



D7.6

Report on the co-development and technical workshops, V2

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Deliverable abstract

The overarching goal of ENVRI-FAIR is for all participating RIs to improve their FAIRness and prepare the connection of their data repositories and services to the European Open Science Cloud. This deliverable reports the efforts Task 7.3 contributed to the development of common FAIRness goals in the second half of the project. The objective of this task is to provide co-development support driven by an implementation plan that identified by each subdomain, joint use cases among RIs or subdomains, and other needs identified during the project. In the second half of the project, Task 7.3 focused on the support for the integration with ENVRI-Hub, testing and validation of the developed services by subdomains, and exploitation and knowledge transfer.



DELIVERY SLIP

| | Name | Partner Organisation | Date |
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DOCUMENT AMENDMENT PROCEDURE

Amendments, comments and suggestions should be sent to the Project Manager at manager@envri-fair.eu.

GLOSSARY

A relevant project glossary is included in Appendix A. The latest version of the master list of the glossary is available at <http://doi.org/10.5281/zenodo.4471374>.

PROJECT SUMMARY

ENVRI-FAIR is the connection of the ESFRI Cluster of Environmental Research Infrastructures (ENVRI) to the European Open Science Cloud (EOSC). Participating research infrastructures (RI) of the environmental domain cover the subdomains Atmosphere, Marine, Solid Earth and Biodiversity / Ecosystems and thus the Earth system in its full complexity.

The overarching goal is that at the end of the proposed project, all participating RIs have built a set of FAIR data services which enhances the efficiency and productivity of researchers, supports innovation, enables data- and knowledge-based decisions, and connects the ENVRI Cluster to the EOSC.

This goal is reached by: (1) well defined community policies and standards on all steps of the data life cycle, aligned with the wider European policies, as well as with international developments; (2) each participating RI will have sustainable, transparent, and auditable data services, for each step of data life cycle, compliant to the FAIR principles. (3) the focus of the proposed work is put on the implementation of prototypes for testing pre-production services at each RI; the catalogue of prepared services is defined for each RI independently, depending on the maturity of the involved RIs; (4) the complete set of thematic data services and tools provided by the ENVRI cluster is exposed under the EOSC catalogue of services.

TABLE OF CONTENTS

| | |
|--|----|
| D7.6 – Report on the co-development and technical workshops, V2..... | 4 |
| 1 Introduction..... | 4 |
| 2 Plan, methods, and actions..... | 4 |
| 2.1 Agenda identified in the previous phase | 4 |
| 2.2 Methods..... | 5 |
| 2.3 Timeline, and expected output | 5 |
| 3 Report of the Activities | 5 |
| 3.1 ENVRI Knowledge Base | 5 |
| 3.2 ENVRI-Hub | 5 |
| 3.3 Support the development of solutions to common problems | 6 |
| 3.4 Training activities..... | 6 |
| 3.5 Support and Contributions to the task forces | 6 |
| 4 Summary | 8 |
| 5 References..... | 9 |
| 6 Appendix 1: Glossary..... | 10 |

D7.6 – Report on the co-development and technical workshops, V2

1 Introduction

This deliverable (D7.6) reports the consultancy and support activities WP7 provides in the second half of the project (between July 2021 to June 2023) for the FAIR development and technology transfer within individual RIs.

The task performs the following actions:

- Provides consultation and guidance for adopting services inherited from earlier projects, e.g., ENVRIplus, as well as those provided/promoted by relevant mature projects, such as EOSC Pilot and EOSC Hub.
- Conducts collaboration activities (workshops, face-to-face meetings, etc.) with RIs to put work into practice.
- Supports the RIs in implementing services for enabling FAIR data: a) implementation of FAIR metadata and data, b) implementation of services for data findability and access, c) implementation of high-level services and d) implementation of FAIR data interoperability and re-use.

In the first half of the project, Task 7.3 supported WP8-11 together with WP5 and six on the joint FAIR adoption, customisation, and recommendations. T7.3 advised RIs on adopting services, co-developed required services with the RIs, and supported RIs in implementing those services. Essentially, T7.3 took services in an architectural setting recommended by WP5 and the task forces, co-developed these together with the subdomains, and supported their implementation by RIs. Due to the support nature of the WP7, it is not always easy to separate the activities of WP7 from WP5, the subdomains WP8-11 and the task forces, since almost all the WP7 members have multiple roles in the project.

In the second half of the project, Task 7.3 continues with the support actions which require longer efforts, e.g., developing and testing the data management services being developed; in the meantime, it also prioritises support for the development of the ENVRI-Hub services. As a follow-up deliverable of D7.5 submitted by Task 7.3, D7.6 starts with the plans of the activities we made in D7.5 and reports key achievements and output in the last two years.

2 Plan, methods, and actions

2.1 Agenda identified in the previous phase

At the beginning of the project, we identified a number of common activities from subdomains (as shown in D7.5) WP7 should provide support:

1. implementation activities planned by each subdomain (via specific deliverables),
2. individual discussion WP7 had with each subdomain on their use cases,
3. activities in different task forces coordinated by WP5,
4. training activities,
5. observations from interactions the ENVRI community has with the EOSC, RDA and other initiatives.

In the first two years, some common activities successfully finished and made good progress for the development of data management services. In D7.5, we highlighted the following common activities for the second half of the project:

1. **Contribute to the ENVRI-Hub development.** WP7 will continue developing the knowledge pillar in the ENVRI-Hub and contribute to the development of general architecture and two other key components: ENVRI catalogue and demonstrators.
2. **Contribute to the development of solutions to common problems.** WP7 will actively identify the common technical problems from the common development plan and initialise agile tasks to explore solutions.

3. **Contribute to the validation use cases.** From the common activities we identified from the use cases, WP7 will initialise the validation support activities with the use case teams from the subdomains.
4. **Contribute to the training and knowledge transfer.** WP7 will join the training effort and contribute to the training material related to technical development.
5. **Contribute to the task forces.** Within those TFs, the activities related to the use cases, common development support, and ENVRI-Hub will be specifically prioritised in WP7.

Task 7.3 followed the agenda in the second phase.

2.2 Methods

The development of FAIR data management services is time-consuming, and RIs in different subdomains often have their development plan and roadmap. In the first half of the project, the WP7 team has already realised the following risks for the development support in D7.5: 1) **Lost focus on the urgent requirements** from the subdomains can make WP7 less connected with the subdomains, 2) **Investing too much time on less critical technical problems** can create a gap between WP7 and the technical needs from the subdomains, and 3) **Lost awareness of the technical development status of RIs.**

To mitigate those risks, the subdomain representative members in WP7 closely followed the technical development in subdomains, tracked their plan, and understood the latest requirements (members of WP are also members of the subdomain WPs). Via those subdomain representatives, WP7 continuously reviews the development status from the subdomains and prioritises the technical problems to which WP7 can contribute to the context of the use cases and the ENVRI-Hub.

2.3 Timeline, and expected output

In the second half of the project, we took the actions described in 2.1 as the starting point, and aimed to operate the ENVRI Knowledge Base in a continuous integration and deployment manner. We support the development of the ENVRI-Hub by integrating the knowledge base with ENVRI-Hub. In the meantime, we support developers from subdomains to tackle the dynamic needs by setting up agile tasks.

3 Report of the Activities

In this section, we will briefly report the support activities based on the following activities:

1. The development of ENVRI Knowledge Base,
2. The development of ENVRI-Hub,
3. The development of the emerging common problems,
4. Training and knowledge transfer,
5. Contributing to different task forces coordinated by WP5.

3.1 ENVRI Knowledge Base

Knowledge Base development requires input from different subdomains when indexing their online resources to make them searchable. The detailed activities and technical details will be reported in a separate deliverable D7.4.

3.2 ENVRI-Hub

ENVRI-Hub is an important action conducted in the second half of the project. WP7 contributed to the ENVRI-Hub by

1. supporting the architecture design of the ENVRI-Hub (via TF6). Several WP7 members (e.g., UvA, MARIS, INGV, TIB etc.) participated in the TF6, and joined the discussion on the ENVRI-Hub requirement analysis, architecture design, technical choices, and integration. WP7 contributed to the ENVRI-Hub white paper, which was later exploited as part of the ENVRI-Hub following proposal.
2. integrating the ENVRI Knowledge Base with the ENVRI-Hub. The UvA team interacted with the core development team of ENVRI-Hub in IAGOS/JUELICH and explored different

integration choices, namely in loosely or tightly coupled. During the project, UvA and JUELICH developed a loose coupling solution, which is online accessible¹. The technical details will be included in D7.4.

3. Investigating possible Virtual Research Environment (VRE) options for the science cases in ENVRI-Hub. The UvA team explored different VRE choices based on the science cases of the ENVRI-Hub. Since most science demonstrators are based on Jupyter notebooks, UvA proposed a solution called Notebook-as-a-Virtual Research Environment (NaaVRE)². The solution is also jointly supported by LifeWatch ERIC.

3.3 Support the development of solutions to common problems

In the second half of the project, we can see two prioritised common development problems each subdomain faces:

1. Service testing and validation is another important activity in the second phase of the project. In the previous phase, a test plan of the data management services was reported (D7.7). Detailed WP7 support for testing and validation results will be reported in a separate deliverable D7.8.
2. Science case demonstrator development. The WP7 partners (Maris, ACTRIS, INGV and LifeWatch) are also embedded in the science case demonstrator teams in WP8-11. The technical details of the science case demonstrators have been reported in each subdomain WPs.

3.4 Training activities

In the training work package, various materials have been developed for the community to study those topics. WP7 participants have participated both as students and teachers in training. The ENVRI-FAIR Training Catalogue is at <https://trainingcatalogue.envri.eu/> and the platform at: <https://training.envri.eu/>.

In the second half of the project, WP7 supported training activities via ENVRI winter schools in 2021, and summer school in 2022. UvA delivered a lecture on web service development in ENVRI winter school 2021 and provided lab support for the Jupyter environment in the ENVRI summer school 2022 together with a lecture on NaaVRE.

3.5 Support and Contributions to the task forces

WP7 has actively participated in all task forces³ organised by WP5. Those task forces (TFs) closely work with the subdomains, investigating solutions to those common challenges subdomain developers face during their development. WP7 joins the effort of all task forces, in which WP7 partners lead TF1, TF2, TF4, and TF5, and participate in all the others.

TF1 ENVRI Catalogue of Services

In the first half of the project TF1 produced a white paper agreeing consensually on how to implement the catalogue. The decision was to utilise the EPOS architecture with CERIF[1] as the metadata standard for the catalogue entries (because of the richness of the format, its longevity, its wide use and its proven ability to interoperate with many other metadata formats) and to use the ingestion pipeline based on EPOS-DCAT-AP with validation using SHAPES/SHACL.

In the period reported on by this deliverable, the catalogue and ingestion pipeline have been implemented, the catalogue populated with metadata records converted from RIs from all four subdomains of ENVRI, the catalogue connected to the developing ENVRI-Hub and the ENVRI-Hub catalogue service registered in the EOSC marketplace. Thus, the twin objectives of the project, namely improving FAIRness (achieved by homogenised metadata) and onboarding to EOSC (e.g., Marketplace through simplified metadata record representing the ENVRI-Hub and catalogue) have been achieved. The TF1 is coordinated and supported by WP7.

¹ <https://search.envri.eu/>

² <https://doi.org/10.1002/spe.3098>

³ <https://envri.eu/task-forces-implementing-the-envri-hub/>

TF2 ENVRI (VO) AAI implementation

In the first half of the project, a landscape survey recorded the state and plans for RIs in ENVRI for authentication and authorisation of access to digital assets at the RIs hosting those assets within ENVRI. TF2 produced a white paper recording agreement on the architecture to be used - basically, the AARC blueprint architecture proposed by GREANT consisting of OpenID Connect (OIDC) for authentication and OAuth2 for authorisation.

In the period reported on by this deliverable, TF2 has overseen a proof-of-concept project where three RIs (EPOS, AnaEE and EMSO) demonstrated single sign-on and federated access among them. This means that a user, e.g., AnaEE, can log on locally and be also permitted to access digital assets at EMSO and EPOS. This achievement demonstrates one aspect of open access to FAIR digital assets. The TF2 is coordinated and supported by WP7.

TF3 PIDs identification types and registries

Through regular virtual meetings and “discussion sessions” at ENVRI Week meetings, WP7 technical staff participated in the discussions TF3 coordinated on “all things PID”. While the virtual meetings tended to involve a relatively small number of representatives from the project member RIs, the open sessions gathered a much broader audience.

The reports prepared by TF3 represent interesting and valuable snapshots of both what were perceived as best practices for assigning and using PIDs (for data), and how the actual implementations towards fulfilling these progressed throughout the ENVRI-FAIR project. When compared with the information collected by WP5 on the evolution of the PID-related FAIRness Implementation Profiles, the TF3 outputs illustrate that it is not enough to look at the FAIRification of data objects when judging the level of interoperability between ENVRIs, but that non-data assets are just as important.

TF4 Triple stores, data storage certification and FAIR vocabularies

TF4 aims to share knowledge between RIs that are experienced with triple stores, related technologies and applications, and data storage certification and RIs that are planning to use these technologies in their own applications. WP7 experts led TF4, and WP7 action in the process was to support the transfer of (technical) knowledge across the RIs, thus contributing to the overall aim of efficient and effective technology adoption and convergence.

For triple stores and CTS data storage certification, TF4 performed the following tasks: Landscape existing technologies, Collect and share experience reports, Support implementations. Throughout its 3-year lifetime, TF4 has continuously surveyed RI implementations of triple stores and CTS certification of their data repositories. This surveying was conducted orally and documented in regular monthly meetings by reviewing the activities of RIs along these two task areas. As a result, for both triple store technologies and CTS certification, we observe steady adoption among the ENVRIs. Indeed, in 2020 only BODC and ICOS were actively using triple-store technologies. BODC used these technologies in particular for its Vocabulary Service, while ICOS had decided early on to build on triple store technology for its metadata management. Similarly, at the beginning of TF4’s lifetime, only BODC had conducted CTS-certification for its data repositories. Additionally, TF4 contributed to the conceptualisation of the ENVRI-Hub, especially with an early CKAN-based prototype for a system that could harvest DCAT-formatted metadata about ENVRI datasets and services. Moreover, TF4 supported the adoption of the I-ADOPT Framework to facilitate interoperability between existing variable description models. Finally, the task force acted as a platform to discuss data quality, specifically an ENVRI vocabulary for data quality, with the aim to agree across the ENVRI subdomains to adopt the IODE Quality Flag Scheme. TF4 operated primarily via virtual calls, which were held monthly on the first Friday starting January 2020 and ending December 2022, with a total of 34 meetings. In addition, TF4 co-organised sessions at ENVRI weeks and participated in WP5 activities.

TF5 Licenses citation and usage tracking (of data and VRE)

TF5 has 3 topics of common interest, including

- 1) Licenses for metadata and data. Targeting the "R" for Reusability in FAIR, the TF will come up with a recommendation on which metadata items should be used to document license (and data policy) information in metadata standards.
- 2) Data citation. The TF defines a scheme for data identification that is suitable for both a) tracking of data use down to the granularity of the individual Principal investigate (PII, contributing

- organisation, or framework; b) giving the data user an easy way of citing a dataset or the collection of data used for a use case.
- 3) Data usage tracking. This task will need to collaborate with indexing agencies for data use and connect with ongoing efforts in other fora. The TF is while writing up its results as a report. For the task on license metadata, a comprehensive analysis of licence metadata representation in existing metadata schemas for scientific data has been conducted. The aim is to identify an existing metadata schema that can be adapted to meet the needs of the ENVRI community with respect to machine-actionable attribution requirements.

A team within TF5 is working on the General Data Protection Regulation (GDPR). This relates to personal data. ENVRI catalogues include personal data, e.g., name of service contact or asset supplier. Mechanisms to protect personal data relating to citation and usage tracking but also to AAAI (TF2). The intention is to produce an appropriate privacy policy and mechanisms for ensuring user consent to the use of personal data.

TF6 ENVRI-Hub

TF6 coordinates the development and implementation of ENVRI-FAIR cross-domain demonstrator services and use cases to be exposed at EOSC via the ENVRI-Hub [2]. TF6 oversees the design of the architecture and functionalities of the ENVRI-Hub, which will be driven by the applications, or use cases, and user needs, respectively. The ENVRI-Hub will contain four main pillars: the ENVRI catalogue of services and datasets (TF1), the knowledge base developed by WP7, the training gateway (WP6) and a set of use case demonstrators (WP8-WP11). A unified search at the landing page enables a smooth user experience by accessing these pillars simultaneously. The unified search interface allows users to search content from the ENVRI knowledgebase, service catalogue and training catalogue. TF6 monitors the evolution of services provided at the EOSC Portal. WP7 also explored the possible Jupyter notebook-based VRE [3, 4] options for the future ENVRI-Hub.

4 Summary

This report summarises the support activities conducted in WP7 in the second half of the project. The activities focus on supporting 1) ENVRI -HUB development and integration, 2) service testing and validation for data management services, and 3) knowledge transfer and training. Many supporting activities are joint with the subdomains and RIs in the context of different task forces. In the last phase of the project, validating and testing services from subdomains and making them ready for integration with EOSC via the ENVRI Catalogue of Services and in the future via ENVRI-Hub is prioritised by RIs from all subdomains. WP7 technical specialists were involved in the testing process of different RIs. WP7 team also supported developing the continuation proposal of ENVRI-Hub in the Horizon European call.

During the second half of the project, WP7 organised/participated in different workshops and meetings with subdomains on the common activities identified above, as shown in Table 1. performed at the beginning of ENVRI-FAIR and will perform several other times during the project. Detailed information about the meetings can be found online⁴.

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https://docs.google.com/spreadsheets/d/1JINwEC1gSLZmJlimSBMQg37t610kahiBvKj_CloxxWA/edit#gid=1578698276

Table 1. The summary of the workshops and meetings related to common activities.

| Common development activities | Meetings and workshops | Key contributions |
|--|--|--|
| ENVRI Knowledge base activities | Via the technical workshop and meetings during ENVRI week. | Collected valuable feedback from the community |
| ENVRI-Hub development and integration | Via TF6 meetings, and peer to peer discussion between UvA and Juelich. | Explore the integration options and develop a working prototype. |
| Test support meetings | Meetings with Sub-domains during ENVRI week | Agreement on the test plan and steps. |
| Training-related activities | ENVRI winter/summer schools in 2021 and 2022. | Deliver lecture and lab support. |

5 References

1. CERIF: <https://www.eurocris.org/services/main-features-cerif>
2. Petzold, A., Bundke, U., Schleiermacher, C., Gomes, A. R., Seemeyer, K., Adamaki, A., Vermeulen, A., Zhao, Z., Boulanger, D., Carval, T., and Hienola, A.: The ENVRI-Hub as a service for accelerating FAIRification of the Environment Domain Research Infrastructures, EGU General Assembly 2023, Vienna, Austria, 24–28 Apr 2023, EGU23-7708, <https://doi.org/10.5194/egusphere-egu23-7708>, 2023.
3. Zhao, Z., Koulouzis, S., Bianchi, R., Farshidi, S., Shi, Z., Xin, R., Wang, Y., Li, N., Shi, Y., Timmermans, J., Kissling, W.D.: Notebook-as-a-VRE (NaaVRE): From private notebooks to a collaborative cloud virtual research environment. *Softw Pract Exp*. spe.3098 (2022). <https://doi.org/10.1002/spe.3098>.
4. Shi, Y., Koulouzis, S., Bianchi, R., Timmermans, J., Kissling, W. D., and Zhao, Z.: Generating geospatial data products of ecosystem structure from LiDAR using Notebook-as-a-VRE (NaaVRE), EGU General Assembly 2023, Vienna, Austria, 24–28 Apr 2023, EGU23-11716, <https://doi.org/10.5194/egusphere-egu23-11716>, 2023.

6 Appendix 1: Glossary

Table 2. Glossary

| | |
|----------------------|--|
| ACTRIS | Aerosols, Clouds, and Trace gases Research InfraStructure network |
| Catalogue (Metadata) | A collection of metadata, usually established to make the metadata available to a community. A metadata catalogue has an access service. |
| CERIF | Common European Research Information Format |
| CODATA | Committee on data for Science and Technology |
| DOM | Document Object Model (DOM) is the data representation of the objects that comprise the structure and content of a document on the web. |
| ENVRI | (1) The ENVRI Community of Environmental Research Infrastructures. (2) FP7 project on Implementation of common solutions for a cluster of ESFRI infrastructures in the field of Environmental Sciences. |
| ENVRIplus | ENVRIplus is a Horizon 2020 project bringing together Environmental and Earth System Research Infrastructures, projects, and networks together with technical specialist partners to create a more coherent, interdisciplinary, and interoperable cluster of Environmental Research Infrastructures across Europe. |
| ENVRI-FAIR | An EU-funded project which stands for ENVironmental Research Infrastructures building Fair services Accessible for society, Innovation, and Research. |
| FAIR | Findability, Accessibility, Interoperability, and Reusability of digital assets |
| Elastic Search | Elasticsearch is a search engine based on the Lucene library. |
| EOSC | European Open Science Cloud |
| FITSM | The name for a family of standards for lightweight IT service management (ITSM). |
| GDPR | General Data Protection Regulation, a regulation in EU law on data protection and privacy in the European Union and the European Economic Area. |
| GO FAIR | A bottom-up international approach for the practical implementation of the European Open Science Cloud (EOSC). |
| GUI | A GUI (graphical user interface) is a system of interactive visual components for computer software. |
| H2020 | Horizon 2020, European level research funding scheme |
| Knowledge Base (KB) | (1) A store of information or data that is available to draw on. (2) The underlying set of facts, assumptions, and rules which a computer system has available to solve a problem. |
| LifeWatch | European e-Science infrastructure for biodiversity and ecosystem research |
| Metadata | Data that describes other data. Metadata summarises basic information about data, which can make finding and working with particular instances of data easier. |

| | |
|----------------------|---|
| NetCDF | A file format |
| RM-ODP | Reference Model of Open Distributed Processing (RM-ODP) is a reference model in computer science, which provides a coordinating framework for the standardisation of open distributed processing (ODP) |
| OIL-e | Ontology of the ENVRI Reference Model |
| Ontology | (In computer science and information science) an ontology is a formal naming and definition of the types, properties, and interrelationships of the entities that really or fundamentally exist for a particular domain of discourse. |
| Ontowiki | A free and open-source semantic wiki application, meant to serve as an ontology editor and a knowledge acquisition system. |
| Open Semantic Search | A free software for building an own Search Engine, an explorer for discovery of large document collections, media monitoring, text analytics, document analysis & text mining platform based on Apache Solr or Elasticsearch. |
| OWL | Web Ontology language |
| Provenance | The pathway of data generation from raw data to the actual state of data |
| RDA | Research Data Alliance |
| RDBMS | A software system used to maintain relational databases |
| RDF | Resource Description Framework |
| RI | Research Infrastructure |
| SPARQL | SPARQL is an RDF query language—that is, a semantic query language for databases—able to retrieve and manipulate data stored in Resource Description Framework format. |
| Semantics | The encoding of meaning using a formal language. |
| Semantic Mediawiki | Semantic MediaWiki is an extension to MediaWiki that allows for annotating semantic data within wiki pages, thus turning a wiki that incorporates the extension into a semantic wiki. |
| Triple | A triple is a data entity composed of subject-predicate-object |
| Triplestores | A triplestore or RDF store is a purpose-built database for the storage and retrieval of triples through semantic queries. |
| VRE | virtual research environment |
| Wikidata | A collaboratively edited multilingual knowledge graph hosted by the Wikimedia Foundation. |
| W3C | World Wide Web Consortium |
| WP | Work Package |
| YAML | A human-readable data-serialisation language. |