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MS6.1 Outcome of testing components to achieve core technical & semantic interoperability in cross-domain use cases

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Lead Author (Org)	**UPM**
Contributing Author(s) (Org)	**DTU-DeiC, STFC**
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1.0	2024-04-02	Anne Sofie Fink, DTU-DeiC	Review

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TERMINOLOGY

Terminology/Acronym	Description
EC	European Commission
EFC	EOSC FAIR Champions
EOSC	European Open Science Cloud
ESFRI	European Strategy Forum on Research Infrastructures
GA	Grant Agreement to the project
GDPR	General Data Protection Regulation
RI	Research Infrastructures
RPO	Research Performing Organisations
SIP	Semantic Interoperability Profile
SF	Synchronisation Force
SRIA	Strategic Research and Innovation Agenda of the EOSC
TBT	Technical Bridging Team
EOSC IF	EOSC Interoperability Framework

1. Executive Summary

FAIR-IMPACT aims to support the implementation phase of the European Open Science Cloud. To this end, FAIR-IMPACT has a focus on the EU Interoperability Framework. The perspective for this milestone report is on technical and semantic interoperability. The EOSC Interoperability Framework (EOSC-IF), released in February 2021, aims to facilitate service federation (EOSC components) within the EOSC ecosystem, organised into technical, semantic, organisational, and legal layers.

The report outlines EOSC projects and components, explores FAIRCORE4EOSC components, and presents test results aligning with EOSC-IF recommendations. A checklist tests were designed based on EOSC-IF recommendations, verified for interoperability compliance, and compiled using the SIP Wizard tool. The checklists were completed manually based on the information of each component present in the different documents and online.

As a preliminary result, while technical interoperability recommendations are progressing well, challenges remain in semantic interoperability, particularly in utilising semantic artefacts catalogues/repositories. Future plans involve delving deeper into semantic interoperability following the recommendations that the FAIR IMPACT project will develop related to semantic artefact governance. Also, we plan to extend the tests to additional future EOSC components.

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1 Introduction

The EOSC Interoperability Framework (EOSC-IF) document [1] was released in February 2021 to address the federation of services in the EOSC ecosystem. These services will be deployed as part of the EOSC Core and the EOSC Exchange.

The framework is organised in four layers: technical, semantic, organisational and legal. The technical layer is a low level layer with focus mainly on the exchange of the information between IT systems. It includes mechanisms for authentication, open specifications for EOSC Services, and a clear PID Policy.

The semantic layer adds a new level of abstraction, which addresses the representation of the information exchange, by using semantic artefacts. These artefacts can have a low semantic level (as schemas) or a more complex semantic level (as ontologies).

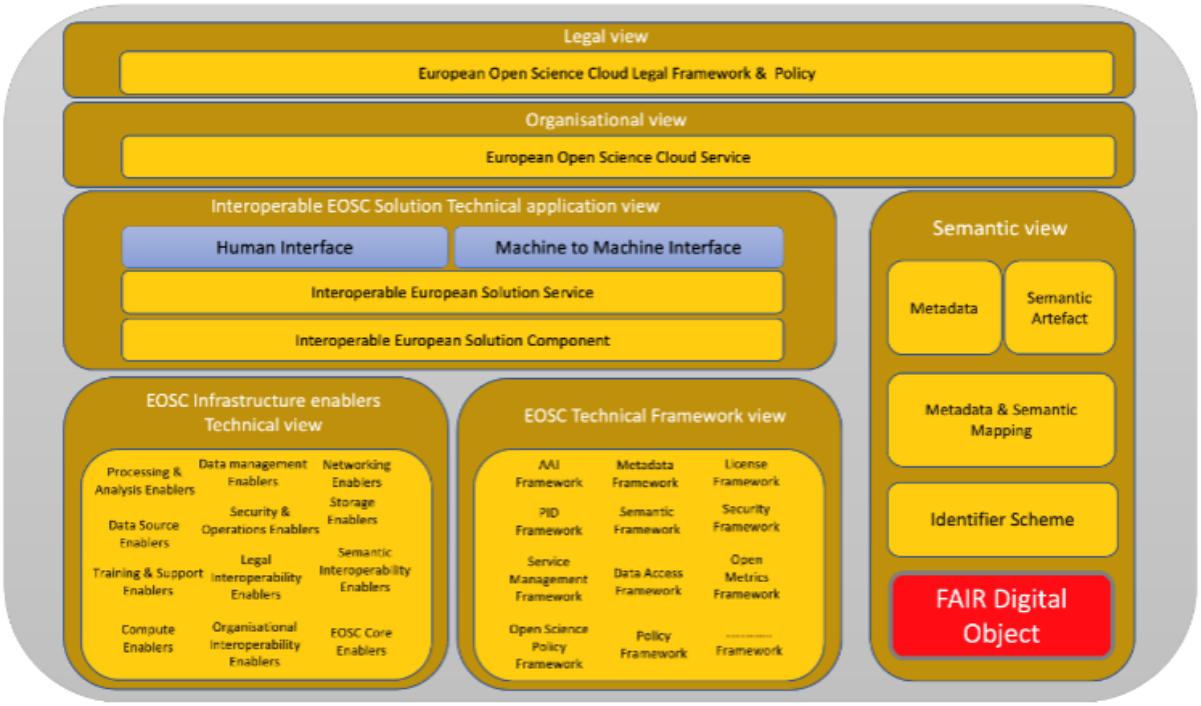

Figure 1. EOSC IF High Level Viewpoint

Each layer of the IF framework identifies a collection of problems detected and a set of recommendations to integrate services and resources in EOSC. These problems and recommendations are used as a baseline for creating a testing template for EOSC components.

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In relation to this template, we have created a profile in the Semantic Interoperability Profile (SIP wizard tool[1]), which will be used to execute the tests. The results can be shared as nanopublication in different formats (including RDF and HTML).

FAIRCORE4EOSC[2] is a European project developing new services for the EOSC Core. In this report, we analyse the implementation of the EOSC-IF recommendations in these service components.

The FAIRCORE4EOSC project is viewed as a 'sister project' for FAIR-IMPACT. The two projects are complementary instruments enabling an operational, open and FAIR EOSC ecosystem. Where FAIRCORE4EOSC will develop EOSC-Core components to adopt, FAIR-IMPACT in its turn will support the implementation of FAIR-enabling practices across scientific communities and research outputs at a European, national, and institutional level.[3]

In section 2, we outline EOSC Projects and beyond as background to further study the EOSC services that are currently being developed as well as future services that will be developed in EOSC related projects (according to the EOSC roadmap).

In section 3, we explore more in detail the different components developed in the project FAIRCORE4EOSC.

In section 4, we present the results of the tests executed on the EOSC components selected from project FAIRCORE4EOSC. In this section, we mapping these components with the recommendations given by the EOSF IF (technical and semantic layers).

Finally, in section 5, we present some preliminary results of the analysis and we outline our future testing plans.

1.1 Objectives

The main objective of this report is to test the interoperability capacities of the EOSC components that are being developed in the EOSC-related projects with focus on FAIRCORE4EOSC.

The second objective of this report is to create a template with a collection of tests to assess their interoperability. This template has been created with the support of the SIP wizard. This template will be used not only for this report, but also for the rest of the project for monitoring the evolution of the EOSC components. The final results will be incorporated into deliverable *D6.1: Guidelines for the usage of components for technical and semantic interoperability in cross-domain use cases*, due M36.

[1] https://sip-wizard.ds-wizard.org/

[2] https://faircore4eosc.eu/

[3] https://fair-impact.eu/news/fair-impact-and-faircore4eosc-two-acronyms-remember

1.2 Methodology

The following methodology has been applied to the execution of the tests.

- Selection of test questions. Tests have been designed taking into account the questions presented in the EOSC IF document (Annex I).
- Means of verification. The means of verification are questions to verify the interoperability compliance of the component.
- Selection of components. In this step, we have selected a collection of components from the EOSC ecosystem. In this report, we have focused on the components that will be developed in the project FAIRCORE4EOSC. However, a collection of components from EOSC related projects have been identified.
- Tests' Execution on the components. In this case, we have tested the components using the tool SIP Wizard. Profiles generated can be found in this report.

2 Description of EOSC projects and related components (present and future)

FAIR-IMPACT supports the implementation of FAIR-enabling practices, tools and services across scientific communities at European, national and institutional level, contributing to an EOSC of FAIR data and services.[4]

In this section we give a brief overview of the The EOSC projects chosen for the purposes of this report and go into more detail with the project components related to interoperability.

2.1 Domain-agnostic projects

The following projects are domain-agnostic in the sense that the projects, their framework, methodologies or related use cases are either not limited to s single scientific domain or are applicable across several domains, scientific or otherwise.

The **FAIRCORE4EOSC** project focuses on the development and realisation of core components for the European Open Science Cloud (EOSC). Supporting a FAIR EOSC and addressing gaps identified in the Strategic Research and Innovation Agenda (SRIA). Leveraging existing technologies and services, the project will develop nine new EOSC-Core components aimed to improve the discoverability and interoperability of an increased amount of research outputs.[5]

[4] https://fair-impact.eu/

[5] https://faircore4eosc.eu/

EuroScienceGateway works on democratising data distribution and data analysis, leveraging a federated open access computational infrastructure through the Galaxy platform for FAIR data analysis, as a gateway for data resources, tools and applications by the FAIR principles.[6]

Skills4EOSC will set up a pan-European network of competence centres to speed up the training of European researchers and harmonise the training of new professional figures for scientific data management.[7]

EOSC Focus has as primary objective to support the EOSC Partnership to meet the objectives outlined in the Memorandum of Understanding between the EU and the EOSC-A. To achieve this, EOSC Focus will implement a number of measures to engage stakeholders and gather information that tracks progress towards KPIs.[8]

e-IRG-SP7 supports the e-IRG policy advisory body in its strategic vision to facilitate integration of European e-Infrastructures and connected services, within and between EU Member States and Associated States at European and global level.[9]

In the **WorldFAIR** project, CODATA (the Committee on Data of the International Science Council) and RDA (the Research Data Alliance) work with a set of 11 disciplinary and cross-disciplinary case studies to advance implementation of the FAIR principles and, in particular, to improve interoperability and reusability of digital research objects, including data.[10]

SCiLake will develop a platform for creation, maintenance, interlinking and unified querying of heterogeneous scientific knowledge graphs, providing advanced, discipline-tailored AI-assisted knowledge discovery services on top of them.[11]

GraspOS will develop and operate an open and trusted federated infrastructure for next generation research metrics and indicators, offering data, tools, services and guidance to support and enable policy reforms of research assessment.[12]

CRAFT-OA aims to make the highly diverse publishing landscape for Open Access journals in Europe more resilient by centralising expertise, collaboration and a joint visibility/indexing layer.[13]

[6] https://www.egi.eu/project/eurosciencegateway/
[7] https://www.skills4eosc.eu/
[8] https://eosc.eu/eosc-focus-project/
[9] https://e-irg.eu/e-irgsp7/
[10] https://worldfair-project.eu/
[11] https://scilake.eu/
[12] https://graspos.eu/
[13] https://www.craft-oa.eu/

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RDA Tiger will provide direct and indirect support for research data alliance groups working on EOSC and FAIR relevant challenges.[14]

2.2 Domain-specific projects

The following projects are domain-specific in the sense that the projects, their framework, methodologies or related use cases are limited to specific scientific domains.

AI4EOSC will deliver an enhanced set of services for the development of Artificial Intelligence (AI), Machine Learning (ML) and Deep Learning (DL) models and applications for the European Open Science Cloud (EOSC). AI4EOSC bases its activities on the technological framework delivered by the DEEP-Hybrid-DataCloud H2020 project, which delivered the DEEP platform to exploit computing resources from pan-European e-Infrastructures.[15]

FAIRease builds the first inter-domain digital architecture for integrated use of environmental data, operating distributed and integrated services for observation and modelling of the earth system, environment and biodiversity.[16]

EOSC4Cancer will make diverse types of cancer data accessible: genomics, imaging, medical, clinical, environmental and socio-economic. It will use and enhance federated and interoperable systems for securely identifying, sharing, processing and reusing FAIR data across borders and offer them via community-driven analysis environments.[17]

The **BeYond-COVID** project aims to make COVID-19 data widely and publicly accessible. Going beyond SARS-CoV-2 data, the project will provide a framework for making data from other infectious diseases open and accessible to everyone.[18]

RAISE contributes to the development of a new and sustainable integrated support framework that will foster startup growth and scale-up within and across Europe in all its dimensions, from initial funding, research support to public incentives and internationalisation.[19]

The **Blue-Cloud 2026** project will build on the Blue-Cloud Europe to develop a thematic marine extension to EOSC for Open Science towards a federated European ecosystem of FAIR open data and analytical services of ocean science.[20]

[14] https://www.rd-alliance.org/get-involved/calling-rda-community/rda-tiger
[15] https://ai4eosc.eu/
[16] https://fairease.eu/
[17] https://eosc4cancer.eu/
[18] https://by-covid.org/
[19] https://theraise.eu/
[20] https://blue-cloud.org/

The **AquaINFRA** project aims to develop a virtual environment equipped with FAIR multi-disciplinary data and services to support marine and freshwater scientists and stakeholders restoring healthy oceans, seas, coastal and inland waters.[21]

3 Description of components developed by FAIRCORE4EOSC

For this milestone report we will focus on the components related to interoperability developed by the FAIRCORE4EOSC project [2]. As the task work moves forward components from additional EOSC projects will become candidates for testing aimed at achieving core technical and semantic interoperability.

The **EOSC Data Type Registry (DTR)** serves as a centralised repository for cataloguing data types and their machine-readable metadata descriptions. It assigns a PID to each data type for consistent reference. The registry aims to standardise the description and discovery of data types within the EOSC ecosystem, thereby making it easier for researchers to understand and use data from various sources.

For seamless integration with other applications, the DTR offers a REST API, while also providing a Web GUI for users to interactively discover and submit data types via a web browser.

The **EOSC Metadata Schema and Crosswalk Registry (MSCR)** is a repository for both Metadata Schemas describing the formats of dataset and the automated translations between these called Crosswalks. The MSCR aims to provide a standardised way to describe and discover metadata schemas and crosswalks in the EOSC ecosystem. By providing a centralised platform for the registration of metadata schemas and crosswalks, the MSCR promotes interdisciplinary discovery and reuse.

The **EOSC PID Graph (PIDGraph)** is a graph database where the PIDs of research artefacts like publication, datasets, projects, institutions, researchers, and funding information make up the nodes of the graph. Relations between the research artefacts are represented by the edges of the graph. This forms a web linking the different entities in the research ecosystem. It allows users to trace the lineage of research data, connect publications to their underlying data, identify collaborations, and uncover funding sources.

The **Research Activity Identifier Service (RAiD)** is a new PID service for assigning a unique, persistent identifier to each research activity, encompassing projects, experiments, or studies, facilitating a structured way to reference and access information about these activities. The RAiD PID ensures that each research activity can be uniquely identified and linked to relevant datasets, publications, researchers, and institutions.

[21] https://aquainfra.eu/

The **Research Discovery Graph (RDGraph)** is a discovery service for EOSC resources and communities. It combines the EOSC catalogue with other sources of research artefacts to provide intelligent community-oriented discovery tools that allows searching on aspects such as disciplines, regions, institutions, funders, projects, researchers, RAiDs, and EOSC services. The service supports both structured formal queries and intuitive natural language prompts for searching.

The **EOSC Compliance Assessment Toolkit (CAT)** is a structured framework for evaluating compliance across various criteria. Besides assessing adherence to the EOSC PID policy, it also facilitates the evaluation of compliance with numerous other important requirements, such as TRUST, FAIR principles, reproducibility, GDPR, licensing, and more.

4 Outcomes of testing components to achieve core technical and semantic interoperability in cross-domain use cases

One of the objectives of this milestone and report is to create a template for testing the EOSC components. Our starting point are the recommendations provided by the EOSC IF report, specially the recommendations of the technical and semantic layers[1]. Based on it, we have created a collection of tests and potential means of verification in a checklist form.

At this stage, the verification is done manually using a specific profile created by the tool Semantic Interoperability Profile (SIP)[22]. As part of the methodology, we use the information provided by this deliverable[3]. We also consider the future use of assessment tools like F-UJI, specially for those cases where resources are the main assessment element.

We have defined two scope levels for the test:

- Service. In this case, the tests applied to the service itself, it means, to the service endpoint.
- Resources inside the service. The tests applied to the resources provided by the service.

There are two particular cases where the scope is relevant to the testing profiles. In the cases that involve PIDs, we can check if the PID is assigned to the service, or if each resource of the service has a PID. The use of semantic artefacts is similar, the semantic artefact can be related to the service, or to the resources inside the service.

4.1 MSCR

[22] https://sip-wizard.ds-wizard.org/

The MSCR (EOSC Metadata Schema and Crosswalk Registry) allows registered users and communities to create, register and version schemas and crosswalks with PIDs.

Technical interoperability

Recommendation #1: Open Specifications for EOSC Services	
Scope	Service
Description	This test is related to the documentation associated with the service, specially with the API endpoint
Checklist	1. Does the service have documentation associated? a. Yes 2. Is it open? Does it follow FAIR principles? a. It can be at least accessed openly, otherwise it is unclear what constitutes as "Reusability" of documentation 3. In the case of using an API, is it documented? a. Yes 4. Is there an open protocol to interact with it? a. Yes, HTTP.

Recommendation #2: A common security and privacy framework (including Authorisation and Authentication Infrastructure).	
Scope	Service
Description	This test checks if exists an authentication service in the system
Checklist	1. Is there a specific authentication protocol implemented? a. Yes, the service is integrated with EOSC AAI that uses SAML based authentication protocol 2. Is this authentication protocol open? a. Yes

Recommendation #3: Easy-to-understand Service-Level Agreements for all EOSC resource providers.

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Scope	Service
Description	This test analyzes the existence and the features of a SLA.
Checklist	1. Is there an SLA (Service Level Agreement) defined to use the service? 2. Is the SLA available and open? 3. Is it clear the payment mode? 4. Are the technical specifications of the service clear? 5. Is it clear how the support system works? 6. Is there an specific section for limitations and constraints of the service? The service doesn't have yet a SLA defined and published

Recommendation #4: Easy access to data sources available in different formats	
Scope	**Service**
Description	This test checks the level of difficulty to access to the data provided by the service
Checklist	1. Is the data access process documented? a. No 2. Does it require authentication to access data (in general)? a. No, everything that is published is available without restrictions (published content vs. draft content). 3. Does the service use more than one data format? a. Yes 4. Are all data formats open? a. Yes

Recommendation #5: A clear EOSC PID policy.	
Scope	Resources inside the service
Description	This test analyzes if the resources of the service has a PID

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	policy or not
Checklist	1. Does your service use resources with a PID? a. Yes 2. Is the PID policy available to users? a. Not yet

Semantic interoperability

Recommendation #1: Clear and precise, publicly-available definitions for all concepts, metadata and data schemas.	
Scope	Resources inside the service
Description	This test checks if the resources managed by the service uses any kind of semantic artefacts.
Checklist	1. Is your metadata publicly-available? a. If this is about the metadata about the service, the question should be more precise. 2. Are your data schemas publicly-available? a. Yes, they will be publicly available in the MSCR Comment: We would interpret “schemas” to refer to schemas associated with data that is available through the APIs of the service.

Recommendation #2: Semantic artefacts preferably with open licences.	
Scope	Resources inside the service
Description	This test checks the license of the resources managed by the service.
Checklist	1. Do your semantic artefacts use open licences? a. Not yet 2. If not, is the licence documented? Are its terms and restrictions clear? a. We will use license values that point to the description of those licenses.

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Recommendation #3: Associated documentation for semantic artefacts.	
Scope	Resources inside the service
Description	This test checks if there is documentation associated with the semantic artefacts managed by the service.
Checklist	1. Are the semantic artefacts documented? a. The semantic artefacts in the case of MSCR are schemas and crosswalks (set of mappings). It is possible to associate documentation for both of those, but the minimal requirements for documentation are really “thin”. 2. Is this documentation publicly available? a. Yes, for humans and machines 3. Is this documentation published in a semantic artefact repository? a. Yes, the MSCR. 4. Do your semantic artefacts have an example of usage? a. Yes, this is planned in a level of “where is this schema/crosswalk used”. 5. Do they have diagrams to show the relations between concepts? a. Yes, there will be a visualization available for at least the schemas.

Recommendation #4: Repositories of semantic artefacts, rules with a clear governance framework.	
Scope	Resources inside the service
Description	This test checks the existance of a governance framework for the semantic artefacts managed by the service.
Checklist	1. Are your semantic artefacts published in a repository? a. This is a bit confusing. Were we talking about metadata about the semantic artefacts before and now switched to the actual content? The MSCR works as both a catalog and repository. 2. Does this repository have a governance policy defined? a. No

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	3. Is it publicly available? a. No

Recommendation #5: A minimum metadata model (and crosswalks) to ease discovery over existing federated research data and metadata.	
Scope	Resources inside the service
Description	This test checks the use of mappings and/or a minimum metadata model.
Checklist	1. Are these semantic artefacts registered as a mapping? a. Not applicable because this service is a mapping registry between metadata. 2. Do your semantic artefacts use a minimum metadata model? a. No

Recommendation #6: Extensibility options to allow for disciplinary metadata.	
Scope	Resources inside the service
Description	This test checks the use of extensibility options to allow user/researchers to add annotations according to the established practices in their communities.
Checklist	1. Are your semantic artefacts based on a pre-existing model? a. Yes 2. Can your semantic artefacts be adapted to other disciplines by adding annotations? a. Yes

Recommendation #7: Clear protocols and building blocks for the federation/harvesting of semantic artefacts catalogues.	
Scope	Resources inside the service
Description	This test explores the use of semantic artefacts catalogs

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Checklist	1. Can your service interact with semantic artefacts? a. Yes 2. Is there a protocol to integrate them in your service? a. Yes 3. Is it publicly available? a. Yes 4. Does it have a governance policy? a. Not yet 5. Do you use a semantic artefacts catalogue? a. No

4.2 PIDGraph

This component will create a graph of PIDs related to organisations, digital objects, researchers and funders.

Technical interoperability

Recommendation #1: Open Specifications for EOSC Services	
Scope	Service
Description	This test is related to the documentation associated with the service, specially with the API endpoint
Checklist	1. Does the service have documentation associated? Partial. Only one of the components has associated the documentation. 2. Is it open? Does it follow FAIR principles? One of the subcomponents has a beta endpoint 3. In the case of using an API, is it documented? Yes, but it is not documented yet 4. Is there an open protocol to interact with it? Yes, HTTP.

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Recommendation #2: A common security and privacy framework (including Authorisation and Authentication Infrastructure).	
Scope	Service
Description	This test checks if exists an authentication service in the system
Checklist	1. Is there a specific authentication protocol implemented? Yes, the service is integrated with EOSC AAI that uses SAML based authentication protocol 2. Is this authentication protocol open? Yes

Recommendation #3: Easy-to-understand Service-Level Agreements for all EOSC resource providers.	
Scope	Service
Description	This test analyzes the existence and the features of a SLA.
Checklist	1. Is there an SLA (Service Level Agreement) defined to use the service? 2. Is the SLA available and open? 3. Is it clear the payment mode? 4. Are the technical specifications of the service clear? 5. Is it clear how the support system works? 6. Is there an specific section for limitations and constraints of the service? For the moment, there is no SLA associated because the maturity level of the product is still low

Recommendation #4: Easy access to data sources available in different formats	
Scope	**Service**
Description	This test checks the level of difficulty to access to the data

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	provided by the service
Checklist	1. Is the data access process documented? Yes 2. Does it require authentication to access data (in general)? No, everything that is published is available without restrictions (published content vs. draft content). 3. Does the service use more than one data format? Yes 4. Are all data formats open? Yes

Recommendation #5: A clear EOSC PID policy.	
Scope	Resources inside the service
Description	This test analyzes if the resources of the service has a PID policy or not
Checklist	1. Does your service use resources with a PID? Yes 2. Is the PID policy available to users? It depends of the PID policy defined by each repository

Semantic interoperability

Recommendation #1: Clear and precise, publicly-available definitions for all concepts, metadata and data schemas.	
Scope	Resources inside the service
Description	This test checks if the resources managed by the service uses

	any kind of semantic artefacts.
Checklist	1. Is your metadata publicly-available? The metadata of the PID Graph is publicly available. 2. Are your data schemas publicly-available? Yes

Recommendation #2: Semantic artefacts preferably with open licenses.	
Scope	Resources inside the service
Description	This test checks the license of the resources managed by the service.
Checklist	1. Do your semantic artefacts use open licences? Semantic artefacts are not licensed 2. If not, is the licence documented? Are its terms and restrictions clear? No

Recommendation #3: Associated documentation for semantic artefacts.	
Scope	Resources inside the service
Description	This test checks if there is documentation associated with the semantic artefacts managed by the service.
Checklist	1. Are the semantic artefacts documented? Yes 2. Is this documentation publicly available? Yes, for humans and machines 3. Is this documentation published in a semantic artefact repository? No 4. Do your semantic artefacts have an example of usage?

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	Yes 5. Do they have diagrams to show the relations between concepts? Yes

Recommendation #4: Repositories of semantic artefacts, rules with a clear governance framework.	
Scope	Resources inside the service
Description	This test checks the existance of a governance framework for the semantic artefacts managed by the service.
Checklist	1. Are your semantic artefacts published in a repository? No 2. Does this repository have a governance policy defined? No 3. Is it publicly available? No

Recommendation #5: A minimum metadata model (and crosswalks) to ease discovery over existing federated research data and metadata.	
Scope	Resources inside the service
Description	This test checks the use of mappings and/or a minimum metadata model.
Checklist	1. Are these semantic artefacts registered as a mapping? No 2. Do these semantic artefacts use a minimum model? No

Recommendation #6: Extensibility options to allow for disciplinary metadata.

Scope	Resources inside the service
Description	This test checks the use of extensibility options to allow user/researchers to add annotations according to the established practices in their communities.
Checklist	1. Are your semantic artefacts based on a pre-existing model? Yes 2. Can your semantic artefacts be adapted to other disciplines by adding annotations? Yes

Recommendation #7: Clear protocols and building blocks for the federation/harvesting of semantic artefacts catalogues.	
Scope	Resources inside the service
Description	This test explores the use of semantic artefacts catalogs
Checklist	1. Can your service interact with semantic artefacts? Yes 2. Is there a protocol to integrate them in your service? No 3. Is it publicly available? No 4. Does it have a governance policy? No

4.3 CAT

The CAT (Compliance Assessment Toolkit) will support the EOSC PID policy with services to encode, record, and query compliance with the policy.

Technical interoperability

Recommendation #1: Open Specifications for EOSC Services

Scope	Service
Description	This test is related to the documentation associated with the service, specially with the API endpoint
Checklist	1. Does the service have documentation associated? Yes. https://doi.org/10.5281/zenodo.7892322 2. Is it open? Does it follow FAIR principles? There is no PID generated for the documentation 3. In the case of using an API, is it documented? Yes, https://api.cat.argo.grnet.gr/swagger-ui/#/ 4. Is there an open protocol to interact with it? Yes, HTTP.

Recommendation #2: A common security and privacy framework (including Authorisation and Authentication Infrastructure).	
Scope	Service
Description	This test checks if exists an authentication service in the system
Checklist	1. Is there a specific authentication protocol implemented? Yes, the service is integrated with EOSC AAI that uses SAML based authentication protocol 2. Is this authentication protocol open? Yes

Recommendation #3: Easy-to-understand Service-Level Agreements for all EOSC resource providers.	
Scope	Service
Description	This test analyzes the existence and the features of a SLA.
Checklist	1. Is there an SLA (Service Level Agreement) defined to

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	use the service? 2. Is the SLA available and open? 3. Is it clear the payment mode? 4. Are the technical specifications of the service clear? 5. Is it clear how the support system works? 6. Is there an specific section for limitations and constraints of the service? For the moment, there is no SLA associated because the maturity level of the product is still low

Recommendation #4: Easy access to data sources available in different formats	
Scope	**Service**
Description	This test checks the level of difficulty to access to the data provided by the service
Checklist	1. Is the data access process documented? Yes 2. Does it require authentication to access data (in general)? There is an authentication service but users can access to all data. 3. Does the service use more than one data format? No 4. Are all data formats open? Yes, previous authentication.

Recommendation #5: A clear EOSC PID policy.	
Scope	Resources inside the service
Description	This test analyzes if the resources of the service has a PID policy or not

Checklist	1. Does your service use resources with a PID? Yes 2. Is the PID policy available to users? Yes, previous authentication

Semantic interoperability

Recommendation #1: Clear and precise, publicly-available definitions for all concepts, metadata and data schemas.	
Scope	Resources inside the service
Description	This test checks if the resources managed by the service uses any kind of semantic artefacts.
Checklist	1. Is your metadata publicly-available? The metadata of the PID Graph is publicly available. 2. Are your data schemas publicly-available? Yes

Recommendation #2: Semantic artefacts preferably with open licenses.	
Scope	Resources inside the service
Description	This test checks the license of the resources managed by the service.
Checklist	1. Do your semantic artefacts use open licences? Semantic artefacts are not licensed 2. If not, is the licence documented? Are its terms and restrictions clear? No

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Recommendation #3: Associated documentation for semantic artefacts.	
Scope	Resources inside the service
Description	This test checks if there is documentation associated with the semantic artefacts managed by the service.
Checklist	1. Are the semantic artefacts documented? Yes 2. Is this documentation publicly available? Yes, for humans and machines 3. Is this documentation published in a semantic artefact repository? No 4. Do your semantic artefacts have an example of usage? Yes 5. Do they have diagrams to show the relations between concepts? Yes

Recommendation #4: Repositories of semantic artefacts, rules with a clear governance framework.	
Scope	Resources inside the service
Description	This test checks the existence of a governance framework for the semantic artefacts managed by the service.
Checklist	1. Are your semantic artefacts published in a repository? No 2. Does this repository have a governance policy defined? No 3. Is it publicly available? No

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Recommendation #5: A minimum metadata model (and crosswalks) to ease discovery over existing federated research data and metadata.	
Scope	Resources inside the service
Description	This test checks the use of mappings and/or a minimum metadata model.
Checklist	1. Are these semantic artefacts registered as a mapping? No 2. Do these semantic artefacts use a minimum model? No

Recommendation #6: Extensibility options to allow for disciplinary metadata.	
Scope	Resources inside the service
Description	This test checks the use of extensibility options to allow user/researchers to add annotations according to the established practices in their communities.
Checklist	1. Are your semantic artefacts based on a pre-existing model? Yes 2. Can your semantic artefacts be adapted to other disciplines by adding annotations? Yes

Recommendation #7: Clear protocols and building blocks for the federation/harvesting of semantic artefacts catalogues.	
Scope	Resources inside the service
Description	This test explores the use of semantic artefacts catalogs
Checklist	1. Can your service interact with semantic artefacts? Yes 2. Is there a protocol to integrate them in your service? No

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	3. Is it publicly available? No 4. Does it have a governance policy? No

4.4 RDGraph

The RDGraph (EOSC Research Discovery Graph Service) delivers advanced discovery tools across EOSC resources and communities. The RDGraph builds upon the EOSC catalogue's content, extending it with additional entities like the Research Activity Identifiers (RAiDs)

Technical interoperability

Recommendation #1: Open Specifications for EOSC Services	
Scope	Service
Description	This test is related to the documentation associated with the service, specially with the API endpoint
Checklist	1. Does the service have documentation associated? Yes. https://doi.org/10.5281/zenodo.7892322 2. Is it open? Does it follow FAIR principles? There is no PID generated for the documentation 3. In the case of using an API, is it documented? Yes 4. Is there an open protocol to interact with it? Yes, HTTP.

Recommendation #2: A common security and privacy framework (including Authorisation and Authentication Infrastructure).	
Scope	Service
Description	This test checks if exists an authentication service in the system

Checklist	1. Is there a specific authentication protocol implemented? Yes, the service is integrated with EOSC AAI that uses SAML based authentication protocol 2. Is this authentication protocol open? Yes

Recommendation #3: Easy-to-understand Service-Level Agreements for all EOSC resource providers.	
Scope	Service
Description	This test analyzes the existence and the features of a SLA.
Checklist	1. Is there an SLA (Service Level Agreement) defined to use the service? 2. Is the SLA available and open? 3. Is it clear the payment mode? 4. Are the technical specifications of the service clear? 5. Is it clear how the support system works? 6. Is there an specific section for limitations and constraints of the service? For the moment, there is no SLA associated because the maturity level of the product is still low

Recommendation #4: Easy access to data sources available in different formats	
Scope	**Service**
Description	This test checks the level of difficulty to access to the data provided by the service
Checklist	1. Is the data access process documented? Yes

	2. Does it require authentication to access data (in general)? No 3. Does the service use more than one data format? No 4. Are all data formats open? Yes

Recommendation #5: A clear EOSC PID policy.	
Scope	Resources inside the service
Description	This test analyzes if the resources of the service has a PID policy or not
Checklist	1. Does your service use resources with a PID? It depends on the data source 2. Is the PID policy available to users? N/A

Semantic interoperability

Recommendation #1: Clear and precise, publicly-available definitions for all concepts, metadata and data schemas.	
Scope	Resources inside the service
Description	This test checks if the resources managed by the service uses any kind of semantic artefacts.
Checklist	1. Is your metadata publicly-available? Yes 2. Are your data schemas publicly-available? Yes

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Recommendation #2: Semantic artefacts preferably with open licenses.	
Scope	Resources inside the service
Description	This test checks the license of the resources managed by the service.
Checklist	1. Do your semantic artefacts use open licences? Semantic artefacts are not licensed 2. If not, is the licence documented? Are its terms and restrictions clear? No

Recommendation #3: Associated documentation for semantic artefacts.	
Scope	Resources inside the service
Description	This test checks if there is documentation associated with the semantic artefacts managed by the service.
Checklist	1. Are the semantic artefacts documented? Yes 2. Is this documentation publicly available? Yes, for humans and machines 3. Is this documentation published in a semantic artefact repository? No 4. Do your semantic artefacts have an example of usage? Yes 5. Do they have diagrams to show the relations between concepts? Yes

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Recommendation #4: Repositories of semantic artefacts, rules with a clear governance framework.	
Scope	Resources inside the service
Description	This test checks the existance of a governance framework for the semantic artefacts managed by the service.
Checklist	1. Are your semantic artefacts published in a repository? No 2. Does this repository have a governance policy defined? No 3. Is it publicly available? No

Recommendation #5: A minimum metadata model (and crosswalks) to ease discovery over existing federated research data and metadata.	
Scope	Resources inside the service
Description	This test checks the use of mappings and/or a minimum metadata model.
Checklist	1. Are these semantic artefacts registered as a mapping? No 2. Do these semantic artefacts use a minimum model? No

Recommendation #6: Extensibility options to allow for disciplinary metadata.	
Scope	Resources inside the service
Description	This test checks the use of extensibility options to allow user/researchers to add annotations according to the established practices in their communities.

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Checklist	1. Are your semantic artefacts based on a pre-existing model? Yes 2. Can your semantic artefacts be adapted to other disciplines by adding annotations? Yes

Recommendation #7: Clear protocols and building blocks for the federation/harvesting of semantic artefacts catalogues.	
Scope	Resources inside the service
Description	This test explores the use of semantic artefacts catalogs
Checklist	1. Can your service interact with semantic artefacts? Yes 2. Is there a protocol to integrate them in your service? No 3. Is it publicly available? No 4. Does it have a governance policy? No

4.5 DTR

The DTR (EOSC Data Type Registry) allows the registration of many different data types. The goal is to achieve a high degree in machine actionability and interoperability in the management of structured research data.

Technical interoperability

Recommendation #1: Open Specifications for EOSC Services	
Scope	Service
Description	This test is related to the documentation associated with the service, specially with the API endpoint

Checklist	1. Does the service have documentation associated? Yes. https://doi.org/10.5281/zenodo.7892322 2. Is it open? Does it follow FAIR principles? There is no PID generated for the documentation 3. In the case of using an API, is it documented? Yes 4. Is there an open protocol to interact with it? Yes, HTTP.

Recommendation #2: A common security and privacy framework (including Authorisation and Authentication Infrastructure).	
Scope	Service
Description	This test checks if exists an authentication service in the system
Checklist	1. Is there a specific authentication protocol implemented? Yes, the service is integrated with EOSC AAI that uses SAML based authentication protocol 2. Is this authentication protocol open? Yes

Recommendation #3: Easy-to-understand Service-Level Agreements for all EOSC resource providers.	
Scope	Service
Description	This test analyzes the existence and the features of a SLA.
Checklist	1. Is there an SLA (Service Level Agreement) defined to use the service? 2. Is the SLA available and open? 3. Is it clear the payment mode? 4. Are the technical specifications of the service clear? 5. Is it clear how the support system works?

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	6. Is there an specific section for limitations and constraints of the service? For the moment, there is no SLA associated because the maturity level of the product is still low

Recommendation #4: Easy access to data sources available in different formats	
Scope	**Service**
Description	This test checks the level of difficulty to access to the data provided by the service
Checklist	2. Is the data access process documented? Yes 3. Does it require authentication to access data (in general)? No 4. Does the service use more than one data format? No 5. Are all data formats open? Yes

Recommendation #5: A clear EOSC PID policy.	
Scope	Resources inside the service
Description	This test analyzes if the resources of the service has a PID policy or not
Checklist	1. Does your service use resources with a PID? It depends on the data source 2. Is the PID policy available to users?

	N/A

Semantic interoperability

Recommendation #1: Clear and precise, publicly-available definitions for all concepts, metadata and data schemas.	
Scope	Resources inside the service
Description	This test checks if the resources managed by the service uses any kind of semantic artefacts.
Checklist	1. Is your metadata publicly-available? Yes 2. Are your data schemas publicly-available? Yes

Recommendation #2: Semantic artefacts preferably with open licenses.	
Scope	Resources inside the service
Description	This test checks the license of the resources managed by the service.
Checklist	1. Do your semantic artefacts use open licences? Semantic artefacts are not licensed 2. If not, is the licence documented? Are its terms and restrictions clear? No

Recommendation #3: Associated documentation for semantic artefacts.	
Scope	Resources inside the service
Description	This test checks if there is documentation associated with the

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	semantic artefacts managed by the service.
Checklist	1. Are the semantic artefacts documented? Yes 2. Is this documentation publicly available? Yes, for humans and machines 3. Is this documentation published in a semantic artefact repository? No 4. Do your semantic artefacts have an example of usage? Yes 5. Do they have diagrams to show the relations between concepts? Yes

Recommendation #4: Repositories of semantic artefacts, rules with a clear governance framework.	
Scope	Resources inside the service
Description	This test checks the existance of a governance framework for the semantic artefacts managed by the service.
Checklist	1. Are your semantic artefacts published in a repository? No 2. Does this repository have a governance policy defined? No 3. Is it publicly available? No

Recommendation #5: A minimum metadata model (and crosswalks) to ease discovery over existing federated research data and metadata.	
Scope	Resources inside the service

Description	This test checks the use of mappings and/or a minimum metadata model.
Checklist	1. Are these semantic artefacts registered as a mapping? No 2. Do these semantic artefacts use a minimum model? No

Recommendation #6: Extensibility options to allow for disciplinary metadata.	
Scope	Resources inside the service
Description	This test checks the use of extensibility options to allow user/researchers to add annotations according to the established practices in their communities.
Checklist	1. Are your semantic artefacts based on a pre-existing model? Yes 2. Can your semantic artefacts be adapted to other disciplines by adding annotations? Yes

Recommendation #7: Clear protocols and building blocks for the federation/harvesting of semantic artefacts catalogues.	
Scope	Resources inside the service
Description	This test explores the use of semantic artefacts catalogs
Checklist	1. Can your service interact with semantic artefacts? Yes 2. Is there a protocol to integrate them in your service? No 3. Is it publicly available? No 4. Does it have a governance policy? No

4.6 RAID

The RAiD (EOSC Research Activity Identifier Service) provides persistent, unique and resolvable information for research projects. The EOSC RAiD will mint Persistent Identifiers for research projects, which will allow users and services to manage information about project-related participants, services, and outcomes.

Technical interoperability

Recommendation #1: Open Specifications for EOSC Services	
Scope	Service
Description	This test is related to the documentation associated with the service, specially with the API endpoint
Checklist	1. Does the service have documentation associated? Yes (https://metadata.raid.org/en/latest/) 2. Is it open? Does it follow FAIR principles? Yes, but there is no PID associated to the documentation and license 3. In the case of using an API, is it documented? Yes (https://api.demo.raid.org.au/swagger-ui/index.html#/raido-stable-v1) 4. Is there an open protocol to interact with it? Yes, HTTP.

Recommendation #2: A common security and privacy framework (including Authorisation and Authentication Infrastructure).	
Scope	Service
Description	This test checks if exists an authentication service in the system
Checklist	1. Is there a specific authentication protocol implemented? No

	2. Is this authentication protocol open? No

Recommendation #3: Easy-to-understand Service-Level Agreements for all EOSC resource providers.	
Scope	Service
Description	This test analyzes the existence and the features of a SLA.
Checklist	1. Is there an SLA (Service Level Agreement) defined to use the service? 2. Is the SLA available and open? 3. Is it clear the payment mode? 4. Are the technical specifications of the service clear? 5. Is it clear how the support system works? 6. Is there an specific section for limitations and constraints of the service? For the moment, there is no SLA associated because the maturity level of the product is still low

Recommendation #4: Easy access to data sources available in different formats	
Scope	**Service**
Description	This test checks the level of difficulty to access to the data provided by the service
Checklist	1. Is the data access process documented? Yes 2. Does it require authentication to access data (in general)? No

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	3. Does the service use more than one data format? No, there is a metadata schema defined in the documentation associated. 4. Are all data formats open? Yes

Recommendation #5: A clear EOSC PID policy.	
Scope	Resources inside the service
Description	This test analyzes if the resources of the service has a PID policy or not
Checklist	1. Does your service use resources with a PID? It depends on the data source 2. Is the PID policy available to users? N/A

Semantic interoperability

Recommendation #1: Clear and precise, publicly-available definitions for all concepts, metadata and data schemas.	
Scope	Resources inside the service
Description	This test checks if the resources managed by the service uses any kind of semantic artefacts.
Checklist	1. Is your metadata publicly-available? Yes 2. Are your data schemas publicly-available? Yes

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Recommendation #2: Semantic artefacts preferably with open licenses.	
Scope	Resources inside the service
Description	This test checks the license of the resources managed by the service.
Checklist	1. Do your semantic artefacts use open licences? Semantic artefacts (metadata schema) are not licensed 2. If not, is the licence documented? Are its terms and restrictions clear? No

Recommendation #3: Associated documentation for semantic artefacts.	
Scope	Resources inside the service
Description	This test checks if there is documentation associated with the semantic artefacts managed by the service.
Checklist	1. Are the semantic artefacts documented? Yes, in the documentation associated and in the API 2. Is this documentation publicly available? Yes, only human readable. 3. Is this documentation published in a semantic artefact repository? No 4. Do your semantic artefacts have an example of usage? No 5. Do they have diagrams to show the relations between concepts? No

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Recommendation #4: Repositories of semantic artefacts, rules with a clear governance framework.	
Scope	Resources inside the service
Description	This test checks the existence of a governance framework for the semantic artefacts managed by the service.
Checklist	1. Are your semantic artefacts published in a repository? No 2. Does this repository have a governance policy defined? No 3. Is it publicly available? No

Recommendation #5: A minimum metadata model (and crosswalks) to ease discovery over existing federated research data and metadata.	
Scope	Resources inside the service
Description	This test checks the use of mappings and/or a minimum metadata model.
Checklist	1. Are these semantic artefacts registered as a mapping? No 2. Do these semantic artefacts use a minimum model? No

Recommendation #6: Extensibility options to allow for disciplinary metadata.	
Scope	Resources inside the service
Description	This test checks the use of extensibility options to allow users/researchers to add annotations according to the established practices in their communities.
Checklist	1. Are your semantic artefacts based on a pre-existing model? No

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	2. Can your semantic artefacts be adapted to other disciplines by adding annotations? No

Recommendation #7: Clear protocols and building blocks for the federation/harvesting of semantic artefacts catalogues.	
Scope	Resources inside the service
Description	This test explores the use of semantic artefacts catalogs
Checklist	1. Can your service interact with semantic artefacts? No 2. Is there a protocol to integrate them in your service? No 3. Is it publicly available? No 4. Does it have a governance policy? No

4.7 PIDMR

The PIDMR (PID Metadata Resolver) is a generalised resolver for mapping items into records.

Technical interoperability

Recommendation #1: Open Specifications for EOSC Services	
Scope	Service
Description	This test is related to the documentation associated with the service, specially with the API endpoint
Checklist	1. Does the service have documentation associated? Yes (https://apimr.devel.argo.grnet.gr/) 2. Is it open? Does it follow FAIR principles? Yes, but there is no PID associated to the documentation and license

	3. In the case of using an API, is it documented? Yes (https://apimr.devel.argo.grnet.gr/swagger-ui/) 4. Is there an open protocol to interact with it? Yes, HTTPS.

Recommendation #2: A common security and privacy framework (including Authorisation and Authentication Infrastructure).	
Scope	Service
Description	This test checks if exists an authentication service in the system
Checklist	1. Is there a specific authentication protocol implemented? Yes, the service will be integrated with EOSC AAI that uses SAML based authentication protocol and also social authentication systems. 2. Is this authentication protocol open? Yes

Recommendation #3: Easy-to-understand Service-Level Agreements for all EOSC resource providers.	
Scope	Service
Description	This test analyzes the existence and the features of a SLA.
Checklist	1. Is there an SLA (Service Level Agreement) defined to use the service? 2. Is the SLA available and open? 3. Is it clear the payment mode? 4. Are the technical specifications of the service clear? 5. Is it clear how the support system works? 6. Is there an specific section for limitations and

	constraints of the service? For the moment, there is no SLA associated because the maturity level of the product is still low

Recommendation #4: Easy access to data sources available in different formats	
Scope	**Service**
Description	This test checks the level of difficulty to access to the data provided by the service
Checklist	1. Is the data access process documented? Only in the API reference, but not in the documentation associated. 2. Does it require authentication to access data (in general)? No 3. Does the service use more than one data format? Yes. 4. Are all data formats open? Yes

Recommendation #5: A clear EOSC PID policy.	
Scope	Resources inside the service
Description	This test analyzes if the resources of the service has a PID policy or not
Checklist	1. Does your service use resources with a PID? Yes, because is a PID resolver. 2. Is the PID policy available to users?

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	Not yet

Semantic interoperability

Recommendation #1: Clear and precise, publicly-available definitions for all concepts, metadata and data schemas.	
Scope	Resources inside the service
Description	This test checks if the resources managed by the service uses any kind of semantic artefacts.
Checklist	1. Is your metadata publicly-available? Yes 2. Are your data schemas publicly-available? Yes

Recommendation #2: Semantic artefacts preferably with open licenses.	
Scope	Resources inside the service
Description	This test checks the license of the resources managed by the service.
Checklist	1. Do your semantic artefacts use open licences? Semantic artefacts (metadata schema) are not licensed 2. If not, is the licence documented? Are its terms and restrictions clear? No

Recommendation #3: Associated documentation for semantic artefacts.	
Scope	Resources inside the service
Description	This test checks if there is documentation associated with the

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	semantic artefacts managed by the service.
Checklist	1. Are the semantic artefacts documented? Yes, (meta)data schemas are described in the documentation of the API 2. Is this documentation publicly available? Yes. 3. Is this documentation published in a semantic artefact repository? No 4. Do your semantic artefacts have an example of usage? No 5. Do they have diagrams to show the relations between concepts? No

Recommendation #4: Repositories of semantic artefacts, rules with a clear governance framework.	
Scope	Resources inside the service
Description	This test checks the existence of a governance framework for the semantic artefacts managed by the service.
Checklist	1. Are your semantic artefacts published in a repository? No 2. Does this repository have a governance policy defined? No 3. Is it publicly available? No

Recommendation #5: A minimum metadata model (and crosswalks) to ease discovery over existing federated research data and metadata.	
Scope	Resources inside the service

Description	This test checks the use of mappings and/or a minimum metadata model.
Checklist	1. Are these semantic artefacts registered as a mapping? No 2. Do these semantic artefacts use a minimum model? No

Recommendation #6: Extensibility options to allow for disciplinary metadata.	
Scope	Resources inside the service
Description	This test checks the use of extensibility options to allow user/researchers to add annotations according to the established practices in their communities.
Checklist	1. Are your semantic artefacts based on a pre-existing model? No 2. Can your semantic artefacts be adapted to other disciplines by adding annotations? No

Recommendation #7: Clear protocols and building blocks for the federation/harvesting of semantic artefacts catalogues.	
Scope	Resources inside the service
Description	This test explores the use of semantic artefacts catalogs
Checklist	1. Can your service interact with semantic artefacts? No 2. Is there a protocol to integrate them in your service? No 3. Is it publicly available? No 4. Does it have a governance policy? No

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4.8 RSAC

The Research Software APIs and Connectors (RSAC) ensure the long-term preservation of research software in different disciplines.

Technical interoperability

Recommendation #1: Open Specifications for EOSC Services	
Scope	Service
Description	This test is related to the documentation associated with the service, specially with the API endpoint
Checklist	1. Does the service have documentation associated? Yes, although one of the subcomponents doesn't have one. 2. Is it open? Does it follow FAIR principles? Yes, but there is no PID associated to the documentation and license 3. In the case of using an API, is it documented? The sub-components have documentation associated in their Github repositories. There is no service endpoint reported on some of them but a demo is provided.. 4. Is there an open protocol to interact with it? Yes, HTTPS.

Recommendation #2: A common security and privacy framework (including Authorisation and Authentication Infrastructure).	
Scope	Service
Description	This test checks if exists an authentication service in the system
Checklist	1. Is there a specific authentication protocol implemented? Yes, with the Google Authentication System. Also, a

	future integration with the EOSC AAI system is planned to be integrated with EOSC Core. 2. Is this authentication protocol open? No

Recommendation #3: Easy-to-understand Service-Level Agreements for all EOSC resource providers.	
Scope	Service
Description	This test analyzes the existence and the features of a SLA.
Checklist	1. Is there an SLA (Service Level Agreement) defined to use the service? 2. Is the SLA available and open? 3. Is it clear the payment mode? 4. Are the technical specifications of the service clear? 5. Is it clear how the support system works? 6. Is there an specific section for limitations and constraints of the service? For the moment, there is no SLA associated because the maturity level of the product is still low

Recommendation #4: Easy access to data sources available in different formats	
Scope	**Service**
Description	This test checks the level of difficulty to access to the data provided by the service
Checklist	1. Is the data access process documented? Yes 2. Does it require authentication to access data (in

	general)? No, only to create it. 3. Does the service use more than one data format? Yes. 4. Are all data formats open? Yes

Recommendation #5: A clear EOSC PID policy.	
Scope	Resources inside the service
Description	This test analyzes if the resources of the service has a PID policy or not
Checklist	1. Does your service use resources with a PID? Yes. 2. Is the PID policy available to users? Depending on the data source

Semantic interoperability

Recommendation #1: Clear and precise, publicly-available definitions for all concepts, metadata and data schemas.	
Scope	Resources inside the service
Description	This test checks if the resources managed by the service uses any kind of semantic artefacts.
Checklist	1. Is your metadata publicly-available? Yes 2. Are your data schemas publicly-available? Yes

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Recommendation #2: Semantic artefacts preferably with open licenses.	
Scope	Resources inside the service
Description	This test checks the license of the resources managed by the service.
Checklist	1. Do your semantic artefacts use open licences? Semantic artefacts (metadata schema) are not licensed 2. If not, is the licence documented? Are its terms and restrictions clear? No

Recommendation #3: Associated documentation for semantic artefacts.	
Scope	Resources inside the service
Description	This test checks if there is documentation associated with the semantic artefacts managed by the service.
Checklist	1. Are the semantic artefacts documented? Yes, (meta)data schemas are described in the documentation of the API 2. Is this documentation publicly available? Yes. 3. Is this documentation published in a semantic artefact repository? No 4. Do your semantic artefacts have an example of usage? No 5. Do they have diagrams to show the relations between concepts? No

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Recommendation #4: Repositories of semantic artefacts, rules with a clear governance framework.	
Scope	Resources inside the service
Description	This test checks the existence of a governance framework for the semantic artefacts managed by the service.
Checklist	1. Are your semantic artefacts published in a repository? No 2. Does this repository have a governance policy defined? No 3. Is it publicly available? No

Recommendation #5: A minimum metadata model (and crosswalks) to ease discovery over existing federated research data and metadata.	
Scope	Resources inside the service
Description	This test checks the use of mappings and/or a minimum metadata model.
Checklist	1. Are these semantic artefacts registered as a mapping? No 2. Do these semantic artefacts use a minimum model? No

Recommendation #6: Extensibility options to allow for disciplinary metadata.	
Scope	Resources inside the service
Description	This test checks the use of extensibility options to allow user/researchers to add annotations according to the established practices in their communities.
Checklist	1. Are your semantic artefacts based on a pre-existing model?

	No 2. Can your semantic artefacts be adapted to other disciplines by adding annotations? No

Recommendation #7: Clear protocols and building blocks for the federation/harvesting of semantic artefacts catalogues.	
Scope	Resources inside the service
Description	This test explores the use of semantic artefacts catalogs
Checklist	1. Can your service interact with semantic artefacts? No 2. Is there a protocol to integrate them in your service? No 3. Is it publicly available? No 4. Does it have a governance policy? No

5 Conclusions and next steps

The recommendations of the EOSC-IF are mainly focused on data interoperability. In the case of the EOSC ecosystem, most of the components are services that have been integrated in the EOSC marketplace. Some challenges must be addressed to integrate and to make them interoperable: i) how a service must be described?, ii) can we use semantic artefacts to describe them?, iii) do we need a PID for each service? and iv) should we extend these questions to the resources managed by these services?

There is no clear answer to all these questions. Some of them have been addressed by the EOSC Association Technical Interoperability Task Force in the deliverable *"Design considerations for Technical Interoperability in EOSC"*[23]. Nevertheless, there is still a gap in the implementation of semantic interoperability between services in general, and EOSC services in particular.

[23] https://zenodo.org/record/8109528

In this report, we have identified a collection of tests, with checklists associated, related to the implementation of the EOSC-IF recommendations adapted to services. These tests have been applied to the components that are being created in FAIRCORE4EOSC for both domain agnostic and cross domain purposes.

Results are provisional due to the maturity level of the components, the project will end in May 2025. Nevertheless, it has been a valuable exercise to detect gaps and test the checklist.

Most of the technical interoperability recommendations are in the process of compliance. These are related to the documentation of APIs, open specifications of protocols used and integration with an authentication service. In the case of semantic interoperability, the implementation is irregular due to a clear recommendation of using semantic artefacts in services. Adding to this end is the complexity of using semantic artefacts in the resources managed by the services.

Our future plans are to dig deeper into the semantic aspects of interoperability between services looking for use cases. Also, a clear definition of metadata for describing EOSC services is also relevant.

Results will be shared with the project FAIRCORE4EOSC and tests will be executed in the next components' releases.

6 References

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