, N33, N11, N08, N05... Reqs F-004, N-003 Gap GAP-005	
Open data access & discovery	C-ODAR-02
9 Services 2 Functionalities	
Provide open, unified access to datasets, publications and project outputs (open science).	
Needs N08, N10, N02, N30, N18, N16	
Data quality & validation (5 components)	
<i>Workflows and tools to check, validate and certify the quality of citizen science data.</i>	
Automated & rule-based data validation	C-DQV-01
3 Services 15 Functionalities	
Validate data quality automatically — cross-checks, validation workflows, real-time and standards-based rules.	
Needs N04 Reqs F-008 Gap GAP-004	
Expert & peer-review validation	C-DQV-02
2 Services 4 Functionalities	
Support human-in-the-loop validation: expert review, peer review and collaborative verification.	
Needs N04, N08 Reqs F-008 Gap GAP-004	
Data reliability scoring & quality signals	C-DQV-03
4 Functionalities	
Assess reliability and surface quality to users — quality stamps, credibility signals, status display.	
Needs N04, N19 Reqs F-008 Gap GAP-004	
Sensor & measurement calibration (low-cost-instrument QA)	C-DQV-04
3 Services 3 Functionalities 1 Resource	
Support calibration and quality assurance for low-cost sensors and DIY measurement instruments.	
Needs N04, N05 Reqs F-008 Gap GAP-004	
Validated data access & quality monitoring	C-DQV-05
5 Services 1 Functionality	



Expose validated, traceable, quality-monitored data (incl. EU-scale validation harmonisation).
Needs N04, N03

Data privacy & protection (5 components)

Consent, privacy, security and ethical governance of sensitive participant data.

Data protection & GDPR compliance C-DPP-01

8 Services 7 Functionalities 2 Resources

Keep data handling GDPR/legally compliant — privacy-by-design, compliance tracking and regulatory monitoring.

Needs N07, N08, N01, N37, N05, N06... **Reqs** C-001 **Gap** GAP-009

Consent management C-DPP-02

6 Functionalities

Manage user consent — adaptive, granular and explicit, including consent for AI processing.

Needs N07, N08, N06 **Reqs** C-001

Sensitive-data governance & access control C-DPP-03

6 Services 10 Functionalities

Govern sensitive data with role-based, revocable, secure access control and sensitive-data flagging.

Needs N07, N08, N06, N02 **Reqs** N-006

Data ownership, sovereignty & participant control C-DPP-04

4 Services 14 Functionalities

Give participants ownership and control of their data — sovereignty, self-determination, usage transparency, anti-exploitation.

Needs N07, N28, N04, N30, N09 **Reqs** C-002

Anonymisation & pseudonymisation C-DPP-05

1 Service 2 Functionalities

Anonymise or pseudonymise participant data and metadata.

Needs N07, N11, N06

Identity & EU-compliant services (5 components)

Federated identity, authentication and EU-compliant hosting and tools.

Citizen-owned federated identity (AAI / SSO) C-IDEN-01

5 Services 8 Functionalities 1 Resource

Provide one citizen-owned, non-institutional identity, federated across platforms with single sign-on.

Needs N14, N08, N05, N03, N13, N10... **Reqs** N-001 **Gap** GAP-001

Persistent login & user profile C-IDEN-02

5 Functionalities

Keep users logged in and save their profile and contributions across sessions.

Needs N11, N03 **Reqs** N-001 **Gap** GAP-001

Identity & contribution portability C-IDEN-03

5 Functionalities

Let users carry their account, identity and recognition across platforms.

Needs N14, N19, N05, N28 **Gap** GAP-001

EU-compliant / sovereign tooling (GDPR-safe) C-IDEN-04

9 Services 1 Resource

Offer EU-hosted, GDPR-compliant alternatives to commercial tools (storage, video, docs, signing, AI).

Needs N22, N08, N19, N11, N10, N30... **Reqs** C-004 **Gap** GAP-009

Accreditation & credential recognition (Europass / ECTS / EQF) C-IDEN-05

3 Services 3 Functionalities

Support accredited training and portable credentials.

Needs N19, N14, N17 **Gap** GAP-006



4.2 What the layer provides

Data and repositories. The most-evidenced component in the whole catalogue's foundation is FAIR data storage and repositories at scale (C-ODAR-01, 61 stories): a place for citizen science data to live, findable and reusable, that small and medium projects do not have to provision themselves. This directly answers the sustainability gap GAP-005 and connects to D2.2's hosting requirement (RIECS-REQ-F-004). It is complemented by open data access and discovery (C-ODAR-02), which makes that data usable beyond the project that produced it.

Quality. Data quality is the single most-reported problem in the evidence, and it surfaces here as a cluster of validation components: automated and rule-based validation (C-DQV-01, 49 stories), expert and peer review (C-DQV-02), reliability scoring (C-DQV-03) and sensor/measurement calibration (C-DQV-04). Together they address GAP-004 and D2.2's RIECS-REQ-F-008.

Privacy and compliance. A substantial privacy block covers GDPR compliance (C-DPP-01), sensitive-data governance (C-DPP-03), consent management (C-DPP-02), anonymisation (C-DPP-05) and data ownership and participant control (C-DPP-04). The last of these is notable: the community asks not only that data be handled lawfully but that participants own and control their own data so a sovereignty ask voiced by the community, which the catalogue records as a requirement (RIECS-REQ-C-002) rather than an assumption. The privacy block answers GAP-009 (unresolved cross-border legal/ethics handling).

Identity. The identity group makes participation possible across the federation. Its central component is citizen-owned federated identity (C-IDEN-01): one non-institutional login recognised across platforms, filling GAP-001. Around it sit persistent login and profile (C-IDEN-02), identity and contribution portability (C-IDEN-03), accreditation and credential recognition through European instruments such as Europass/ECTS/EQF (C-IDEN-05, seeding GAP-006), and EU-compliant, sovereign tooling (C-IDEN-04), GDPR-safe, EU-hosted alternatives to commercial tools, the clearest expression in L0 of the European technological-sovereignty point of view. Several identity components are *emerging* (single-voice) and are flagged as such; they are kept because they articulate a coherent and strategically important demand even where corroboration is still thin.

4.3 Who asks for it

L0 is demanded by citizens, researchers, NGOs and the others, which is consistent with its intention with a common infrastructure. NGOs and practitioners are relatively prominent in the privacy and data-governance components, and technology providers in the identity and sovereign-tooling components, but no single group dominates the layer. Further details can be found in the platform's *By stakeholder group* view ([/#/catalogue/stakeholders](#)).



4.4. Key findings for this layer

- The foundation is the part nobody else provides with ten structural gaps; these are shared services (identity, quality, hosting, compliance) that exist today only inside individual platforms, if at all.
- Quality and data dominate the evidence. The most-evidenced foundation components concern storing, opening and validating data, matching the finding that data quality is the field's number-one problem.
- Sovereignty is asked for, not only imposed. Participant data ownership (C-DPP-04) and EU-compliant sovereign tooling (C-IDEN-04) show that European data sovereignty is asked for by the community, not merely imposed as a policy goal. The sovereign-tooling component is still emerging and should be watched as more evidence arrives.



5. Layer L1: Interoperability & Federation

RIECS shall let platforms and the European cloud interoperate: standards, APIs, discovery, and an EOSC node.

L1 is the federation contract i.e. the part of the architecture that lets the rest connect. It holds 16 components across 5 component groups (Interoperability & data standards, External system integration, Project discovery & outreach, European scale & deduplication, and Search & filtering) from 222 catalogue entries and 267 story appearances. It shows how RIECS opens to others: the standards, APIs and discovery surfaces through which existing platforms join as peers, and through which the RI connects upward to the European research-infrastructure landscape.

RIECS connects rather than replaces and does so by invitation, with no privileged actor. At this point, existing standards and tools such as PPSR Core, Darwin Core, the major platforms, are treated as examples to learn from and to base an open standard on, not technologies to mandate. The literature finds that participation platforms already abound and that the real shortfall is connective tissue, with *people independently ask to connect and standardise, not to rebuild*. L1 specifies that connective tissue.

Two of the ten structural gaps fall here: the absence of a federated cross-domain directory (GAP-002) and the low adoption of shared metadata standards and tooling (GAP-003).

5.1 Components

L1 component groups and components are presented in the tables below:

Interoperability & data standards (5 components)	
<i>Standards, metadata and APIs that make citizen science data FAIR and exchangeable.</i>	
Data standards, metadata & provenance C-ODAR-03 3 Services 20 Functionalities 3 Resources Provide shared metadata standards (e.g. PPSR Core), provenance and traceability for reproducible data. Needs N04, N05, N10, N30, N36, N06... Reqs F-009, F-010 Gap GAP-003	
FAIR / CARE data compliance C-INTS-01 8 Services 6 Functionalities Make data FAIR and CARE compliant — findable, accessible, interoperable, reusable, with preservation and long-term availability. Needs N08, N03, N04, N22, N07 Reqs C-003	
Interoperability standards & data exchange C-INTS-02 1 Service 17 Functionalities 2 Resources Let systems interoperate — open interoperability standards, interoperable interfaces, extensible and federated data exchange. Needs N01, N14, N04, N05, N08, N07... Reqs F-009 Gap GAP-003	
EOSC & research-infrastructure federation C-INTS-03 2 Services 4 Functionalities Federate upward into EOSC and sibling research infrastructures (LifeWatch, GBIF/DiSSCo, ENVRI, policy systems). Needs N30, N14, N05, N28 Reqs I-002	
Secure & trustworthy data exchange (cybersecurity baseline) C-INTS-04 8 Services 4 Functionalities 1 Resource Keep exchange secure and the platform trustworthy — cybersecurity baseline, secure protocols, reliability. Needs N10, N06, N28, N33, N14, N04... Reqs N-006	



External system integration (5 components) <i>Connecting the platform to external infrastructures (EOSC, Zenodo, OSF, institutional systems).</i>	
Open APIs & connectors (API-first integration) C-ESI-01 3 Services 5 Functionalities 1 Resource Expose open APIs, connectors and ingestion pipelines so external tools and data plug in (API-first). Needs N14, N33, N04, N05, N08 Reqs I-001 Gap GAP-003	
External platform & data-source integration C-ESI-02 9 Functionalities 2 Resources Integrate external platforms and data sources — connectivity, interlinking, multi-source aggregation. Needs N14, N02, N01, N25 Reqs I-001	
Federated, non-centralised architecture C-ESI-03 2 Services 1 Functionality Run a federated, non-centralised architecture where projects and datasets federate rather than centralise. Needs N15, N07, N14 Reqs N-002	
Integration with repositories & tools C-ESI-04 1 Service 6 Functionalities Integrate with research repositories and tools (GitHub, Zenodo, OSF, institutional repositories, libraries). Needs N14, N08 Reqs I-001	
Integration with institutions & research infrastructures C-ESI-05 3 Services 15 Functionalities 2 Resources Integrate with institutions and research infrastructures (incl. the EOSC ecosystem) and link informal work to formal research. Needs N02, N14, N01, N05, N11, N04... Reqs I-002	
Project discovery & outreach (2 components) <i>Finding projects and raising public awareness, including classroom and dissemination support.</i>	
Project & initiative discovery (European directory) C-PDO-01 16 Services 16 Functionalities Provide a pan-European, filterable directory of citizen science projects and initiatives, with cross-catalogue sync and a unified discovery portal. Needs N01, N02, N30, N33, N16, N03... Reqs F-001 Gap GAP-002	
Discovery of people, resources & opportunities C-PDO-02 3 Services 4 Functionalities 1 Resource Let users discover experts, collaborators, resources, conferences, journals and funding calls across the ecosystem. Needs N01, N20, N33, N31, N26 Gap GAP-002	
European scale & deduplication (2 components) <i>Cross-border scaling, comparability and avoiding duplication across the EU RI ecosystem.</i>	
Deduplication & redundancy reduction C-ESD-01 2 Services 13 Functionalities Detect and avoid duplicated projects, data and infrastructure across the federation — dedup alerts, conflict resolution, cross-catalogue sync. Needs N05, N01, N24, N02, N03, N15...	
Pan-European scale & geographic reach C-ESD-02 5 Services 12 Functionalities Operate at pan-European scale — geographic scalability, cross-country/cross-border reach and a shared European citizen pool. Needs N28, N01, N05, N02, N09, N15... Reqs N-003	
Search & filtering (2 components) <i>Faceted search and filtering across projects, data, funding and organisations.</i>	
Faceted search & filtering of projects & resources C-SF-01 16 Functionalities Let users search and filter projects, training, journals, organisations and funding by interest, topic, domain, capacity and more.	



Needs N01, N26, N12, N22, N29, N08...	Reqs F-001	Gap GAP-002
Data filtering (spatial, temporal, taxonomic) C-SF-02		
1 Service 4 Functionalities		
Filter data by region, location, date, time period and taxon, with locality-aware suggestions.		
Needs N10, N01, N09, N04, N11		

5.2 What the layer provides

Discovery: finding what already exists. The most-evidenced L1 component is a pan-European directory of projects and initiatives (C-PDO-01, 68 stories), extended by discovery of people, resources and opportunities (C-PDO-02) and by faceted search and filtering (C-SF-01, C-SF-02). Together they answer GAP-002 and D2.2's RIECS-REQ-F-001. This is federation in its simplest, most-requested form: making the existing landscape visible in one place, without absorbing it.

Standards and interoperability. A cluster of standards components forms the technical core of federation, the contract: data standards, metadata and provenance (C-ODAR-03, 58 stories), interoperability standards and data exchange (C-INTS-02), FAIR/CARE compliance (C-INTS-01) and secure, trustworthy data exchange (C-INTS-04). These address GAP-003 and D2.2's RIECS-REQ-F-009/F-010. So RIECS specifies the contract (the standard, the crosswalks, the conformance), learning from existing schemas rather than anointing one; this is the "RIECS-Compatible" or "RIECS-Readiness Levels" idea that lets platforms interoperate as equals.

External integration and scale. Open APIs and connectors (C-ESI-01, API-first), external platform and data-source integration (C-ESI-02), integration with institutions and research infrastructures (C-ESI-05), and a federated, non-centralised architecture (C-ESI-03) specify how peers actually plug in; pan-European scale (C-ESD-02) and deduplication (C-ESD-01) specify that it must work at European scale without re-creating the same records many times. These connect to D2.2's integration requirements (RIECS-REQ-I-001) and its modular, federated architecture requirement (RIECS-REQ-N-002).



Federation upward (EOSC and ESFRI)

Beyond connecting citizen science platforms to each other (peer federation, above), RIECS aims to be positioned as a node in the European research-infrastructure landscape, responding to the consortium vision and expectations from the funding call. This federation upward, that the architecture adds deliberately, implies the alignment with the EOSC (the European Open Science Cloud) and its interoperability framework, its identity federation (EOSC AAI / eduGAIN), its Marketplace/Catalogue, and FAIR data with persistent identifiers, as well as the interoperability with existing ESFRI infrastructures such as LifeWatch, GBIF/DiSSCo, eLTER-RI, Operas and ENVRI.

In the catalogue this is C-INTS-03 (EOSC & research-infrastructure federation), addressing D2.2's RIECS-REQ-I-002. Two notes. First, EOSC is not confined to L1: it threads through several layers since EOSC AAI touches L0 identity (C-IDEN-01), FAIR data and PIDs touch L0 open data (C-ODAR-01), while the interoperability framework and Marketplace sit in L1. Second, EOSC is an architect-added component, part of positioning RIECS as an ESFRI-scale research infrastructure, and not a direct community request; it is flagged as such in the addressing, in the same way as the domain-neutrality property, so it is not mistaken for story-level demand.

5.3 Who asks for it

L1 demand is broad but tilts towards the actors who most need to connect: researchers and CS networks for standards and institutional integration, technology providers for APIs and interoperability (L1 is in fact technology providers' single top layer), and policy makers for the European directory and scale. As with L0, the foundation/federation centre is shared across groups rather than owned by one (see [/#/catalogue/stakeholders](#)).

5.4 Key findings for this layer

- **The most-wanted single component is discovery.** A pan-European directory (C-PDO-01) is the best-evidenced component of the whole centre confirming that the field's first need is to *see and connect* what exists, not to build another platform.
- **Federation is a contract, learned from existing standards, not a mandate.** The standards cluster specifies interoperability by reference to schemas like PPSR Core and Darwin Core as examples, consistent with "no privileged actor"; it fills GAP-003 without decreeing a winner.
- **Upward federation is a design choice, marked as such.** The EOSC/RI node (C-INTS-03) is deliberately added for ESFRI positioning and is flagged as architect-added rather than story-demanded, so the deliverable does not overstate community demand for it.



6. Layer L2: Participation & Workflow

RIECS shall let people create projects, collect data and take part, accessibly.

With L2 the catalogue crosses from the centre to the edge. It is the first of the citizen and project-facing layers. It has 29 components across 6 component groups, namely: *Citizen data collection & integration*, *Usability & modular workflows*, *Project participation spaces*, *Accessibility & multilingual support*, *Multimedia & storytelling contribution*, and *Participant communication & onboarding*; from 356 catalogue entries and 283 story appearances.

A word on how to read this layer and the two that follow. L2–L4 are the federate-able edge: much of what they describe is already done well, somewhere, by an existing platform. The design intent is therefore to federate capable peers for these components wherever possible, and to build only where federation cannot reach. This decision is taken in the technology mapping of D2.2 not here. The catalogue's job in L2–L4 is to state, from the evidence, *what participation must be possible*; it does not claim that RIECS itself must implement each item.

One structural gap falls squarely here: multilingual support and accessibility as afterthoughts in existing tools (GAP-008); a second, the pipeline from citizen data to authorities (GAP-007), is seeded here through official-data integration and continued in L3.

6.1 Components

L2 component groups and components are presented in the tables below:

Citizen data collection & integration (8 components)	
<i>Collecting citizen-contributed data and integrating it with official datasets.</i>	
Data integration with official, IoT & municipal systems C-CDC-02	
2 Services 9 Functionalities	
Integrate citizen data with official datasets, monitoring systems, IoT and municipal/research databases.	
Needs N04, N33, N26, N02, N30, N05... Gap GAP-007	
Citizen data access, ownership & control C-CDC-03	
5 Services 5 Functionalities 2 Resources	
Give citizens access to and control over their own contributed data (ownership, co-ownership, visibility).	
Needs N07, N04, N01, N36, N10, N19...	
Incident & issue reporting to authorities C-CDC-04	
5 Services 9 Functionalities	
Let citizens report incidents and issues (defects, hazards, crises) to municipalities/authorities, with follow-up and dashboards.	
Needs N08, N11, N01, N03, N19	
Geospatial mapping & real-time reporting C-CDC-05	
4 Functionalities	
Map and tag reports geospatially and surface them in real time.	
Needs N11, N03	
Mobile & field data collection C-CDC-01	
1 Service 9 Functionalities 1 Resource	
Collect data via mobile, offline, on-site and device-agnostic tools.	
Needs N11, N13, N05, N03, N14, N19... Reqs F-006	
Data entry forms & survey tools C-CDC-06	
1 Service 10 Functionalities	
Provide configurable data-entry forms, surveys and supplementary capture.	
Needs N11, N04, N05, N03, N10, N02 Reqs F-006	
Crowdsourcing & large-scale collection C-CDC-07	



7 Services 4 Functionalities Run crowdsourcing and large-scale (ML-grade) data collection with workflows and logistics. Needs N11, N04
Thematic & participatory data collection C-CDC-08 4 Services 9 Functionalities 1 Resource Collect thematic data and let citizens shape collection. Needs N11, N05, N04, N02, N01, N19
Usability & modular workflows (4 components) <i>Simple interfaces, modular components and streamlined low-effort workflows.</i>
Usable, intuitive & performant interface C-UMW-01 2 Services 11 Functionalities Provide a user-friendly, intuitive, responsive interface across web and mobile. Needs N03, N13, N14, N11, N02, N16... Reqs N-004
Low-barrier & low-effort participation C-UMW-02 8 Services 11 Functionalities Make participation low-barrier and low-effort — micro-tasks, quick submission, non-digital and low-tech options. Needs N01, N03, N10, N21, N13, N08...
Modular, customisable & automated workflows C-UMW-03 6 Services 20 Functionalities 1 Resource Offer modular, customisable and automatable workflows and components (plug-and-play, project-level customisation). Needs N14, N10, N11, N02, N28, N15... Reqs N-002
Open-source & open infrastructure C-UMW-04 4 Services 2 Functionalities 5 Resources Be open-source and open-infrastructure, autonomy-preserving and transparent. Needs N14, N08, N22, N37, N29, N11... Reqs N-007
Project participation spaces (5 components) <i>In-project access, communication and discovery of tasks, materials and opportunities.</i>
Project creation, setup & management C-PPS-01 5 Services 10 Functionalities Let users design, set up, configure and manage citizen science projects (incl. proposal & feasibility tools). Needs N11, N26, N18, N30, N12, N16... Reqs F-004
Project profile & information display C-PPS-02 2 Services 23 Functionalities Present each project's profile and details — tasks, time, device needs, status, summaries and results. Needs N01, N11, N07, N24, N05, N17...
In-project communication & discussion C-PPS-03 1 Service 8 Functionalities Provide in-project communication — discussion forums, channels, subscriptions and Q&A. Needs N02, N23, N26, N07, N04, N01
Participation opportunities & workspace C-PPS-04 5 Services 7 Functionalities Give participants a workspace with activities, materials, opportunities and invitations (schools, institutions, collaborators). Needs N02, N01, N18, N03, N10, N19...
In-project contributor roles & recognition C-PPS-05 1 Service 3 Functionalities Attribute contributor roles and surface recognition within projects. Needs N01, N06, N18, N20
Accessibility & multilingual support (3 components) <i>Accessible, multilingual interfaces and materials for diverse users.</i>
Accessibility & inclusive UI (WCAG) C-AML-01



4 Services 7 Functionalities Be accessible and inclusive by design — WCAG-compliant UI, accessible results and welcoming interaction. Needs N03, N06, N01, N30 Reqs N-005 Gap GAP-008
Multilingual interface & translation C-AML-02 4 Services 5 Functionalities 2 Resources Support multiple languages — multilingual interface, materials, surveys and consent, with translation services. Needs N03, N16, N05, N18, N14, N07... Reqs N-005 Gap GAP-008
Accessible content, plain language & cultural adaptation C-AML-03 2 Services 7 Functionalities 2 Resources Deliver content in plain language, editable formats and culturally adapted forms. Needs N33, N02, N05, N25, N20, N03... Reqs N-004 Gap GAP-008

Multimedia & storytelling contribution (3 components) <i>Tools for citizens to contribute multimedia, narratives and observations easily.</i>
Multimedia capture & upload (photo/video/audio/3D) C-MS-C-01 1 Service 19 Functionalities Let citizens capture and upload photos, video, audio and 3D media, with automatic metadata and media-based identification. Needs N11, N04, N19, N36, N30, N03... Reqs F-006
Storytelling & narrative contribution C-MS-C-02 4 Services 3 Functionalities 1 Resource Let citizens contribute stories and turn data into narratives, with visibility for their stories. Needs N18, N20, N33, N19, N02
Transcription & media processing C-MS-C-03 5 Functionalities 1 Resource Assist with transcription and automated processing of contributed media. Needs N17, N12, N04, N20

Participant communication & onboarding (6 components) <i>Channels and tools to recruit, onboard and communicate with participants.</i>
Participant communication C-PCO-01 5 Services 8 Functionalities 1 Resource Provide communication channels between participants, researchers and projects. Needs N02, N20, N37, N19, N11
Onboarding, guidance & user support C-PCO-02 10 Services 5 Functionalities 2 Resources Onboard and support participants — onboarding tools, guidance, accompaniment and help. Needs N01, N17, N02, N14, N19, N05... Reqs F-012
Co-design & participatory methods C-PCO-03 6 Services 6 Functionalities Support co-design and participatory methods — equitable protocols, survey/method design and citizen-needs. Needs N11, N19, N22, N23, N04, N20...
Inclusive participation (youth, children, family) C-PCO-06 6 Services 3 Functionalities 1 Resource Make participation inclusive for youth, children and families. Needs N03, N01, N02, N22, N14, N05
Remote & digital participation C-PCO-07 2 Services 6 Functionalities Enable remote and digital participation (workshops, infrastructure, transnational, interactive). Needs N10, N22, N14, N12, N01, N17
Participant support & adaptability C-PCO-08 4 Services 1 Functionality Support participants long-term — human/legal support, supportive feedback and adaptability. Needs N04, N13, N01, N09, N11



6.2 What the layer provides

Data collection: the act at the heart of citizen science. A large cluster specifies how contributions are made: mobile and field collection (C-CDC-01), data-entry forms and survey tools (C-CDC-06), crowdsourcing at scale (C-CDC-07), geospatial mapping and real-time reporting (C-CDC-05), thematic and participatory collection (C-CDC-08), and integration with official, IoT and municipal data sources (C-CDC-02). These connect to D2.2's configurable data-collection requirement (RIECS-REQ-F-006). C-CDC-02 also begins the citizen-data-to-policy pipeline that GAP-007 identifies as missing, by letting citizen-collected data meet authoritative sources; the policy end of that pipeline is in L3. The community also asks, again, that contributors own and control the data they collect (C-CDC-03), echoing the ask in L0.

Workflows and usability. Modular, customisable workflows (C-UMW-03, the most-evidenced usability component) let projects be assembled rather than coded, connecting to D2.2's modular-architecture requirement (RIECS-REQ-N-002); low-barrier participation (C-UMW-02), a usable, performant interface (C-UMW-01, RIECS-REQ-N-004) and open-source infrastructure (C-UMW-04, RIECS-REQ-N-007) specify that taking part must be easy and the platform itself open.

Accessibility and multilingualism. A dedicated group answers GAP-008 directly: accessible, inclusive UI to WCAG (C-AML-01), multilingual interface and translation (C-AML-02), and plain-language, culturally adapted content (C-AML-03), all tied to D2.2's accessibility and usability requirements (RIECS-REQ-N-004/N-005). The community's framing matters: accessibility and language are asked for as first-class requirements, not afterthoughts, which is exactly the deficiency GAP-008 names.

Participation spaces and communication. Project creation and management (C-PPS-01), project profiles (C-PPS-02), in-project discussion (C-PPS-03), and a set of communication and onboarding components such as participant communication (C-PCO-01), onboarding and support (C-PCO-02, RIECS-REQ-F-012), co-design and participatory methods (C-PCO-03), and inclusive participation for youth, children and families (C-PCO-06) make a project a place people can join and stay in. The multimedia/storytelling group (C-MS-01..03) is mostly *emerging* (single-voice) and is kept as a watch-list of contribution modes beyond structured data.

6.3 Who asks for it

L2 is driven above all by citizens and by CS practitioners with researchers prominent in the data-collection and workflow components. It is the layer closest to the everyday act of participation, and its demand profile reflects that (see [/#/catalogue/stakeholders](#)).

6.4 Key findings for this layer.

- **Accessibility and language are first-class asks.** A whole component group is devoted to them, directly answering GAP-008, evidencing that inclusion is a requirement of participation.



- **Participation is modular and low-barrier by demand.** The strongest usability signal is for assemble-don't-code workflows and low-effort participation, matching the modular-architecture requirement of D2.2 (RIECS-REQ-N-002).
- **The policy pipeline starts at collection.** Integrating citizen data with official and municipal sources (C-CDC-02) is the first half of the missing citizen-data-to-policy pipeline (GAP-007), completed in L3.
- **Edge framing applies.** Many L2 components are well served by existing platforms; the design intent is to federate them as peers where possible.

PRE-APPROVAL



7. Layer L3: Knowledge, Analysis & Impact

RIECS shall turn contributions into analysis, reuse, decisions and policy evidence.

L3 is where contributed data becomes knowledge. It holds 19 components across 3 component groups (*Data reuse & export*, *Policy outputs & visualisation*, and *Project showcasing & dashboards*) from 237 catalogue entries and 216 story appearances. It completes two pipelines that begin in earlier layers: the citizen-data-to-policy pipeline whose collection end is in L2 (closing GAP-007), and the impact-evidence component that the field lacks altogether (GAP-010). Like L2 and L4, it is part of the federate-able edge: analysis and visualisation tools are widespread, so the design intent is to connect capable tools where possible rather than rebuild them.

Three of the ten structural gaps land or intersect in this layer: the pipeline from citizen data to policy or official use (GAP-007, continuing from L2 and shared with L5), the lack of cross-project recognition (GAP-006, carrying forward from L0 to L4), and the absence of shared impact-assessment instruments (GAP-010, shared with L4).

7.1 Components

L0 component groups and components are presented in the tables below:

Data reuse & export (11 components)	
<i>Enabling reuse, export and well-governed licensing of citizen science data.</i>	
Data analysis, ML & processing C-DRE-02	
3 Services 19 Functionalities 3 Resources	
Provide analysis, machine-learning and processing over the data (incl. spatial, exploration and decision support).	
Needs N12, N04, N28, N20, N11, N14... Reqs F-005, F-007	
Affordable open-access publication C-DRE-04	
2 Services 1 Functionality 1 Resource	
Support affordable open-access publication of citizen science outputs.	
Needs N08, N06, N19	
Open data access & sharing C-DRE-03	
8 Services 11 Functionalities	
Provide open access to research and public data, with simple usage explanations and credit.	
Needs N08, N36, N06, N04, N03, N25...	
Dataset discovery, search & exploration C-DRE-05	
4 Services 5 Functionalities	
Discover, search and filter datasets across platforms (temporal, spatial, demographic).	
Needs N11, N10, N07, N04, N02	
Data organisation, storage & streaming C-DRE-06	
2 Services 7 Functionalities 1 Resource	
Organise, store, aggregate and stream datasets (incl. large/historical data and ingestion).	
Needs N05, N12, N10, N09, N11, N28...	
Qualitative & mixed-method data support C-DRE-07	
2 Services 2 Functionalities	
Give qualitative and narrative data equal support and workflows.	
Needs N05, N22, N04, N11	
Data export & sharing C-DRE-01	
2 Services 9 Functionalities	
Export and share data (modelling, impact, ESG, anonymised) with selective download.	
Needs N05, N01, N20, N04, N12	
Data reuse & licensing C-DRE-08	
1 Service 6 Functionalities 3 Resources	



Support data reuse — eligibility, transparency, controlled mechanisms, licensing and templates. Needs N05, N10, N11, N06, N08, N37... Reqs C-002
Provenance & data lineage C-DRE-09 2 Services 10 Functionalities Track and display data provenance and lineage (incl. cultural provenance and data journey). Needs N06, N05, N23, N11, N01 Reqs F-010
Attribution, citation & persistent identifiers C-DRE-10 8 Functionalities Ensure contributor attribution, citation, persistent identifiers and FAIR profiles. Needs N05, N19, N06, N07, N08 Reqs C-003, F-013 Gap GAP-006
Data usage policies & management C-DRE-11 2 Services 6 Functionalities 2 Resources Govern data usage policies and manage large-scale datasets and planning. Needs N07, N06, N37, N12, N17, N16... Reqs C-002

Policy outputs & visualisation (5 components) <i>Reports, visualisations and dashboards that turn data into policy-ready evidence.</i>
Data visualisation & dashboards C-POV-01 9 Functionalities Visualise data and impact on dashboards and customisable visual builders. Needs N12, N31, N20, N04, N18 Reqs F-007
Report generation & export C-POV-02 2 Services 3 Functionalities Generate and export policy-ready reports, investment justifications and financial/ESG reporting. Needs N26, N25, N14 Gap GAP-007
Policy evidence & decision support C-POV-03 11 Services 11 Functionalities Turn citizen science data into policy evidence and decision support — recommendations, explainers, deliberation and advocacy. Needs N25, N04, N18, N01, N23, N33... Reqs F-015 Gap GAP-007
Impact assessment & tracking C-POV-04 6 Services 13 Functionalities Assess and track impact — metrics, longitudinal and collective impact, sustainability assessment. Needs N26, N20, N28, N12, N14, N05 Reqs F-016 Gap GAP-010
Analysis, comparison & evaluation C-POV-05 11 Services 16 Functionalities Analyse, compare and evaluate across projects, communities and engagement processes. Needs N04, N05, N20, N14, N12, N28... Gap GAP-010

Project showcasing & dashboards (3 components) <i>Displaying, mapping and showcasing project profiles, outcomes and metadata.</i>
Project showcasing & public display C-PSD-01 4 Services 9 Functionalities 1 Resource Showcase projects and initiatives publicly — profiles, topics, status, metadata and ongoing activities. Needs N26, N18, N20, N02, N11, N37...
Contribution & results dashboards C-PSD-02 1 Service 8 Functionalities 1 Resource Present contribution and results dashboards (class, teacher, public, aggregate). Needs N26, N01, N02, N19, N04, N06
Geographic visualisation of contributions & results C-PSD-03 9 Functionalities Map contributions and results geographically (local-to-European context, monitoring areas). Needs N06, N11, N01, N26, N09



7.2 What the layer provides

Reuse, analysis and credit. The data-reuse group is the largest: reuse and licensing (C-DRE-08, the most-evidenced L3 component), analysis, ML and processing (C-DRE-02, RIECS-REQ-F-005/F-007), open data access and sharing (C-DRE-03), export (C-DRE-01), dataset discovery (C-DRE-05), provenance and lineage (C-DRE-09, RIECS-REQ-F-010), and attribution, citation and persistent identifiers (C-DRE-10). The last connects reuse to recognition: persistent identifiers and citation let contributions be credited, seeding GAP-006 (cross-project recognition), which L4 takes up in full. The presence of explicit data usage policies (C-DRE-11) and licensing again reflects the ownership/sovereignty thread (RIECS-REQ-C-002).

Policy and impact: the missing pipelines. The policy-outputs group is where two of the field's acknowledged absences are answered. Policy evidence and decision support (C-POV-03) and report generation (C-POV-02) complete the citizen-data-to-policy pipeline (GAP-007, with RIECS-REQ-F-015); impact assessment and tracking (C-POV-04) and analysis, comparison and evaluation (C-POV-05) provide the shared impact instruments the field lacks (GAP-010, with RIECS-REQ-F-016), so that projects can demonstrate value in comparable terms. These components are the direct catalogue counterpart of the impact framework in D2.4, and a clear demonstration that the catalogue answers gaps it did not invent.

Visualisation and showcasing. Data visualisation and dashboards (C-POV-01, RIECS-REQ-F-007), contribution and results dashboards (C-PSD-02), geographic visualisation (C-PSD-03) and public project showcasing (C-PSD-01) make results legible to participants, funders and the public. That return that sustains engagement is a thread continued in L4's feedback components.

7.3 Who asks for it

L3 demand is led by researchers and scientists (analysis, reuse, provenance) and by policy makers and CS networks (policy evidence, impact, reporting), the actors who consume and act on citizen science data rather than only contribute it (see [/#/catalogue/stakeholders](#)).

7.4 Key findings for this layer.

- **The catalogue closes the two "downstream" gaps.** Policy evidence (C-POV-03) and impact assessment (C-POV-04) answer gaps (GAP-007 and GAP-010) and align with the D2.4 impact framework.
- **Analysis is an enhancement, not the first build.** Analysis/ML components are well evidenced but are widespread in existing tools; the edge framing applies, so the intent is to federate capable analysis tooling rather than rebuild it.
- **Reuse links to recognition.** Attribution, citation and persistent identifiers (C-DRE-10) connect data reuse to contributor credit, seeding the recognition agenda that L4 completes (GAP-006).



8. Layer L4: Community, Recognition & Capacity

RIECS shall recognise contributors and build community, skills and connections.

L4 is the largest layer of the catalogue: 55 components across 7 component groups, from 687 catalogue entries and 497 story appearances. This is the top layer for every stakeholder group. Its seven groups, by weight, are: *Community building* (13 components, 168 catalogue entries), *Guidance & methodological support* (10/152), *Training materials & courses* (8/95), *Collaboration & matchmaking* (8/95), *Contribution feedback & retention* (8/85), *Methods, equipment & documentation* (5/63) and *Expertise discovery & directories* (3/29).

The size of L4 must be read with care, and the catalogue says so: if demand is highest here does not mean L4 is where RIECS's distinctive value lies. L4 is the federate-able edge: community, training and collaboration are exactly the things many existing platforms, networks and organisations already do. The catalogue records the strength of this demand honestly, while the architecture's value judgement is that RIECS should federate capable providers for most of L4 and concentrate its own build effort on the centre (L0–L1). Counting components, or stories, is not ranking importance because it reflects the profile of users reached during the first period.

One structural gap is answered squarely here, the absence of cross-project recognition infrastructure (GAP-006), and two others are continued from earlier layers (ethics/legal handling GAP-009; impact guidance GAP-010).

8.1 Components

L4 component groups and components are presented in the tables below:

Contribution feedback & retention (8 components)	
<i>Feeding back to contributors and tracking their impact to retain them.</i>	
Contribution feedback C-CFR-01	
2 Services 16 Functionalities 1 Resource	
Give participants feedback on their contributions — accuracy, results, data usage and confirmations.	
Needs N20, N04, N11, N08, N32, N18...	Reqs F-014
Recognition & acknowledgement C-CFR-02	
2 Services 8 Functionalities 2 Resources	
Recognise and acknowledge contributors — public, institutional and skill-based recognition.	
Needs N19, N21, N03, N18, N02, N04...	Reqs F-013 Gap GAP-006
Retention, motivation & gamification C-CFR-03	
2 Services 9 Functionalities	
Retain and motivate participants — long-term engagement, re-engagement, gamification and competition.	
Needs N01, N20, N21, N13, N18, N19...	
Compensation & material incentives C-CFR-05	
3 Services 1 Functionality 2 Resources	
Compensate and reimburse contributors fairly, with material incentives where appropriate.	
Needs N19, N37, N20	
Contribution tracking & aggregation C-CFR-04	
1 Service 10 Functionalities	
Track and aggregate contributions and participation across projects and over time.	
Needs N20, N14, N02, N06, N08, N11...	
Contribution transparency & value C-CFR-06	
3 Services 8 Functionalities	
Show how contributions are used and explain their value and purpose to contributors.	



Needs N11, N19, N01, N20, N06 Reqs F-014
Contribution impact visibility & analytics C-CFR-07 1 Service 6 Functionalities Make contribution impact visible with analytics (incl. longitudinal). Needs N02, N19
Progress & demographic tracking C-CFR-08 8 Functionalities Track training/professional progress and participation demographics/representativeness. Needs N20, N04, N23, N03, N11

Community building (13 components) <i>Building and sustaining local and cross-project citizen science communities.</i>
Recruitment & inclusive outreach C-COM-02 6 Services 8 Functionalities 3 Resources Recruit participants and reach diverse and marginalised audiences inclusively. Needs N18, N02, N16, N03, N23, N11... Reqs F-002
Promotion, dissemination & social media C-COM-03 10 Services 20 Functionalities Promote and disseminate citizen science — social media, news outlets, content creation and automated sharing. Needs N02, N18, N11, N30, N06, N21... Reqs F-017
Events & meetups C-COM-04 1 Service 6 Functionalities Organise events and meetups with registration and referrals. Needs N02, N33, N11
Awareness & advocacy C-COM-05 6 Services 3 Functionalities 1 Resource Raise public awareness and advocate for citizen science (campaigns, ambassadors, cultural shift). Needs N18, N02, N19, N31, N22 Reqs F-017
Community building & networking C-COM-01 14 Services 13 Functionalities Build and connect communities — networking, communities of practice, co-labs and cross-community links. Needs N02, N01, N03, N11, N22, N27... Reqs F-003
Community continuity, roles & governance C-COM-06 6 Services 5 Functionalities Sustain communities beyond funding — persistence, role/responsibility mapping and community-led governance. Needs N19, N03, N17, N12, N22, N08...
Inclusive & low-barrier community participation C-COM-07 5 Services 8 Functionalities 1 Resource Make community participation inclusive and low-barrier (rural, diverse, accessible). Needs N03, N16, N33, N26, N11, N30...
Workshops & facilitated engagement C-COM-08 7 Services 5 Functionalities Run workshops and facilitated engagement (interactive sessions, one-to-one support, study-design input). Needs N02, N23, N19, N10, N17, N16...
Local & place-based community C-COM-09 5 Services 9 Functionalities Support local and place-based communities — neighbourhood, regional routes and local context. Needs N02, N11, N16, N05, N26, N10
Community contacts & messaging C-COM-10 1 Service 4 Functionalities 1 Resource Provide contact directories and direct messaging between community members. Needs N02, N14, N11, N01, N17
Equity, inclusion & cultural respect C-COM-11 4 Services 2 Functionalities Ensure equitable, inclusive and culturally respectful community participation.



Needs N27, N37, N19, N26, N33
Co-creation & interest groups C-COM-12 1 Service 7 Functionalities Enable co-creation opportunities, thematic interest groups and cross-project knowledge. Needs N01, N11, N10, N23, N19, N02
Community resources & repositories C-COM-13 2 Services 3 Functionalities 1 Resource Provide community resource repositories, literature and science-communication materials. Needs N33, N01, N18, N02

Collaboration & matchmaking (8 components)
<i>Connecting people and enabling collaborative workspaces across projects and disciplines.</i>
Matchmaking (researchers, mentors, projects) C-CMM-02 5 Services 8 Functionalities Match citizens, researchers, mentors and projects — demand-driven matchmaking and expertise discovery. Needs N01, N17, N18, N03, N02 Reqs F-002
Collaborative workspaces & co-creation C-CMM-03 5 Services 15 Functionalities Provide shared workspaces for collaboration, co-design, co-creation and team coordination. Needs N02, N01, N07, N23 Reqs F-003
Stakeholder & cross-sector collaboration C-CMM-04 13 Services 4 Functionalities Enable multi-stakeholder, cross-sector and institutional collaboration (against fragmentation). Needs N02, N15 Reqs F-018
Mentoring & peer learning C-CMM-05 7 Services 3 Functionalities Support mentoring, peer coaching and peer learning between participants. Needs N02, N04, N06, N17, N23, N14
Networking spaces & connections C-CMM-01 2 Services 8 Functionalities Provide networking spaces and direct connections between citizen scientists. Needs N02, N01, N21 Reqs F-003
Researcher & cross-stakeholder networking C-CMM-06 11 Services 2 Functionalities Connect researchers, funders, policy-makers, PhD students and NGOs. Needs N02, N01, N03, N31, N32
Events, congresses & exchanges C-CMM-07 4 Services 2 Functionalities Host events, congresses, online exchanges and surveys (incl. self-propagating). Needs N02, N01, N03
Cross-community & regional networks C-CMM-08 4 Services 2 Functionalities Connect schools, regions and Europe-wide practitioner networks with two-way learning. Needs N19, N01, N15, N08

Guidance & methodological support (10 components)
<i>Best-practice, legal, ethical and methodological guidance plus impact and evaluation support.</i>
Methodological support & resources C-GMS-02 8 Services 8 Functionalities 5 Resources Provide methodological support — scientific methods, methods repositories and protocol guidance. Needs N33, N16, N18, N19, N37, N01...
Ethics & legal guidance C-GMS-03 7 Services 3 Functionalities 7 Resources Provide ethics and legal guidance — consent, licensing, liability, compliance and public-value safeguards. Needs N37, N08, N09, N07, N01, N25... Gap GAP-009
Documentation & templates C-GMS-04 4 Services 8 Functionalities 6 Resources



Offer documentation tools, templates, examples and lessons-learned repositories. Needs N04, N11, N33, N37, N18, N05... Reqs F-011
Recognition, credentials & career support C-GMS-05 11 Services 4 Functionalities Recognise participation with credentials, certificates, seals and career-relevance support. Needs N31, N19, N27, N10, N02 Reqs F-013 Gap GAP-006
Impact & evaluation guidance C-GMS-06 6 Services 21 Functionalities 2 Resources Guide impact measurement and evaluation of projects and engagement. Needs N11, N26, N01, N18, N22, N10... Reqs F-016 Gap GAP-010
Best-practice & project guidance C-GMS-01 12 Services 4 Functionalities 6 Resources Guide projects with best-practice examples, funding, data-handling and partnership guidance. Needs N02, N37, N33, N04, N22, N01...
Contributor notifications & updates C-GMS-07 6 Functionalities Notify contributors and researchers of steps, data usage, requests and initiatives. Needs N02, N20, N32, N14, N11 Reqs F-014
Contribution & project tracking C-GMS-08 1 Service 8 Functionalities Track contributions, participation and project development status. Needs N04, N01, N19, N20, N06, N07...
Engagement, motivation & confidence support C-GMS-09 6 Services 2 Functionalities Support engagement, motivation and confidence (incl. patient/public and researcher perspective). Needs N18, N26, N03, N01, N02, N22
Tool, service & architecture management C-GMS-10 4 Services 3 Functionalities Manage tools, service reliability and architecture alignment. Needs N11, N33, N14, N08 Reqs N-007

Training materials & courses (8 components) <i>Discovering and providing training materials, workshops and courses.</i>
Courses, workshops & curricula C-TMC-02 8 Services 9 Functionalities 5 Resources Offer courses, workshops and curricula (incl. curriculum alignment, learning units and credentials). Needs N18, N01, N16, N03, N33, N12...
Train-the-trainer & educator support C-TMC-03 1 Service 3 Resources Support trainers and educators — train-the-trainer frameworks, teaching guides and professional development. Needs N37, N05, N31
Scientific literacy & capacity building C-TMC-04 4 Services Build scientific literacy, skills and capacity among participants and the public. Needs N18, N03, N02, N12 Reqs F-017
Training materials & resource library C-TMC-01 11 Services 6 Functionalities 12 Resources Provide a library of training materials, documentation and educational resources. Needs N16, N03, N11, N04, N20, N12... Reqs F-011
Material discovery, search & access C-TMC-05 5 Services 5 Functionalities Discover, search, filter, download and control access to training materials. Needs N11, N29, N03, N33, N17, N01...
Project guidance, toolkits & proposal support C-TMC-06 5 Services 2 Functionalities 8 Resources Guide projects with toolkits, implementation and proposal-formulation support. Needs N37, N31, N25, N11, N02, N14... Reqs F-012



Vocabularies, definitions & protocols C-TMC-07 1 Functionality 3 Resources Provide shared CS vocabularies, definitions and standardised protocol libraries. Needs N33, N16
Courses, assessment & training spaces C-TMC-08 5 Services 1 Functionality 1 Resource Offer training hubs, shared spaces, assessment/grading and training recommendations. Needs N02, N33, N01

Methods, equipment & documentation (5 components) <i>Documenting methods, licensing and sharing equipment and hardware with guidelines.</i>
Equipment lending & management C-MED-01 10 Services 4 Functionalities 6 Resources Manage and lend equipment and instruments — registries, availability tracking, maintenance and safety. Needs N03, N11, N02, N34, N22, N33...
Open hardware & DIY tools C-MED-02 4 Services 5 Functionalities 1 Resource Support open hardware and DIY tools — integration, discovery, recognition and DIY-lab work. Needs N34, N10, N04, N11, N37, N19
Methodology & protocol documentation C-MED-03 6 Services 3 Functionalities 1 Resource Document methodologies, protocols, manuals and recording guidelines. Needs N16, N05, N04, N37, N33
Tool & API documentation C-MED-04 3 Services 3 Functionalities 3 Resources Document tools and APIs clearly, ensuring usability. Needs N14, N11, N02, N06, N20, N05...
Standards, vocabularies & licensing documentation C-MED-05 2 Services 9 Functionalities 3 Resources Document standards, vocabularies, normative alignment and licensing. Needs N04, N05, N08, N37, N07, N24...

Expertise discovery & directories (3 components) <i>Finding and recognising experts and skilled contributors across the ecosystem.</i>
Expert directory & discovery C-EDD-01 8 Services 6 Functionalities Discover experts and expertise — directories, skills marketplace and location/topic filtering. Needs N17, N02, N19, N01 Reqs F-012
Contributor & role registries C-EDD-02 1 Service 6 Functionalities 2 Resources Maintain registries of citizen scientists, contributors, trainers and their roles/profiles. Needs N01, N02, N31, N16, N30, N17...
Expertise recognition & matching C-EDD-03 3 Services 2 Functionalities 1 Resource Recognise non-institutional and industry expertise and match it to projects. Needs N01, N19, N17, N18, N02

8.2 What the layer provides

Recognition is the gap RIECS must build into the edge. Although L4 is broadly federate-able, recognition is the part of it that behaves like a centre component: cross-project credit needs a *shared* infrastructure, which is precisely what no platform provides (GAP-006). The catalogue specifies it through recognition and acknowledgement (C-CFR-02), recognition, credentials and



career support (C-GMS-05) and the attribution/PID component already noted in L3 (C-DRE-10), all tied to D2.2's recognition requirement (RIECS-REQ-F-013). This is a case where the design intent will likely be to build a shared mechanism even though the surrounding layer is federated. This is flagged by the gap.

Community, collaboration and matchmaking. The community group is the heaviest: community building and networking (C-COM-01, RIECS-REQ-F-003), promotion and dissemination (C-COM-03, RIECS-REQ-F-017), recruitment and inclusive outreach (C-COM-02, RIECS-REQ-F-002), plus collaborative workspaces (C-CMM-03), networking spaces (C-CMM-01), matchmaking of researchers, mentors and projects (C-CMM-02, RIECS-REQ-F-002) and cross-sector collaboration (C-CMM-04, RIECS-REQ-F-018). Discovery and collaboration are, across the corpus, among the most-wanted components of all.

Guidance, training and methods. Capacity-building is a large, well-evidenced block: training materials and a resource library (C-TMC-01, RIECS-REQ-F-011), courses and curricula (C-TMC-02), best-practice guidance (C-GMS-01), methodological support (C-GMS-02), ethics and legal guidance (C-GMS-03, which addresses the cross-border legal/ethics GAP-009 from the capacity side), impact and evaluation guidance (C-GMS-06, the most-evidenced L4 component, supporting GAP-010), and the methods, equipment and documentation group. The high share of *Resource*-typed units here (training material, templates, documentation) is the one place in the catalogue where resources are prominent.

Feedback and expertise. Contribution feedback (C-CFR-01, RIECS-REQ-F-014) closes the loop with participants by feeding back what their data produced, and the expertise discovery & directories group helps people find the skills and people they need.

8.3 Who asks for it

L4 is the top layer for every stakeholder group, but most strongly for citizens and researchers, with education systems, NGOs and CS networks prominent in training, outreach and collaboration. This breadth is exactly why the layer is large; it is also why the catalogue is careful not to equate its size with priority (see [/#/catalogue/stakeholders](#)).

8.4 Key findings for this layer.

- **The layer with highest demand is the federate-able one.** L4 carries the most demand and tops every stakeholder group, yet community, training and collaboration are widely provided already; the design intent is to federate capable providers, not to rebuild them.
- **Recognition can be the exception as a shared mechanism RIECS should build.** Cross-project credit (C-CFR-02, C-GMS-05) needs shared infrastructure that does not exist (GAP-006), so it behaves like a centre component inside the edge.
- **Capacity-building is where resources matter.** Training libraries, courses and documentation make L4 the one layer where *Resource*-typed units are prominent (RIECS-REQ-F-011).
- **Size is not priority.** The catalogue states explicitly that the volume of L4 demand does not rank it above the smaller, harder-to-provide centre.



9. Layer L5: Governance of the RI

RIECS shall govern the infrastructure: participatory governance, sustainability, ethics and AI accountability.

L5 governs the infrastructure itself. It holds 14 components across 3 component groups (Governance & transparency, Funding & sustainability, and AI transparency & ethics) from 142 catalogue entries and 116 story appearances.

It sits outside the centre/edge distinction as governance is neither built nor federated as a service but spans the whole research infrastructure. It shows one of the project's most important remarks: sustainability and governance, not technology, decide whether a research infrastructure survives.

Three of the ten structural gaps intersect in this governance layer: the sustainability aspect of hosting for small/medium projects (GAP-005, supporting L0), the governance and oversight of the citizen-data-to-policy pipeline (GAP-007, backing up L2 and L3), and the institutionalized handling of cross-border legal and ethics compliance (GAP-009, working alongside L0 and L4).

9.1 Components

L5 component groups and components are presented in the tables below:

Governance & transparency (8 components)	
<i>Transparent, participatory governance frameworks for the platform and projects.</i>	
Transparency & accountability C-GOV-02	
1 Service 10 Functionalities 1 Resource	
Be transparent and accountable — governance, project, financial and funding-decision transparency.	
Needs N23, N30, N07, N08, N16, N04...	
Digital sovereignty & non-commercial governance C-GOV-03	
6 Services 1 Functionality	
Safeguard digital sovereignty and a non-commercial, no-lock-in, geopolitically resilient public resource.	
Needs N22, N15, N08, N11 Reqs C-004	
National nodes & ESFRI/RI positioning C-GOV-04	
5 Services 7 Functionalities 6 Resources	
Organise national nodes and position RIECS in the ESFRI / research-infrastructure landscape.	
Needs N24, N14, N15, N02, N09, N19...	
Participatory & community self-governance C-GOV-01	
8 Services 5 Functionalities	
Govern participatively — citizen/community/civil-society input, self-governance and empowerment.	
Needs N23, N02, N08, N33, N37, N18...	
Governance frameworks, models & templates C-GOV-05	
2 Services 5 Functionalities 2 Resources	
Provide governance frameworks, models, templates, published rules and decision processes.	
Needs N23, N08, N07, N32	
Governance autonomy & non-interference C-GOV-06	
4 Services 8 Functionalities 1 Resource	
Protect governance autonomy and non-interference (federated, public-controlled, value-aligned).	
Needs N08, N01, N09, N07, N10, N22...	
Ethics governance & oversight C-GOV-07	
5 Services 3 Functionalities	
Govern ethics and oversight — ethics committees, dynamic updates, CARE/TRUST compliance.	
Needs N07, N08, N01, N33 Gap GAP-009	
Policy-readiness of data & outputs C-GOV-08	
5 Functionalities	



Make data and outputs policy-ready and aligned to local policy and resource-sharing rules.
Needs N04, N03 Reqs F-015 Gap GAP-007

Funding & sustainability (3 components)
<i>Discovering, connecting to and sustaining funding for citizen science projects.</i>
Funding opportunity discovery & matching C-FUN-01 7 Services 7 Functionalities 2 Resources Surface funding opportunities — a directory with notifications, filtering, curation and funder connections. Needs N22, N03, N12, N26, N02, N01...
Funding acquisition support C-FUN-02 2 Services 4 Functionalities 5 Resources Support funding acquisition — application help, convincer toolkits, gap analysis and route exploration. Needs N22, N31, N03, N18, N10, N01...
Long-term sustainability & institutional support C-FUN-03 7 Services 5 Resources Sustain the infrastructure long-term — sustainability models, diversified funding and institutional support. Needs N22, N23, N11, N17, N10 Reqs N-007 Gap GAP-005

AI transparency & ethics (3 components)
<i>Transparent, ethical and auditable use of AI in citizen science.</i>
AI transparency, audit & disclosure C-AIE-01 6 Functionalities 2 Resources Make AI transparent — disclosure, uncertainty indication, audit trails and model metadata standards. Needs N30, N04, N07, N05
AI ethics & citizen-aligned AI C-AIE-02 5 Services 1 Functionality 1 Resource Keep AI ethical and aligned to citizen values — ethical frameworks, co-creation and purpose-built CS tools. Needs N30, N07, N04, N37
AI & automated data processing C-AIE-03 2 Functionalities 1 Resource Integrate AI and automated data-processing pipelines responsibly. Needs N04, N01

9.2 What the layer provides

Governance and transparency. The governance group specifies how the infrastructure is run: participatory, community self-governance (C-GOV-01), transparency and accountability (C-GOV-02), governance frameworks and templates (C-GOV-05), governance autonomy and non-interference (C-GOV-06), ethics governance and oversight (C-GOV-07, addressing the ethics side of GAP-009), and policy-readiness of outputs (C-GOV-08, the governance end of the GAP-007 policy pipeline, RIECS-REQ-F-015). Two governance components carry the project's strategic positioning explicitly: national nodes and ESFRI/RI positioning (C-GOV-04) and digital sovereignty and non-commercial governance (C-GOV-03), the governance expression of the European-sovereignty stance (RIECS-REQ-C-004). C-GOV-03 is *emerging* (single-voice) and is flagged as such: it is strategically central but, like the EOSC and domain-neutrality properties, is partly an architect-added design goal rather than a heavily-voiced community demand.

Funding and sustainability. Long-term sustainability and institutional support (C-FUN-03) speaks directly to the survival question and to the hosting-sustainability GAP-005 (with RIECS-REQ-N-007, maintainability); funding opportunity discovery (C-FUN-01) and



funding-acquisition support (C-FUN-02) help the projects that federate with RIECS to sustain themselves. The catalogue records sustainability as a required component and a named risk, not as a solved problem since funding is not secured.

AI transparency and ethics. A small but forward-looking group: AI transparency, audit and disclosure (C-AIE-01), AI ethics and citizen-aligned AI (C-AIE-02), and AI and automated data processing (C-AIE-03). Two of the three are *emerging*; they are kept as an explicit accountability commitment as AI enters citizen science workflows, rather than dropped for thin corroboration.

9.3 Who asks for it

L5 demand comes from NGOs, CS networks, research infrastructures and policy makers, for whom governance, sustainability and ethics are operational concerns, together with citizens' asks for transparency and community control (see [/#/catalogue/stakeholders](#)).

9.4 Key findings for this layer.

- **Governance and sustainability decide survival.** The main constraint on a research infrastructure is governance and funding, not technology. Sustainability (C-FUN-03) is recorded as a requirement and a risk, not a solved problem.
- **Sovereignty and ESFRI positioning live here too.** Digital-sovereignty governance (C-GOV-03) and national nodes / ESFRI positioning (C-GOV-04) make the European, public-interest, federated character of RIECS an explicit governance component.
- **AI accountability is committed early.** A dedicated AI-ethics group is kept despite thin corroboration, as a forward-looking accountability stance rather than a claim of present component.



10. Layer L6: The cross-cutting property - multi-domain support

The six functional layers (L0-L5) are completed by one further layer that behaves differently from the rest: L6, the cross-cutting property of multi-domain support, or domain-neutrality. It does not sit on top of the others or beside them, it runs through all of them. It gathers the demand that is specific to particular research domains (environmental monitoring, health and patient involvement, biodiversity, social citizen science, and others) and reads it not as a set of domain verticals but as a single transversal requirement on the whole infrastructure.

Rather than build a separate stack for each domain (which would invite capture by one community), RIECS keeps this demand together as evidence of an anti-capture design stance: the same horizontal components must work across every citizen science domain equally. L6 is therefore numbered as a layer for completeness, but it is realised across L0-L5 rather than as a vertical of its own.

None of the ten specific structural gaps land directly or exclusively in this layer, as it represents a transversal multi-domain support property realized globally across the entire architecture.

10.1 Components

L6 component group and component are presented in the table below:

Cross-cutting · domain-neutrality (1 component)	
Multi-domain support (domain-neutrality)	C-XDOM-01
68 Services 69 Functionalities 11 Resources	
Serve every citizen science domain equally (biodiversity, environmental, health, social...) with the same horizontal capabilities — an anti-capture, domain-neutral platform.	
Needs N11, N04, N01, N02, N10, N03...	Reqs F-018

10.2 What it provides

This component is unusual in scale with 149 catalogue entries drawn from 90 user stories, precisely because it absorbs all the domain-specific demand that would otherwise have formed separate verticals. Kept together, that demand specifies a single capability: that every service, functionality and resource RIECS offers works the same way regardless of the scientific domain a project belongs to. In practice this means domain-neutral data models and metadata, domain-agnostic participation and workflow tools, and discovery and analysis that span domains rather than siloing them.

10.3 A transversal property, realised across the layers

Domain-neutrality is flagged as an architect-interpreted, design-level requirement, so that its large catalogue-entry count is not mistaken for a single, narrow story-level request. It is the clearest expression of RIECS as shared, neutral infrastructure: an anti-capture principle that keeps the infrastructure open to every citizen science community on equal terms, enforced consistently across layers L0-L5.



11. Other analysis findings

This section reports what the analysis behind the catalogue found: the evidence and confidence, the cross-cutting property, the convergence with the consortium's demand framework, the headline findings, and the coverage, gaps and caveats.

11.1 Evidence and confidence

Two complementary signals describe how strongly the catalogue is evidenced.

At the component level, the corroboration label is a confidence weight having that 131 of the 151 components are corroborated i.e. backed by two or more independent stories, and 20 are emerging (single-voice; Figure 10). As explained in section 2.3, the emerging components are kept as evidence rather than dropped.

At the catalogue-entry level, the underlying evidence forms a pyramid (Figure 11): of the 1,980 catalogue entries, 102 are validated i.e. corroborated across multiple models and multiple stories, 462 are repeated in more than one story, and 1,416 are single-source. The large single-source tail is expected for a first open co-design round and is the natural material for a refined catalogue to revisit as more engagement data appear. Reporting it openly, grounds the strength of the evidence.

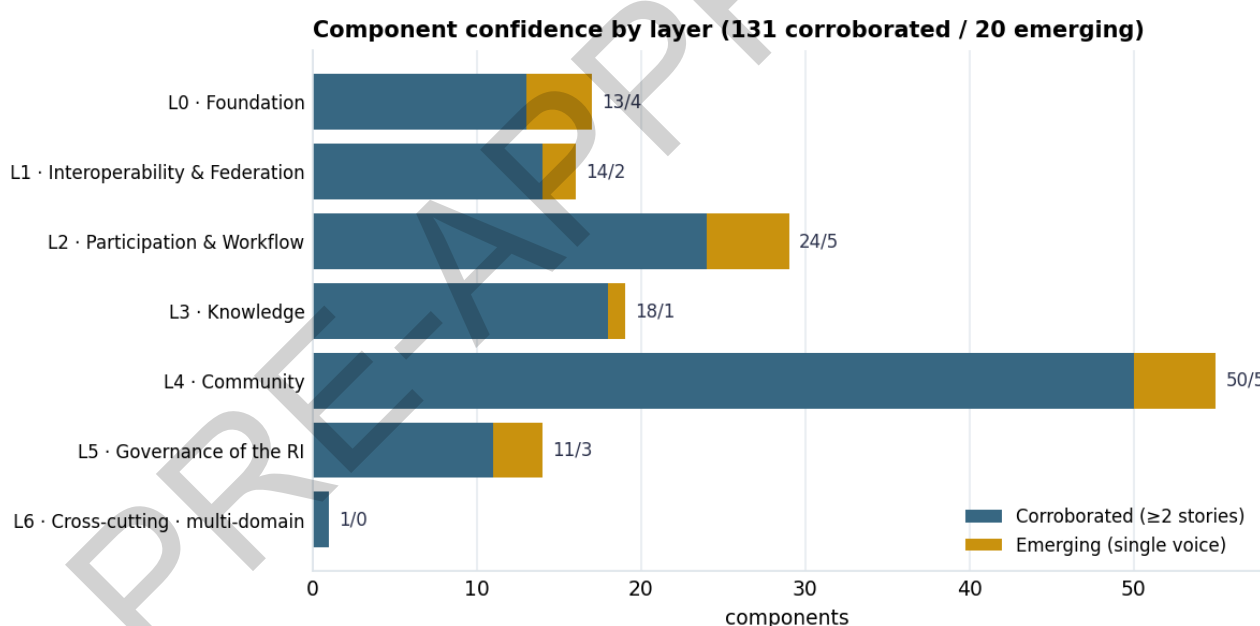


Figure 9. Component confidence by layer (corroborated vs emerging).



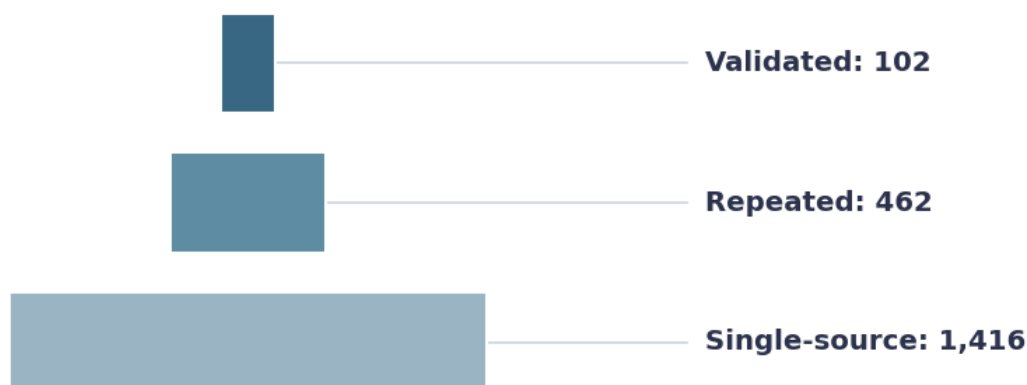


Figure 10. The catalogue-entry evidence pyramid of 1.980 catalogue entries.

11.2 The cross-cutting property: multi-domain support (domain-neutrality)

One block of demand does not belong to any single layer: catalogue entries that are specific to a research domain such as environmental monitoring or health. Rather than create domain verticals (which would invite capture by one community), these are kept together as evidence of a transversal architecture property: RIECS must serve every citizen science domain equally with the same horizontal components working across biodiversity, health, environmental (those are the selected domains in RIECS-Concept) and others, including social citizen sciences. Like other IT components, or the EOSC citizen science thematic node in preparation, domain-neutrality is a design property for RIECS and it is flagged as such in the addressing, so it is not mistaken for a single story-level request.

11.3 Coverage of demand: needs, gaps and requirements

Because each component is addressed to the needs, requirements and structural gaps it serves, the catalogue can be checked against the communities demand. The aggregate result is a strong convergence (Figure 12; Table 6):

- the **151 components collectively address all 37 of the 37 needs** (N01–N37);
- **they address all 10 of the 10 structural gaps** (GAP-001...010), 33 components carry at least one gap; and
- **they satisfy all 31 of the 31 D2.2 technical requirements** (RIECS-REQ), 68 components carry at least one D2.2 requirement.

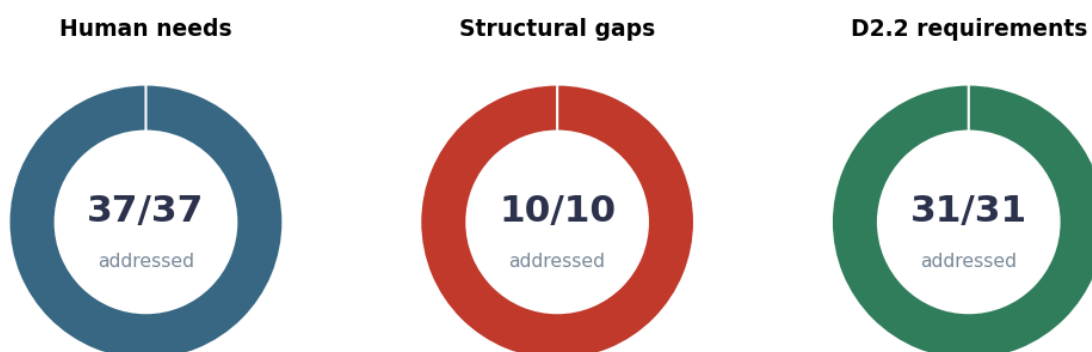


Figure 11. Convergence: needs, gaps and D2.2 requirements addressed by the catalogue.

Table 6. Coverage summary: needs, gaps and requirements, and the number of components addressing each.

Framework element	Total	Addressed	Components carrying at least 1
Consortium-validated needs (N01–N37)	37	37	151
Structural gaps (GAP-001...010)	10	10	33
D2.2 technical requirements (RIECS-REQ)	31	31	68

This convergence deserves a careful word: full coverage is meaningful because D2.2 and D2.3 followed two distinct but complementary analytical routes and their alignment could have failed: the needs and the gaps were authored independently of this analysis, several are narrow and specific, and the addressing was done item by item, so a component that genuinely had nothing to say about a given need or gap was left unlinked. That the catalogue nonetheless meets every need, gap and requirement is therefore a result: different readings of the same evidence base landing in the same place. In other words, their alignment around the same validated needs, structural gaps and requirements strengthens the coherence of the RIECS concept and confirms that the catalogue is connected to the wider WP2 feasibility work.

It is equally important to say what this convergence is not: it is not a claim that the required components already exist in some tool that would be the "X% already covered" error the project explicitly avoids. The firm signal for what RIECS must build is the set of structural gaps, which is exactly where the catalogue's centre (L0–L1) concentrates .

11.4 Key findings

The catalogue's headline findings are summarised below, each with the architectural implication that follows from it. (These are rendered on the platform as the Takeaways view, [/#/catalogue/takeaways](#); D2.2 calls the equivalent sections "Key findings". The prose and numbers come from the shared catalogue data.)



- A **demand-led functional specification**. The catalogue is 151 components "RIECS shall provide X", consolidated from 789 accepted user stories into 1,980 catalogue entries. Nothing in it is a wish-list item: every component traces back to attributable demand.
- **Build the centre, federate the edges**. The backbone and the federation contract (L0–L1: identity, FAIR data, quality, compliance, standards and APIs, the EOSC node) with 33 components that RIECS must build and operate, where the structural gaps concentrate. The participation, knowledge and community layers (L2–L4: 103 components) are largely a matter of federating capable existing platforms as peers. RIECS is infrastructure, not a portal of portals.
- **Demand is highest at the edge; the value is the centre**. The single loudest layer is L4 (Community, Recognition & Capacity, 497 stories), and the edge tops every stakeholder group. Yet the edge is the federate-able part; the smaller L0–L1 centre is precisely what no single existing platform provides. Counting components is not the same as ranking importance.
- **Demand is about what you can do**. Among the typed catalogue entries, functionalities (1,111) outnumber services (694), with resources the thinnest band (174). The platform's job is overwhelmingly to enable action; the thin resource layer is consistent with federating others' datasets and tools rather than hosting them.
- **Domain-neutrality is a design stance**. A cross-cutting block of domain-specific catalogue entries is kept as evidence that the platform must serve every domain equally. This property is imposed by design to differentiate also from other existing RIs already using citizen science in some specific contexts and domains.
- **Evidence is weighted** but nothing is discarded. 131 components are corroborated by two or more independent stories; 20 are single-voice emerging. The weak signal is kept as evidence rather than dropped, so the specification is honest about confidence without losing the long tail.
- **Built reproducibly and traceably**. 789 user stories to 1,980 catalogue entries to 151 components, extracted with three independent models. Each catalogue entry is a real extracted sentence, not a model paraphrase, and every component traces down to its catalogue entries and the stories behind them.
- **It says what, not with what**. It says federation with no privileged actor. D2.3 specifies the functionalities; which existing technology to federate or build is the map in D2.2 and the design in D3.5. Existing platforms are peers to plug into the L0–L1 core, not tools to adopt by decree.

Taken together, these support a single conclusion: RIECS is the functional backbone that real demand asks to build the centre that no one else provides, federate the capable edge as peers, serve every domain equally, and keep technology selection in the 2nd phase of this project.

11.5 Stakeholder coverage

The catalogue can be cut by who asks for each component. Table 7 summarises the demand by stakeholder groups: the number of stories attributed to each group, the number of components those stories drive, and the layers each group most demands. The full, interactive cut is the platform's *By stakeholder group* view ([/#/catalogue/stakeholders](#)).



Table 7. Demand by stakeholder group

Stakeholder group	Stories	Components	Top layers
Citizens	254	142	L4 · L2 · L1
Researchers & scientists	215	133	L4 · L3 · L2
NGOs	64	106	L4 · L5 · L0
Education systems	64	84	L4 · L1 · L2
Technology providers	32	47	L1 · L4 · L2
Policy makers	29	54	L4 · L1 · L3
CS networks	26	61	L4 · L1 · L3
Companies	25	63	L4 · L2 · L3
CS practitioners	20	48	L2 · L4 · L0
Students	12	26	L4 · L2 · L5
Research infrastructures	12	27	L4 · L1 · L5

Two readings follow. First, the community-facing edge (especially L4) is the top layer for almost every group, and reinforces that demand volume sits at the edge. Second, the foundation is shared rather than owned: no single group dominates L0–L1, confirming that the centre is a common infrastructure that everyone relies on and no one provides alone.

A caveat must be stated clearly. The stakeholder attribution is only as representative as the engagement behind it. The corpus is weighted towards citizens and researchers; some groups (notably policy makers, students and research infrastructures) are represented by relatively few stories, and several stories were contributed by proxies speaking on behalf of a group rather than by its members directly. The component counts per group should therefore be read as indicative of where each group's voiced demand fell, not as a precise measure of importance to that group. Broadening and balancing this engagement is a task for the refined catalogue.



BY WHO ASKS

The catalogue by stakeholder group ⁱ

Citizens · 264 **Researchers & scientists · 219** NGOs · 67 Education systems · 67 Policy makers · 42
 Technology providers · 32 CS networks · 26 Companies · 25 CS practitioner · 20 Students · 13
 Research infrastructures · 13 Other · 1

133 components are driven by **Researchers & scientists** stories — ranked within each layer by how many of their stories back each component.

L0 · Foundation · 12

FAIR data storage & repositories (at scale) Open data access & repositories	24
Automated & rule-based data validation Data quality & validation	19
Sensitive-data governance & access control Data privacy & protection	14
Data protection & GDPR compliance Data privacy & protection	10
Open data access & discovery Open data access & repositories	9

Figure 12. The catalogue by stakeholder group: the layers each group most demands

11.6 Needs by priority

All 37 needs are realised by at least one component; they span priorities (8 high, 18 medium, 3 low, with 8 unprioritised). The full needs-to-components mapping is in Annex B.

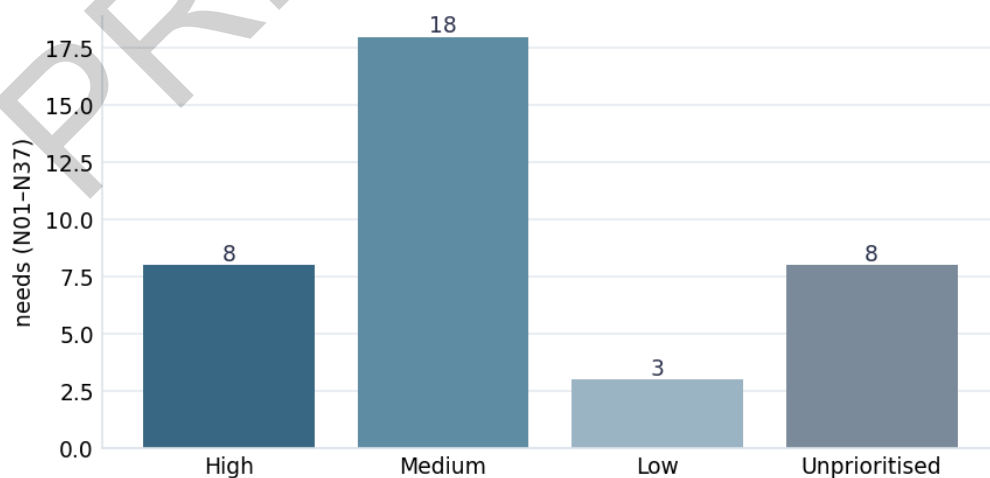


Figure 13. The 37 needs by priority; all are realised by at least one component.



11.7 The structural gaps the catalogue addresses

The firmest signal of what RIECS must build is not a coverage percentage but the set of structural gaps identified by the consortium (D2.1/D2.2): demands for which no mature technology exists. The catalogue addresses all ten (Figure 15). Table 8 maps each gap to the components that answer it and to the layers where they concentrate (L0–L1) and the recognition/impact parts of the edge.

Table 8. The ten structural gaps and the components that address them

Gap	What is missing	Addressed by (components)	Layer(s)
GAP-001	Common identity / AAI across platforms	C-IDEN-01, C-IDEN-02, C-IDEN-03	L0
GAP-002	Federated cross-domain directory / discovery	C-PDO-01, C-PDO-02, C-SF-01	L1
GAP-003	Shared metadata standards & tooling (low PPSR-Core adoption)	C-ODAR-03, C-INTS-02, C-ESI-01	L1
GAP-004	Shared, domain-neutral validation / QA service	C-DQV-01, C-DQV-02, C-DQV-03, C-DQV-04	L0
GAP-005	Sustainable hosting for small/medium projects	C-ODAR-01, C-FUN-03	L0, L5
GAP-006	Cross-project recognition / credit infrastructure	C-IDEN-05, C-CFR-02, C-GMS-05, C-DRE-10	L0, L3, L4
GAP-007	Pipeline from citizen data to policy / official use	C-CDC-02, C-POV-02, C-POV-03, C-GOV-08	L2, L3, L5
GAP-008	Multilingual support & accessibility as first-class	C-AML-01, C-AML-02, C-AML-03	L2
GAP-009	Cross-border legal / ethics handling (GDPR, ethics)	C-IDEN-04, C-DPP-01, C-GMS-03, C-GOV-07	L0, L4, L5
GAP-010	Shared impact-assessment instruments	C-POV-04, C-POV-05, C-GMS-06	L3, L4



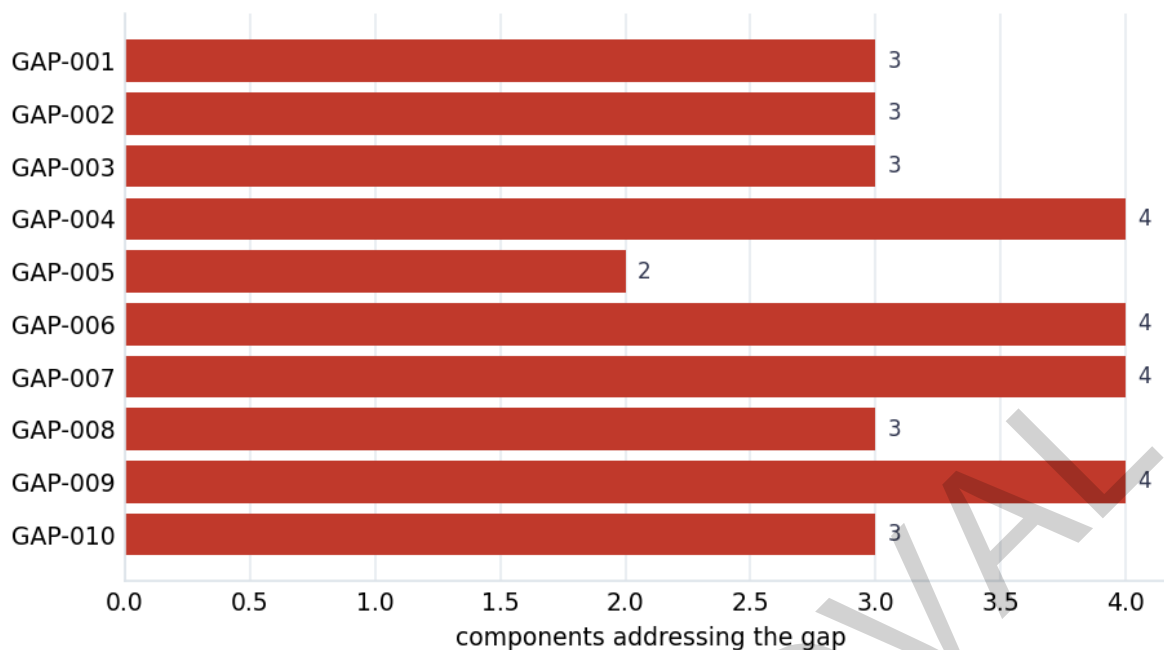


Figure 14. The ten structural gaps and the number of components that address each.

That every gap is addressed is a genuine result but it is a statement about demand and specification, not about delivery: it says the catalogue *specifies* a component for each gap, not that the component already exists. Indeed, the whole point of a gap is that it does not. The gap-to-component map is hand-curated and documented, and is open to revision.

11.8 Limitations and threats to validity

The principal limitations of this catalogue are stated explicitly.

- **Interpretive, AI-assisted coding.** Statements and their typing were extracted by language models. This is interpretive coding, defended on reliability and validity grounds (multi-model agreement, literal evidence, human review) rather than determinism; the full argument is in D2.2. Different reasonable coders, either human or machine, would produce somewhat different boundaries.
- **Uneven and partly proxied engagement.** The demand corpus is weighted towards citizens and researchers, with thinner coverage of some stakeholder groups, and some stories were contributed by proxies. The stakeholder cut is indicative, not definitive. D4.2 (citizens) is consortium-validated; D4.3/D4.4 (stakeholders) were accepted into the corpus but not separately human-validated.
- **A large single-source tail.** Most catalogue entries are single-voice; the corroborated catalogue rests on a minority with two or more independent voices. Confidence is reported per component, but the catalogue should be read as a first round, not a settled specification.
- **Curated cross-references.** The links from components to the structural gaps and to the D2.2 requirements are a hand-curated semantic map; the needs link is automatic. The map is documented and revisable, and was chosen because the automatic crosswalk was too noisy at this granularity.



- **"Covered" is a soft signal.** Where the catalogue indicates that a related technology exists, this is a soft nearest-match, not proof that any tool fully delivers the component; it must not be read as "already solved".
- **Specification, not ratification.** The "shall" statements are extracted and reviewed through the validation views, but the catalogue is a preliminary concept at M18; per-item consortium ratification and the build/federate verdict belong to D2.2/D3.5.

None of these undermines the catalogue's purpose. Together they provide a better understanding on how it should be used as an evidence-led, honestly-bounded first specification, to be refined in the upcoming tasks of this project.

PRE-APPROVAL



12. The catalogue online

The catalogue's online form is available under test at <https://concept.riecs.eu/catalogue> resulting in a site that is living and participatory, a working instrument through which the catalogue keeps being developed and contested. In other words, this document is a snapshot of it. Both the document and the online platform read the same data as this table shows:

Table 9. The interactive platform (cross-reference map)

Topics from this D2.3	Online platform view
Catalogue (components)	https://concept.riecs.eu/catalogue/#/catalogue/components
Traceability (Story explorer)	https://concept.riecs.eu/catalogue/#/catalogue/stories
Stakeholder coverage	https://concept.riecs.eu/catalogue/#/catalogue/stakeholders
Key findings	https://concept.riecs.eu/catalogue/#/catalogue/takeaways
Methodology (9-step chain)	https://concept.riecs.eu/catalogue/#/catalogue/methods
Participatory validation	https://concept.riecs.eu/catalogue/#/contribute/catalogue
Convergence	https://concept.riecs.eu/catalogue/#/technologies https://concept.riecs.eu/catalogue/#/crosswalk

The online catalogue offers four ways to read the same specification:

- **Overview / components** (/#/catalogue/components): the functional specification as a collapsible tree, *layer to group to component*, each component opening to its services/functionalities/resources and the stories behind it. Visitors can take a component and read its "shall" statement, its evidence (catalogue entries and stories), its confidence, and the needs, gaps and D2.2 requirements it addresses;
- **Story explorer** (/#/catalogue/stories) and reverse traceability: search any user story and see where it landed (component to group to layer), evidence that every component traces to real demand. Users also can move from a need or a gap to the components that answer it (Annexes B–D),
- **By stakeholder group** (/#/catalogue/stakeholders) to see what a given audience asks for: the same components cut by *who asks* for them (citizens, researchers, NGOs, policy makers, and others), with each group's most-demanded layers.
- **Key findings** (/#/catalogue/takeaways) with findings of the catalogue.
- Every component, and every link it draws to a need, a requirement or a gap, and it carries its validation state.

For wider validation, the Contribute / Validate views (for the catalogue, the requirements, the convergence and the technologies) let the consortium and the community to Accept, Edit or Reject each item by saying whether they agree or not, and propose a correction (*is the component coherent? do its catalogue entries belong? are the name and the addressing right?*).



CONTRIBUTE

Validate the catalogue

d
2/13 reviewed
Download JSON

Component 3 of 13 · C-PDO-01 · L1 · Project discovery & outreach · corroborated

Project & initiative discovery (European directory)

The platform shall provide a pan-European, filterable directory of citizen-science projects and initiatives, with cross-catalogue sync and a unified discovery portal.

Is this a coherent component?

One clear thing the platform provides — not two unrelated things bundled, not a sliver of a bigger one.

Coherent Too broad **Too narrow** Mis-named Wrong layer

Better name (optional)

suggest a clearer name...

Do these catalogue entries belong here? (10 of 32)

Mark any catalogue entry that was mis-grouped into this component — it describes something else.

R0004 Discover citizen science projects Service	Belongs	Doesn't	Unsure
R0019 Discover citizen science projects Functionality	Belongs	Doesn't	Unsure
R0036 Project directory listing Service	Belongs	Doesn't	Unsure
R0050 Project discovery for classroom integration Functionality	Belongs	Doesn't	Unsure
R0059 Curated project catalogue Service	Belongs	Doesn't	Unsure
R0077 Aggregate CS projects registry Service	Belongs	Doesn't	Unsure
R0100 Provide project information Functionality	Belongs	Doesn't	Unsure
R0176 Pan-European CS project catalogue Service	Belongs	Doesn't	Unsure

Figure 15. Participatory validation view, where each component can be accepted, edited or rejected.

This makes refinement a built-in, continuous process rather than a one-off complementing this KER1 with a durable, participatory channel. Readers are invited to use it: review the catalogue at the link above and register agreement or proposed changes on the entries that matter to them.



13. Conclusions

This deliverable answers one question: *what must the RIECS platform be able to do?*. And answers it from community-based evidence. The result is a functional specification of 151 components on six functional layers, every one traceable to the citizen science community's own demand and cross-referenced to the needs, gaps and technical requirements it serves.

The main conclusions:

- **RIECS is a connecting research infrastructure.** The strongest and most consistent signal across the 823 co-design stories is that the community wants existing initiatives connected and made interoperable, not replaced. The most wanted single component is discovery of what already exists, and the demand profile is that of an enabling layer. RIECS should connect, with no privileged technology and federation by invitation.
- **Build the centre, federate the edges.** The value RIECS uniquely adds is the centre which is exactly where the field's structural gaps concentrate and where no single platform provides a shared solution. The participation, knowledge and community edge (L2-L4) carries most of the demand but is largely federate-able; recognition is the notable exception that, like the centre, needs a shared mechanism. The precise build-versus-federate verdict for each component is the work of D2.2 and D3.5; the catalogue establishes what is required and where the gaps are.
- **The loudest demand is not the highest value.** The loudest layer is community and recognition (L4, 497 stories), and the edge tops every stakeholder group yet the edge is the federate-able part. The small L0-L1 centre, modest in story count, is precisely what no existing platform provides. Counting components, or stories, is not the same as ranking importance: RIECS's distinctive value is the quiet centre, not the loud edge.
- **One infrastructure for every domain.** A cross-cutting property (L6) runs through all the layers: the same horizontal components must serve every citizen science domain equally. Domain-neutrality is a deliberate anti-capture stance and the RIECS is not specific to any single community.
- **Survival is a question of governance and sustainability, not technology.** Research infrastructures fail for want of governance and funding, not features. RIECS must therefore be a sustainable, European public-interest infrastructure participatory in governance, sovereign in its handling of data, neutral across domains, with sustainability recorded honestly as a requirement and a risk, not a solved problem.
- **The catalogue meets the community demands.** That the catalogue, built from the user stories, lands on every one of the consortium's 37 needs, 10 structural gaps and 31 requirements.
- **A preliminary, living specification, validated in the open.** Every component traces to real user stories, and the consolidation has been reviewed by the authors as domain experts and remains open to review on the live RIECS catalogue, where the consortium and the community can agree, disagree or propose changes to any item. It is a first version: it will be refined as engagement broadens and the large single-voice tail matures. The method is transparent and reproducible. The community that produced the catalogue is the one that will keep refining it.



Annex A. The S/F/R catalogue register (1,980 deduplicated entries)

The catalogue's deduplicated entries, each typed as a Service, Functionality or Resource and carrying its "shall" statement, its need, its component group and its source-story provenance. The register is published as machine-readable JSON on the platform and can be downloaded directly:

- Full deduplicated register: 1,980 entries (694 services / 1,111 functionalities / 174 resources): Living catalogue: https://concept.riecs.eu/catalogue/data/conv_canonical.json. Snapshot uploaded to Zenodo: <https://doi.org/10.5281/zenodo.21074428> (30/06/2026)

PRE-APPROVAL



Annex B. Needs / components / groups

For each of the 37 consortium-validated needs (N01–N37): its theme and priority, the components that realise it, and its component groups.

Need	Name	Theme	Prio.	Caps	Stories	Component groups
N01	Project discovery and matchmaking	Access and discoverability	H	68	149	Project discovery & outreach; Project participation spaces; Participant communication & onboarding; Health & patient involvement
N02	Networking and collaboration spaces	Access and discoverability	H	67	195	Collaboration & matchmaking; Community building; Participant communication & onboarding; Project discovery & outreach
N03	Low-barrier, accessible participation	Access and discoverability	H	43	81	Accessibility & multilingual support; Project discovery & outreach; Data reuse & export; Community building
N04	Data quality control and validation	Data quality and trust	M	63	157	Data quality & validation; Data reuse & export; Open data access & repositories; Guidance & methodological support
N05	Shared data and metadata standards	Data quality and trust	M	42	95	Data reuse & export; European scale & deduplication; Interoperability & data standards; Environmental monitoring
N06	Trust, transparency and provenance	Data quality and trust	M	29	26	Data reuse & export; Participant communication & onboarding; Project showcasing & dashboards; Contribution feedback & retention
N07	Data ownership, privacy and consent	Data governance and compliance	M	32	75	Data privacy & protection; Governance & transparency; Data reuse & export; Open data access & repositories
N08	Open Science, FAIR and CARE compliance	Data governance and compliance	H	41	113	Interoperability & data standards; Open data access & repositories; Data reuse & export; Governance & transparency



N09	Legal clarity and digital sovereignty	Data governance and compliance	L	13	23	European scale & deduplication; Guidance & methodological support; Governance & transparency; Health & patient involvement
N10	Shared digital infrastructure and hosting	Tools, platforms and infrastructure	H	34	55	Data reuse & export; Open data access & repositories; Usability & modular workflows; Environmental monitoring
N11	Data collection and crowdsourcing tools	Tools, platforms and infrastructure	H	63	122	Data reuse & export; Guidance & methodological support; Citizen data collection & integration; Health & patient involvement
N12	Analysis, visualisation and decision support	Tools, platforms and infrastructure	H	21	45	Data reuse & export; Policy outputs & visualisation; Project discovery & outreach; Environmental monitoring
N13	Usability and user-centred design	Tools, platforms and infrastructure	M	11	20	Usability & modular workflows; Data reuse & export; Training materials & courses; Contribution feedback & retention
N14	Interoperability and platform integration	Tools, platforms and infrastructure	M	42	77	Usability & modular workflows; External system integration; Identity & EU-compliant services; Interoperability & data standards
N15	Federated, modular and secure architecture	Tools, platforms and infrastructure	M	9	10	European scale & deduplication; Collaboration & matchmaking; Usability & modular workflows; External system integration
N16	Training materials and documentation	Training and capacity building	H	21	76	Project discovery & outreach; Training materials & courses; Participant communication & onboarding; Methods, equipment & documentation
N17	Support services and expertise access	Training and capacity building	M	26	35	Expertise discovery & directories; Participant communication & onboarding; Project



						discovery & outreach; Training materials & courses
N18	Scientific literacy and public engagement	Training and capacity building	M	33	74	Project discovery & outreach; Guidance & methodological support; Participant communication & onboarding; Training materials & courses
N19	Recognition and credit for contributions	Recognition and engagement	M	45	83	Participant communication & onboarding; Contribution feedback & retention; Community building; Guidance & methodological support
N20	Feedback and communication of results	Recognition and engagement	M	28	89	Contribution feedback & retention; Participant communication & onboarding; Data reuse & export; Health & patient involvement
N21	Volunteer recruitment and retention	Recognition and engagement	L	11	14	Contribution feedback & retention; Participant communication & onboarding; Health & patient involvement; Data reuse & export
N22	Long-term funding and institutional support	Governance and sustainability	M	28	66	Funding & sustainability; Participant communication & onboarding; Community building; European scale & deduplication
N23	Participatory and equitable governance	Governance and sustainability	M	23	38	Governance & transparency; Participant communication & onboarding; Project discovery & outreach; Contribution feedback & retention
N24	A public European resource against fragmentation	Governance and sustainability	M	7	9	European scale & deduplication; Project participation spaces; Methods, equipment & documentation
N25	Policy readiness and evidence pipelines	Policy and impact	M	14	29	Policy outputs & visualisation; Environmental monitoring; Data reuse & export; Guidance & methodological support



N26	Impact assessment and valuation	Policy and impact	M	23	65	Policy outputs & visualisation; Guidance & methodological support; Project showcasing & dashboards; Project discovery & outreach
N27	Cross-domain and transdisciplinary research	Scientific practice	M	5	3	Community building; Environmental monitoring; Guidance & methodological support; Data reuse & export
N28	Scalability and performance	Tools, platforms and infrastructure	L	11	18	European scale & deduplication; Data reuse & export; Interoperability & data standards; Policy outputs & visualisation
N29	Shared resource and materials library	Training and capacity building	M	8	12	Training materials & courses; Health & patient involvement; Usability & modular workflows; Accessibility & multilingual support
N30	AI transparency/algorithm accountability		-	21	36	Project discovery & outreach; Open data access & repositories; AI transparency & ethics; Governance & transparency
N31	Career recognition for researchers		-	14	22	Guidance & methodological support; Project discovery & outreach; Funding & sustainability; Policy outputs & visualisation
N32	Feedback mechanism from policy, how CS data influenced policy		-	7	8	Guidance & methodological support; Contribution feedback & retention; Project discovery & outreach; Governance & transparency
N33	Scientific principles		-	31	64	Project discovery & outreach; Guidance & methodological support; Open data access & repositories; Accessibility & multilingual support
N34	Physical infrastructures		-	4	11	Open data access & repositories; Methods, equipment & documentation; Health & patient involvement;



						European scale & deduplication
N35	Quick availability		-	2	2	Usability & modular workflows; Training materials & courses
N36	Data storage		-	9	14	Data reuse & export; Citizen data collection & integration; Multimedia & storytelling contribution; Interoperability & data standards
N37	Ethics framework / guidelines		-	22	44	Project discovery & outreach; Guidance & methodological support; Participant communication & onboarding; Methods, equipment & documentation



Annex C. Structural gaps / components (10)

The ten structural gaps and the components that address each (the expanded form of Table 8).

Gap	Description	Components
GAP-001	No common identity/AAI layer across citizen science platforms; participants need separate accounts per project.	C-IDEN-01, C-IDEN-02, C-IDEN-03
GAP-002	No federated, cross-domain search/directory covering European CS projects; discovery is fragmented across national portals and domain platforms.	C-PDO-01, C-PDO-02, C-SF-01
GAP-003	CS metadata standards (PPSR Core) have low adoption and no shared tooling; cross-platform data exchange is mostly manual.	C-ODAR-03, C-INTS-02, C-ESI-01
GAP-004	No shared, domain-neutral validation/quality-assurance service; quality mechanisms exist only inside individual platforms (e.g. eBird, iNaturalist).	C-DQV-01, C-DQV-02, C-DQV-03, C-DQV-04
GAP-005	No sustainable hosting offer for small/medium CS projects; platforms depend on project grants and institutional goodwill (cf. OpenSenseMap, Artportalen interviews).	C-ODAR-01, C-FUN-03
GAP-006	No standardised recognition/credit infrastructure for citizen contributions usable across projects and in formal contexts.	C-IDEN-05, C-CFR-02, C-GMS-05, C-DRE-10
GAP-007	No established pipeline from citizen-generated data to policy and official statistics; quality seals and accreditation mechanisms are missing.	C-CDC-02, C-POV-02, C-POV-03, C-GOV-08
GAP-008	Multilingual support and accessibility are afterthoughts in existing tools, excluding non-English-speaking and low-digital-skill audiences.	C-AML-01, C-AML-02, C-AML-03
GAP-009	Cross-border legal/ethics handling (GDPR interpretation, ethics approvals, data location) is unresolved for pan-European participation.	C-IDEN-04, C-DPP-01, C-GMS-03, C-GOV-07
GAP-010	No shared impact-assessment instruments for CS; projects cannot demonstrate value to funders and institutions in comparable terms.	C-POV-04, C-POV-05, C-GMS-06



Annex D. D2.2 requirements (RIECS-REQ) / components (31)

Each of the 31 D2.2 RIECS-REQ requirements and the components that satisfy it.

RIECS-REQ	Requirement	Components
RIECS-REQ-C-001	The RIECS shall implement GDPR-compliant handling of personal data: granular consent management, data minimisation, right-to-erasure support, and clear data-controller arrangements for federated services.	C-DPP-01, C-DPP-02
RIECS-REQ-C-002	The RIECS shall provide clear, machine-readable data-ownership and licensing arrangements for contributed data, including handling of sensitive data (e.g. health, endangered-species locations).	C-DPP-04, C-DRE-08, C-DRE-11
RIECS-REQ-C-003	The RIECS shall operate FAIR and Open Science by default: open licences, persistent identifiers, open formats, and CARE-aligned practices for community-held data.	C-INTS-01, C-DRE-10
RIECS-REQ-C-004	The RIECS shall be operated under European public governance with digital sovereignty safeguards: public control of core infrastructure, EU hosting of core data, and no lock-in to non-European proprietary services.	C-IDEN-04, C-GOV-03
RIECS-REQ-F-001	The RIECS shall provide a federated, multilingual directory of citizen science projects, events and calls, searchable by domain, location and participation mode, so that citizens, students and organisations can find and join relevant activities.	C-PDO-01, C-SF-01
RIECS-REQ-F-002	The RIECS shall provide matchmaking between volunteers (including schools and community groups) and projects based on interests, skills, location and availability, so that recruitment reaches beyond the usual participants.	C-COM-02, C-CMM-02
RIECS-REQ-F-003	The RIECS shall provide community and collaboration spaces (fora, working groups, partner search) connecting coordinators, researchers, volunteers and organisations across countries and disciplines.	C-CMM-03, C-COM-01, C-CMM-01
RIECS-REQ-F-004	The RIECS shall offer shared hosting for citizen science projects - including data storage, repositories and basic web presence - so that projects without technical teams can operate and survive beyond their funding period.	C-ODAR-01, C-PPS-01
RIECS-REQ-F-005	The RIECS shall provide access to computing capacity (including cloud and volunteer computing) for analysis of citizen science data at scale.	C-DRE-02



RIECS-REQ-F-006	The RIECS shall provide configurable data-collection tools (mobile and web) supporting offline field work, media capture, geolocation and sensor input, reusable across projects and domains.	C-MSD-01, C-CDC-01, C-CDC-06
RIECS-REQ-F-007	The RIECS shall provide online analysis and visualisation tools, including AI-assisted processing, that let projects and participants explore, analyse and present collected data without local software.	C-DRE-02, C-POV-01
RIECS-REQ-F-008	The RIECS shall provide data validation and quality-assurance services - expert review workflows, automated checks, calibration support and quality scoring - applicable to citizen-generated data across domains.	C-DQV-01, C-DQV-02, C-DQV-03, C-DQV-04
RIECS-REQ-F-009	The RIECS shall maintain and promote shared data and metadata standards for citizen science (building on PPSR Core, Darwin Core and DCAT) and provide tooling that helps projects adopt them.	C-ODAR-03, C-INTS-02
RIECS-REQ-F-010	The RIECS shall record and expose provenance for contributed data, so that contributors can see how their data are stored, validated and used, and data users can assess origin and processing history.	C-ODAR-03, C-DRE-09
RIECS-REQ-F-011	The RIECS shall provide a curated, multilingual library of training materials, protocols, templates and best-practice examples for citizens, teachers, coordinators and institutions.	C-GMS-04, C-TMC-01
RIECS-REQ-F-012	The RIECS shall provide support services - helpdesk, peer-to-peer exchange, expert and organisation databases, and proposal-writing support - for projects at all stages.	C-PCO-02, C-EDD-01, C-TMC-06
RIECS-REQ-F-013	The RIECS shall provide recognition mechanisms - contribution records, certificates and citable acknowledgement - that credit citizen contributions in scientific outputs and beyond.	C-CFR-02, C-GMS-05, C-DRE-10
RIECS-REQ-F-014	The RIECS shall provide feedback channels that close the loop with participants: notifications on how contributed data were used, project result summaries, and participation statistics.	C-CFR-01, C-GMS-07, C-CFR-06
RIECS-REQ-F-015	The RIECS shall provide policy-facing interfaces - quality seals, evidence summaries and integration paths with official statistics - that make citizen-generated evidence usable by policy-makers.	C-POV-03, C-GOV-08
RIECS-REQ-F-016	The RIECS shall provide impact-assessment tooling - indicators, instruments and reporting templates - for measuring the scientific,	C-POV-04, C-GMS-06



	educational and societal impact of citizen science activities.	
RIECS-REQ-F-017	The RIECS shall support outreach and public-engagement formats (campaigns, school programmes, science-literacy resources) that bring new and under-represented audiences into citizen science.	C-COM-03, C-COM-05, C-TMC-04
RIECS-REQ-F-018	The RIECS shall enable cross-domain data linkage and transdisciplinary collaboration, allowing datasets and methods from different domains (e.g. climate, biodiversity, health) to be combined.	C-CMM-04, C-XDOM-01
RIECS-REQ-I-001	The RIECS shall integrate with existing citizen science platforms and repositories through open APIs and harvesting interfaces, connecting - not replacing - national portals, domain platforms and tools.	C-ESI-01, C-ESI-02, C-ESI-04
RIECS-REQ-I-002	The RIECS shall be interoperable with EOSC and relevant ESFRI research infrastructures, publishing its resources through EOSC-compatible interfaces and metadata.	C-INTS-03, C-ESI-05
RIECS-REQ-N-001	The RIECS shall implement a federated identity and access management layer (AAI), enabling single sign-on across federated services with pseudonymous participation options.	C-IDEN-01, C-IDEN-02
RIECS-REQ-N-002	The RIECS shall follow a modular, federated architecture in which services can be adopted independently, components can evolve separately, and national/domain nodes retain autonomy.	C-ESI-03, C-UMW-03
RIECS-REQ-N-003	The RIECS shall scale to pan-European usage: growing numbers of users, projects, observations and data volumes, including campaign peaks, without degradation of service.	C-ODAR-01, C-ESD-02
RIECS-REQ-N-004	The RIECS user interfaces shall be usable by non-experts: plain language, mobile-friendly, low-bandwidth tolerant, and co-designed with target user groups.	C-UMW-01, C-AML-03
RIECS-REQ-N-005	The RIECS shall meet accessibility and inclusion standards: WCAG 2.2 AA minimum, multilingual operation, and explicit support paths for users with limited digital skills or resources.	C-AML-01, C-AML-02
RIECS-REQ-N-006	The RIECS shall implement security by design: secure transport, role-based authorisation, auditing, and vulnerability management across all federated components.	C-DPP-03, C-INTS-04
RIECS-REQ-N-007	The RIECS shall be designed for maintainability within a realistic operational cost envelope: open-source preference, documented components, deprecation policy and exit strategies.	C-UMW-04, C-FUN-03, C-GMS-10

