

D6.2b

Workflows developed from the Moderation Process to Onboard External Providers

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Abstract

Deliverable 6.2b – “Workflows developed from the Moderation Process to Onboard External Providers” (M30, September 2023) builds on earlier versions of the deliverable submitted in March and September 2022. It is composed of the present report, a demonstrator video and a workflow. The report outlines how external providers, such as research service providers from ESFRI Research Infrastructures or Science Clusters, can integrate EOSC-Core Services with their own service offer.

The initial report included a first iteration of the workflows envisioned to support the different types of possible integration with the EOSC-Core Services. The workflows have now been validated through the implementation of the Service Integration Roadmap, a robust mechanism for monitoring the Service Integration process. The final status of the Science Clusters’ service and data source integration at M30 is provided.

Additionally, the EOSC Service Provider’s Maturity Model has been developed. It is intended for EOSC Service Providers to self-assess the maturity of their integration into the EOSC ecosystem. It is anticipated that it will become a valuable tool for strengthening EOSC as a federated system of systems, including supporting the emerging model of EOSC nodes. It has been published as a workflow on the Social Science and Humanities Open Marketplace.

Version History

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Vo.4	30/09/2023	Sally Chambers (DARIAH), Laure Barbot (DARIAH), Piotr Pawłowski (PSNC), Matej Ďurčo (OEAW), Klaus Illmayer (OEAW), Tibor Kálmán (GWDG)	Update of the Service Integration Matrix (Phase 3), publication of the EOSC Service Provider Maturity Matrix and finalisation of the remaining sections of the report.
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Glossary

EOSC Future project Glossary is incorporated by reference: <https://wiki.eoscfuture.eu/x/JOCK>.

In addition to the project Glossary, the following terms are used:

Acronym	Definition
AAI	Authentication and Authorisation Infrastructure. A service (or distributed set of services) which enables users to be identified and to access protected information, other services, or functionality.
Community AAI	The purpose of the Community AAI is to streamline researchers' access to services, both those provided by their own infrastructure (if they have one) as well as the services provided by infrastructures that are shared with other communities.
Composability	Resource composability means the combined or integrated usage of two or more resources to provide researchers with added value or innovative solutions facilitating and enabling research use cases and fostering collaboration between diverse research communities.
EOSC-Core Service	A service, provided in the context of European Open Science Cloud (EOSC), that provides core EOSC functionality or stimulates interoperability between services offered within the EOSC ecosystem.
Infrastructure Proxy	The Infrastructure Proxy, enables Infrastructures with a large number of resources, to provide them through a single integration point, where the Infrastructure can maintain centrally all the relevant policies and business logic for making available these resources to multiple communities.
Research Service	A service, provided by a research service provider, such as Research Infrastructures, Science Clusters, or other external research service providers, to facilitate data-driven research in any scientific discipline.
Science Clusters	<p>The European Strategy Forum on Research Infrastructures (ESFRI) was established to shape collaboration in five thematic areas to pave the way for Open Access data for the EOSC, see: https://eoscfuture.eu/esfri-thematic-cluster-projects</p> <ul style="list-style-type: none"> • EOSC-Life - https://www.eosc-life.eu/ • ENVRI-FAIR - https://envri.eu/home-envri-fair/ • ESCAPE - https://projectescape.eu/ • SSHOC - https://www.sshopencloud.eu/ • PaNOSC - https://www.panosc.eu/ <p>Further information about the Science Clusters is available at: https://science-clusters.eu/.</p>
Science Projects	To showcase the impact joint open data research projects can have and how the EOSC can support them, ten Science Projects are developed within EOSC Future. These projects will demonstrate and drive the integration of research data and services across scientific domains. They will show the role the European Open Science Cloud can play in each stage of the research process. At the same time, these projects will allow us to finetune the EOSC by closely monitoring researchers' real-life data needs and requirements for cross-domain and composability features https://eoscfuture.eu/data-in-action/ .
SSH	Social Sciences and Humanities

1 Executive Summary

Deliverable 6.2b – “Workflows developed from the Moderation Process to Onboard External Providers” (M30, September 2023), which builds on earlier versions of the deliverable submitted in March and September 2022, is composed of the present report, a demonstrator video and a Social Science and Humanities Open Marketplace workflow. The report outlines how external providers, such as research service providers from ESFRI Research Infrastructures or Science Clusters, can integrate EOSC-Core Services with their own service offer.

The initial report included a first iteration of the workflows envisioned to support the different types of possible integration with the EOSC-Core Services. Additionally, a “Service Integration Roadmap” for monitoring service integration targets in three phases was introduced, including a report on the status of the service integration work at M11 (February 2022).

The second version of this report (M18, September 2022) additionally included the first iteration of the “Service Integration Matrix”, which detailed the current status of the service integration activities. Following the M18 review (November 2022), where further emphasis on the onboarding of Data Sources was recommended, the T6.2 team extended the Service Integration Matrix to provide specific support for the onboarding, indexing and monitoring of Data Sources from the Science Clusters. This shift in focus has been documented in this report.

Furthermore, the report takes into account the further recommendations resulting from the M24 Review (June 2023), such as the request for further granularity regarding the onboarding and integration of services and data sources from the Science Clusters and an increased emphasis on the development of more sophisticated workflow management and orchestrated services to facilitate the “composability” of the data sources and services onboarded to the EOSC Exchange.

In this third and last version of the report (M30, September 2023), the final status of the service and data source integration at M30 is provided. The aim of this updated report documents the transition from a use cases logic to a more comprehensive service integration process, including a presentation of the final status of these workflows at the end of the EOSC Future project. The aim of these workflows is to ensure that research service providers will be able to find their way and the appropriate support to integrate their service offering into the EOSC ecosystem. This report also includes the different levels of integration per EOSC-Core Service. While such workflows can be considered final, it is important to note that they will need to evolve and innovate along with the EOSC system.

Additionally, the report includes an analysis of good practices and lessons learned during the development of the service and data source integration workflows, as well as recommendations for ongoing work beyond the EOSC Future project.

A specific achievement of this reflection phase is the development of a workflow for EOSC Service Providers to self-assess the maturity of their integration into the EOSC ecosystem, which has been published in the Social Science and Humanities Open Marketplace as a [workflow](#). The EOSC Service Provider’s Maturity Model can be used by both individual ESFRI Research Infrastructures, by the Science Clusters and other EOSC Service providers. It is anticipated that the EOSC Service Provider’s Maturity Model will become a valuable tool for strengthening EOSC as a federated system of systems, including supporting the emerging model of EOSC nodes.

2 Introduction

The integration of research services with EOSC-Core Services is one of the essential building blocks for enabling interdisciplinary data-driven research through the EOSC. To facilitate the service integration process, a set of workflows, as well as a monitoring framework needed to be developed. This work was undertaken within task 6.2 “Integration of EOSC-Core Services into European Research Practice” of the EOSC Future project. The first version of this report reported the status of the service integration work at M11 (February 2022). The second version of this report (M18, September 2022) additionally includes the first iteration of the “Service Integration Matrix”, which details the current status of the service integration activities. Deliverable 6.2a built further on previous work on service integration undertaken in the context of the EOSC-hub project where an Integration handbook for service providers was developed [17]. This new iteration of the deliverable, D6.2b (M30, September 2023) reports and comments on real integration use cases, while highlighting the challenges of the research service providers community in integrating their existing service offer with the EOSC-Core. Recommendations for future EOSC-Core developments are also included in a forward looking section.

Chapter 3 of the report outlines the process that was undertaken to develop a set of **Service Integration workflows**, to interconnect the EOSC-Core Services with Research Services provided by the Science Clusters, to meet the needs of EOSC Future’s interdisciplinary/cross-domain Science Projects. Firstly, the foundations of Service Integration, including the different types of possible integrations, are described. Further details are provided about both the Research Services to be integrated, as well as the EOSC-Core Services that are available for integration. This includes the various different levels of integration per EOSC-Core Service. In the last section of this chapter the framework to monitor this process, the “Service Integration Roadmap” is introduced, including the scheduling of three phases (Phase 1, M12-M18; Phase 2, M19-M24 and Phase 3, M25-M30), to help ensure the achievement of the Key Performance Indicators (KPIs) of 10 services integrations by M18 (September 2022), 20 by M24 (March 2023) and 30 by M30 (September 2023). By September 2023, the Task 6.2 team identified over 70 Research Services (from the Science Clusters and their related Research Infrastructures and the Science Projects) with “Integration potential” with EOSC-Core Services. The status of the Service Integration Matrix¹ at the end of each of these phases is provided, including the final status of the service and data source integration at M30.

Chapter 4 introduces each of the EOSC-Core Services in turn and provides reference implementations which demonstrate **how each EOSC-Core Service has been integrated** with a range of different services and data sources from across the different Science Clusters and Research Infrastructures in support of the Science Projects. This includes a description of the various service and data source integration paths possible, as well as the different integration levels.

Chapter 5 provides an analysis of good practices and lessons learned during the development of the service and data source integration workflows, as well as recommendations for ongoing work beyond the EOSC Future project. It includes details about the development of a **EOSC Service Provider’s Maturity Model**, which can be used by both individual ESFRI Research Infrastructures, by the Science Clusters and other EOSC Service providers, to self-assess the maturity of their integration into the EOSC ecosystem. It is intended to help providers assess the current maturity of their integration into the EOSC ecosystem as well as provide practical guidance for increasing that maturity. It is anticipated that the EOSC Service Provider’s Maturity Model will become a valuable tool for strengthening EOSC as a federated system of systems, including supporting the emerging model of EOSC nodes.

In a final concluding chapter, the report acknowledges the important step that EOSC Future has taken in the long-term Open Science evolution in Europe. It emphasises the crucial **partnership** that has developed between the EOSC-Core, the Science Clusters and their related ESFRI Research Infrastructures through the onboarding and integration of service and data source providers into the EOSC Exchange. It highlights the importance of continuing and further strengthening this partnership beyond EOSC Future to ensure that domain-specific knowledge remains firmly embedded in the core operations of EOSC.

¹ <https://docs.google.com/spreadsheets/d/1V1VVpPpTSsBwgYh2FNQ63ChlafeyAWTboGrIgVR7fU/edit#gid=0>

3 Service Integration Workflows

Enabling **interdisciplinary data-driven research** is one of the founding principles of EOSC. The integration of research services with EOSC-Core Services is one of the essential building blocks in this process. The objective of task 6.2 “Integration of EOSC-Core Services into European Research Practice” was to monitor the integration of EOSC-Core Services with external services.

In the context of EOSC Future, external services are research services provided by, for example, ESFRI Research Infrastructures or Science Clusters. Within EOSC Future, 10 interdisciplinary Science Projects were selected [11] to address complex scientific questions on pressing societal issues such as the climate crisis and Covid-19. The service integration requirements stemmed from these cross-domain Science Projects. However, it is important to note that the ultimate validation of service integration in EOSC is their take-up and use by the research community.

The role of the task 6.2 team, led by DARIAH, was to act as a matchmaker between e-Infrastructures providing EOSC-Core Services and the Research Infrastructures and Science Clusters providing research services, which directly meet the needs identified by the Science Projects. To facilitate the service integration process, a set of workflows was developed. The workflows have now been validated through the implementation of the Service Integration Roadmap (see Section 3.4), a robust mechanism for monitoring the Service Integration process. The final status of the Science Clusters’ service and data source integration at M30 is also provided.

3.1 What is Service Integration?

A first important step in the process was to understand what “service integration” meant in practice. EOSC is a complex system of systems serving a diverse, heterogenous, and multi-disciplinary research community. As a result, research service integration with EOSC-Core Services is also a socio-technological activity, which needs to take into account the broad range of research service providers throughout the European research infrastructure landscape including their varied needs and individual priorities.

Service integration can happen at several levels within the EOSC ecosystem. To capture the diversity of possible interactions between the different EOSC layers, distinctions between different sorts of integration and composability can be useful. Figure 3.1, from the EOSC Future Grant Agreement, depicts **vertical** and **horizontal integrations** as two core types of service integration.

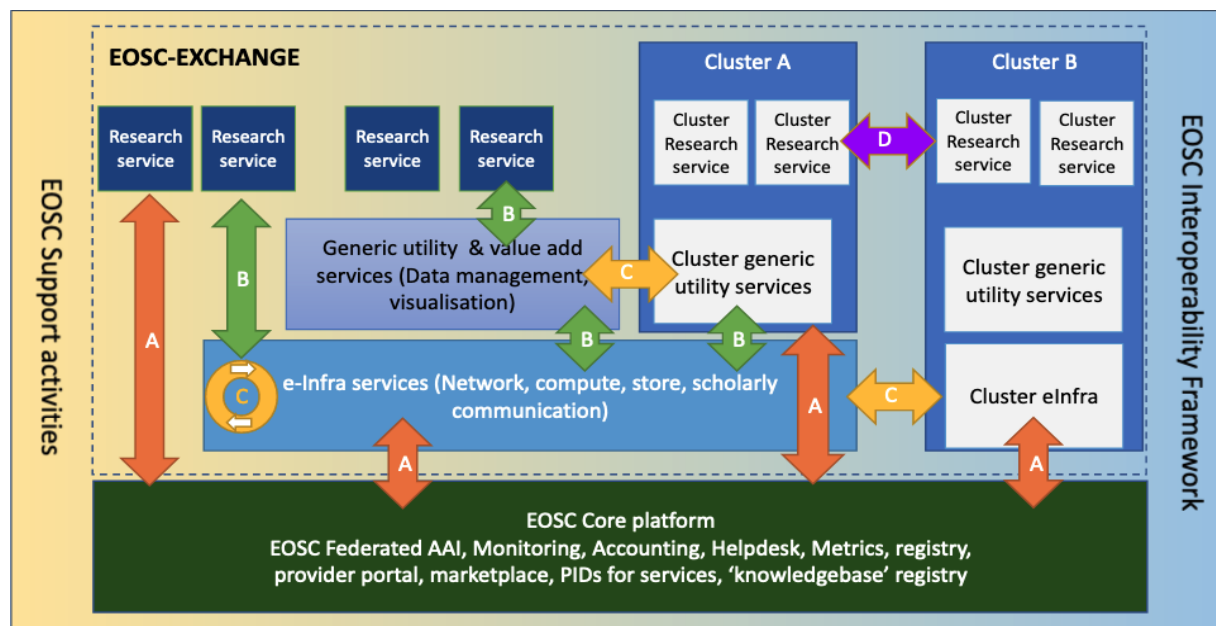


Figure 3.1: Forms of integration and composability

However, it may be useful to explain the two types of integrations in more detail.

Vertical integrations, as shown in Figure 3.1 (by Arrows “A” and “B”) are:

- **A:** Make a Science Cluster service resource interoperable with the EOSC-Core in order to benefit from their composition (e.g., a discovery service for SSH resources integrates with EOSC AAI).
- **B:** Compose a Science Cluster service resource with horizontal added value services in the EOSC-Exchange to enrich the cluster service with additional transparent/elastic/on-demand features, an action which would be facilitated by the EOSC-Core Services (e.g., a materials science service from a Science Cluster is integrated with a horizontal cloud computing service from an e-Infrastructure).

Whereas **horizontal integrations**, shown in Figure 3.1 (by Arrows “C” and “D”) are:

- **C:** Make horizontal service resources from e-Infrastructures and clusters interoperable, an action which would also bring added value to the EOSC Interoperability Framework as the framework to-be-used should surely be proposed to and “branded by” EOSC (e.g., a horizontal data management service from an e-Infrastructure is integrated with data management functions and data from a Science Cluster, or integration between e-Infrastructure services from different organisations).
- **D:** Compose scientific service resources to create added value solutions to handle complex scientific problems (e.g., an epidemiological simulation service from one Science Cluster is composed with a rich data set on logistics and international trade from another Science Cluster to help track the spread of a global pandemic).

Within Task 6.2, the priority is on “**Type A**” integrations. Previous work on service integration has been undertaken within the former EOSC-hub project where an Integration Handbook for service providers was developed [17]. As well as providing procedures for onboarding of new EOSC service providers and their related services, this handbook provided guidelines as to how these service providers could integrate their services with the EOSC-hub services. These EOSC-hub services were a set of services that help service providers enhance their services from an operational perspective. These “federation services” included: federated user authentication, availability and reliability monitoring, usage accounting and a helpdesk. The EOSC-hub “federation services” were the basis of the EOSC-Core Services, which have been further enhanced and extended within the EOSC Future project. These EOSC-Core Services are the initial building blocks for service integration in the context of EOSC Future.

Additionally, the EOSC Interoperability Framework [1] and related EOSC-Core Interoperability Guidelines [4] are crucial tools in the service integration process. Furthermore, they are complemented with the EOSC-Core Service Factsheets, developed in the framework of EOSC Future Task 6.2, which provide high-level introductions to the EOSC-Services and potential integration options (see Section 3.2 for further details).

3.2 EOSC-Core Services

As outlined in the EOSC Architecture and Interoperability Framework [1] the EOSC-Core is the set of enabling services required to operate the EOSC. EOSC-Core Services provide core EOSC functionality or stimulate interoperability between services offered within the EOSC ecosystem. Within EOSC Future, the EOSC-Core Services are listed in the EOSC-Core Service Portfolio [2]. This list provides an overview of the components, contacts and status of the services envisioned to fulfil the functions described in the “Inventory of Core Functions and Inclusion Criteria” deliverable 5.2 [3].

To better understand the EOSC-Core Services, a mapping exercise led by the Task 6.2 team, was undertaken to gather “key facts” about each of the EOSC-Core Services. It is important to note that EOSC-Core Services are often made up of several service components. For example, the EOSC Authentication and Authorisation Infrastructure (AAI) is made up of service components such as the “EOSC-Core Infrastructure Proxy” and the “EOSC AAI Federation”. Task 7.4 monitors the delivery of the Core Services.

Building further on the Integration Handbook for service providers developed within the former EOSC-hub project [17], for each EOSC-Core Service a “Factsheet” has been developed to help research service providers understand:

1. the core service,
2. the potential benefits for the research community as well as
3. the prerequisites for integration and technical details regarding the integration and
4. details of where to get assistance during the integration process.

The EOSC-Core services represent an opportunity to ease providers' work, reduce duplication of effort and contribute to building the EOSC as a system of systems. For researchers and other EOSC users, these integrations also simplify secure access to a range of EOSC services. An overview of the EOSC-Core Services available for integration is provided in Figure 3.2 below.

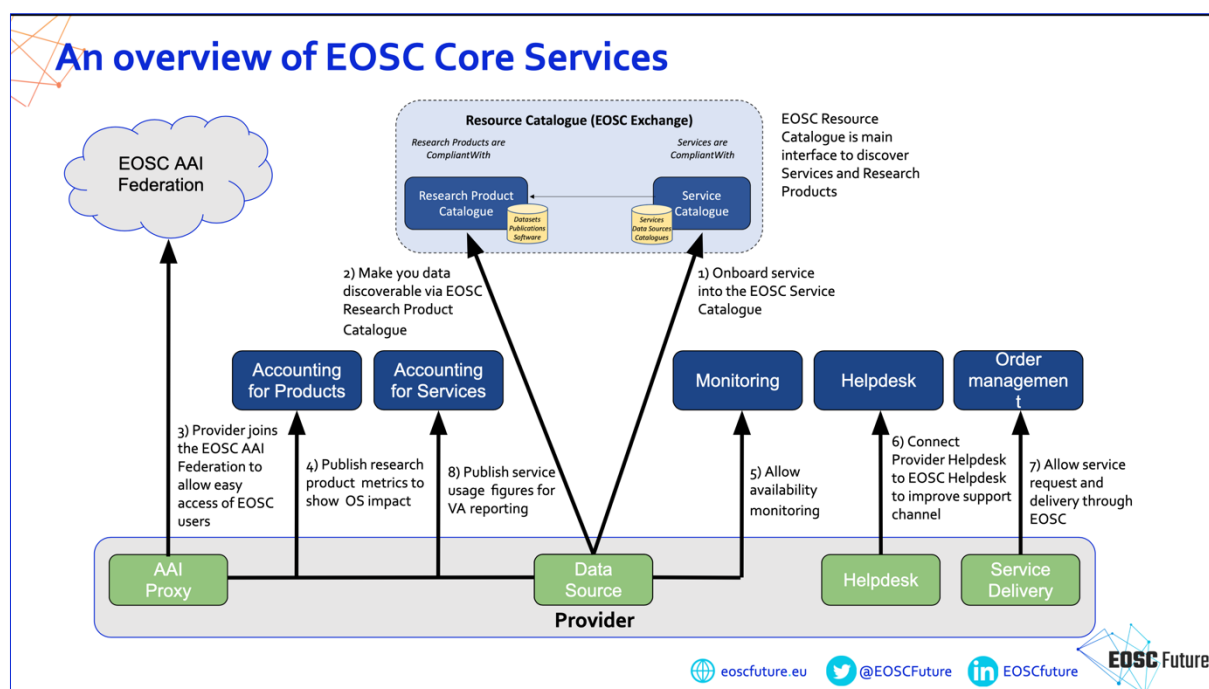


Figure 3.2: An overview of EOSC-Core Services

Table 3-1 below presents an overview of the current list of EOSC-Core Services that are being prepared for integration for research services, their status in terms of technical development, as well as a link to the related EOSC-Core Service Factsheet. Additionally, the Task 7.4 team has integrated the publication of the EOSC-Core Service Factsheets into their process as a prerequisite for moving into production for the EOSC-Core Service in question. On the EOSC Future public wiki, a "EOSC-Core Service Integration" page [18] has been published providing an overview of all the available EOSC-Core Service Factsheets.

Table 3-1: EOSC-Core Services List

Service name	Status	Core Service Factsheet
EOSC AAI Federation	production	There are a number of core documents for the EOSC AAI Federation, such as: EOSC Authentication and Authorisation Infrastructure (AAI): report ² , Authentication and Authorisation for Research and Collaboration (AARC) Blueprint Architecture (BPA) ³ as well as the Core Component, the Research and Collaboration Authentication CA Service for Europe (RCAuth) ⁴ .

² <https://op.europa.eu/en/publication-detail/-/publication/d1bc3702-61e5-11eb-aeb5-01aa75ed71a1/language-en>

³ <https://doi.org/10.5281/zenodo.3672785>

⁴ <https://wiki.eoscfuture.eu/pages/viewpage.action?spaceKey=EOSCSMS&title=EOSC+Core+SP%3A+EOSC+AAI-+HA-RCAuth>

EOSC Order Management	production	Factsheet: https://wiki.eoscfuture.eu/display/PUBLIC/EOSC+Order+Management+-+integration+factsheet
EOSC Helpdesk	production	Factsheet: https://wiki.eoscfuture.eu/display/PUBLIC/EOSC+Helpdesk+-+integration+factsheet
EOSC Monitoring	production	Factsheet: https://wiki.eoscfuture.eu/display/PUBLIC/EOSC+Monitoring+-+integration+factsheet
EOSC Accounting	Accounting for Services (in production) and Accounting for Research Products (in production).	Research products accounting architecture and interoperability guidelines available: https://wiki.eoscfuture.eu/display/PUBLIC/Resource+Products+Accounting+Architecture+and+Interoperability+Guidelines

As outlined in the factsheets, EOSC-Core Services may offer a number of “Integration Options” or “Integration Use Cases”. These integration options are very useful to give research service providers a general idea of the different levels of integration available. For example, one of the EOSC-Core Services, the EOSC Helpdesk [19], offers three integration paths:

- **Full integration:** this path corresponds to the integration of community helpdesks, which implies full synchronisation between EOSC Helpdesk and community helpdesk. This integration is useful for providers and communities with mature helpdesk systems who would like to have tight connection with EOSC Helpdesk, so they could manage the tickets seamlessly in both systems.
- **Ticket redirection:** in this integration the EOSC helpdesk is to be used only as a contact point to redirect the initial request to the provider’s or community mailing or existing helpdesk without further integration. This option is for communities and providers with mature helpdesk system who would like to have only additional channel for requests via EOSC Helpdesk.
- **Direct usage:** in this integration the EOSC helpdesk can be used as the ticketing system for the community and their onboarded services. For this option, it is not necessary for the service provider to maintain their own helpdesk, but they can make use of all benefits provided by the EOSC Helpdesk to support users.

Table 3-2 below presents an overview of the different integration options per EOSC-Core Service. The different options represent a level of gradual integration, from the easiest to the most sophisticated integration possible. Typically, the different options can answer to a question of granularity of the provider needs - does the research provider want to integrate a single service or a whole infrastructure for example - and are the different options also set up to accommodate existing technical frameworks in use within research infrastructures. For example, if a research provider already uses its own Helpdesk or Monitoring solution, it is possible to exchange data between the different systems.

Table 3-2: Overview of the EOSC-Core integration options

EOSC-Core service	Integration Options
EOSC AAI Federation	National academic Federations (e.g., Belnet AAI federation)
	Infrastructure Proxies operated by Research Infrastructures (e.g., DARIAH AAI)
	Infrastructure Proxies operated by e-Infrastructures.
EOSC Monitoring	Monitor an Onboarded Service (monitor extension)
	Monitor an Infrastructure
	Integrate External Monitoring service
	Combined ARGO systems results
	3rd party use of EOSC Monitoring data
EOSC Accounting for Services	Direct usage
	Accounting Infrastructure Integration

EOSC Accounting for Research Products	A workflow for usage accounting (e.g., views and downloads) following the integration of research products from onboarded data sources
EOSC Order Management	Service Order Management Back Office (SOMBO)
	Order Management System (OMS) adapter implementation
	Provider's Order Management System
EOSC Helpdesk	Ticket redirection
	Direct usage
	Full integration

3.3 Research Services

Research services are offered by a research service provider to facilitate data-driven research in any scientific discipline. Within EOSC Future, the identification of service integration requirements from the scientific communities and liaison with research service providers took place at four levels:

1. via the **10 Science Projects** in Task 6.3;
2. via the **5 Science Clusters** (e.g., ENVRI-FAIR for the Environmental Sciences; EOSC-Life for the Life Sciences, ESCAPE for Astronomy and Particle Physics domain, PaNOSC for the materials, health, energy and physics domains and SSHOC for the Social Sciences and Humanities) and their constituent **ESFRI Research Infrastructures** involved in the EOSC Future project [5] & [21] ;
3. via the **research services** onboarded directly in the EOSC catalogue (supported by Task 6.1) and
4. via the **EOSC Early Adopter Programme**, which was intended to increase the adoption of EOSC by providing expertise and resources to researchers; gain insight into user needs and possible EOSC use cases; foster a culture of co-operation between researchers and EOSC providers and integrate new services and resources in EOSC to enrich its functionality.

Research service integration includes identifying and contacting a range of different colleagues working at a number of levels within the research service providers ecosystem, for example, both Senior Managers of European research Infrastructures, technical experts and research coordinators responsible for liaison with the relevant research communities. It is essential that communication is streamlined to support an effective integration process.

As well as direct contact with the representatives of the Science Clusters and from the EOSC-Core Services team, the Task 6.2 team is liaising closely with core working groups and task forces that have been established within EOSC Future to facilitate these effective communications including:

1. Cross-Work Package Working Group: Technical Alignment with the Science Projects [6] ,
2. EOSC Onboarding Strategy Group and the
3. Technical Coordination Board [7] .

Additionally, there are working groups related to specific core services, such as the EOSC Future AAI Implementation Cross-Work Package Working Group [8] , to which the Task 6.2 team also contributes.






It is also important to note that integration needs expressed by the scientific communities engaged in EOSC cover not only services but also other types of research products (this term covers for example software, publications or datasets) and "training materials". At the time of writing, onboarding of services is a clear process and integration needs for the service catalogue are covered by the onboarding process. More clarity is needed for the research products and the training catalogues integration options offered to resource providers, although several use cases are already shared as part of the Interoperability Guidelines [20] .

Since the previous version of the report, the EOSC Portal Team has implemented specific tags for each of the Science Clusters which enable a search query to be performed to provide results of the total number of services and data sources that have been onboarded by a particular cluster. This query-based approach enables the results to be dynamically updated as new resources are onboarded. However, the success of this method depends on the ESFRI Research Infrastructures to accurately add their Science Cluster tag when they onboard their Service or Data Sources.

A thorough review of the metadata of the service and data source descriptions by the Science Clusters, including the correct use of the Science Cluster tag is recommended as the figures presented in Table 3-3 are less than the

total number of onboarded services and data sources reported in the Technical Reports. The total numbers of onboarded services and data sources are calculated on the basis of the OECD [Revised Field of Science and Technology \(FOS\) classification in the Frascati Manual](#) for classifying the EOSC Resources by Scientific Domain, as [described in the EOSC Future wiki](#), which is used by the EOSC Catalogue and Marketplace.

Table 3-3: Overview of the Services and Data Sources on boarded by the Science Clusters

Science Cluster	Domain	Data Sources Onboarded	Services Onboarded	Total
	ENVRI-FAIR: Environmental Sciences	5	81	86
	EOSC-Life: Life Sciences	3	15	18
	ESCAPE: Astronomy and Particle Physics	1	6	7
	PaNOSC: Photon and Neutron Sciences	-	7	7
	SSHOC: Social Sciences and Humanities	3	33	36
Cross-Cluster Total		19	135	154

3.4 Service Integration Roadmap and Matrix

The integration of research services with EOSC-Core Services requires a substantial amount of preparatory work to:

1. understand the complex landscape of research service providers and their needs regarding EOSC-Core Services integration and
2. understand the EOSC-Core Service offer and the integration requirements of each EOSC-Core Service from a policy/governance, legal, technical and research-centred perspective.

A first step in this process was to reach out to each of 10 EOSC Future Science Projects, in close liaison with Task 6.3. An overview of the Science Clusters and their related Science Projects is provided in Table 3-4 below:

Table 3-4: EOSC Future Science Projects

ESCAPE	Understanding of Dark Matter Understanding of Extreme Universe and Gravitational waves
SSHOC	Climate Neural and Smart Cities Access Management for distributed Research Infrastructures (ARIA)
EOSC-Life	COVID-19 metadata Findability and Interoperability in EOSC Imaging Data in EOSC - COVID-19 as Demonstrator
PaNOSC	Serial crystallography Time resolved imaging of biological specimen

ENVRI-FAIR	Impact of Climate change on Biodiversity and Ecosystems in Europe Dashboard on the State of the Environment
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A series of Science Project Templates (MS19) were developed, which included a description of the research and the potential impact of the science project. Additionally, the infrastructure needs of the Science Projects in relation to EOSC have further been investigated within the EOSC Future Cross-Work Package Working Group: Technical Alignment with the Science Projects [6]. Correspondents from e-Infrastructures are suggested to support Science Projects in their implementation plans and this also entails liaison with tasks 6.1 and 6.2 regarding the onboarding and integration processes/workflows.

Based on the Science Projects templates and on the EOSC Architecture and Core services delivery, four main types of integration requirements (which are not fully with the integration types described above in Figure 3.1) can be distinguished: 1) *EOSC-Core AAI, monitoring, accounting*, 2) *EOSC-Core catalogues and marketplace*, 3) *Horizontal service resources (computing & storage)* and 4) *Cluster scientific service resources*.

Considering the service planning (T7.1) and the service delivery of the EOSC Portal & EOSC-Core components (T7.4) the initial phase of service integration conducted by T6.2 focuses on “Type A: EOSC-Core AAI, monitoring, accounting”. An overview of service integration requirements, building further on “MS18 Science Project integration requirements and plans” [9], is provided in Table 3-5 below.

Table 3-5: Integration requirements of the ten EOSC Future Science Projects, organised by Cluster

Cluster	Science Project	Integration Requirements
ESCAPE	Understanding of Dark Matter & Understanding of Extreme Universe and Gravitational waves	<ol style="list-style-type: none"> EOSC-Core AAI, monitoring, accounting <ul style="list-style-type: none"> - AAI federation EOSC-Core catalogues and marketplace <ul style="list-style-type: none"> - Onboarding resources - Software Catalogue Horizontal service resources (computing & storage) <ul style="list-style-type: none"> - DataLake - Additional resources requirements: storage, Compute, Networking Cluster scientific service resources <ul style="list-style-type: none"> - Publication of data sets into the DL - Analysis environment - JupyterLab environment with Binder support - VREs
SSHOC	Climate Neutral and Smart Cities	<ol style="list-style-type: none"> EOSC-Core AAI, monitoring, accounting <ul style="list-style-type: none"> - Access management EOSC-Core catalogues and marketplace <ul style="list-style-type: none"> - Alignment of structured metadata standards - Multilevel data repository adaptation Horizontal service resources (computing & storage) <ul style="list-style-type: none"> - Capacity requirements mostly to be determined but relatively low in scale and can be distributed (legal/privacy concerns?) Cluster scientific service resources <ul style="list-style-type: none"> - Multilevel analysis tool to cater for various types of analysis - JupyterLab environment with Binder support - automatic data harvesting, transformation, merging and processing

SSHOC	Access Management for distributed Research Infrastructures (ARIA)	<ol style="list-style-type: none"> 1. EOSC-Core AAI, monitoring, accounting -AAI 2. EOSC-Core catalogues and marketplace -Generic metadata extension 3. Horizontal service resources (computing & storage) -B2SAFE for form the basis of a generic solution that can be used as a compatible data storage solution for restricted data 4. Cluster scientific service resources -Dataverse platform extension -Domain or cluster specific solution will be extended to be applicable to all interested EOSC service providers.
EOSC-Life	COVID-19 metadata Findability and Interoperability in EOSC	<ol style="list-style-type: none"> 1. EOSC-Core catalogues and marketplace -Framework for a metadata model, characterising the research approach and workflow across research infrastructures and domains. 2. Cluster scientific service resources -Data reuse within and among scientific clusters (Integration type D)
EOSC-Life	Imaging Data in EOSC - COVID-19 as Demonstrator	<ol style="list-style-type: none"> 1. Horizontal service resources (computing & storage) -Need for open access large scale cloud-based storage platforms. -Use of existing resources for HPC and cloud storage
PaNOSC	Serial crystallography & Time resolved imaging of biological specimen	<ol style="list-style-type: none"> 1. EOSC-Core AAI, monitoring, accounting -Umbrella AAI federated with EOSC AAI -EOSC Helpdesk integration -Monitoring services for storage and compute 2. EOSC-Core catalogues and marketplace -Data search enabled over all connected data repositories based on metadata ontologies and digital identifiers 3. Horizontal service resources (computing & storage) -Access to storage and compute with clearly defined access mechanisms -Long-term data archival beyond the RI data policies 4. Cluster scientific service resources - JupyterLab environment with Binder support
ENVRI-FAIR	Impact of Climate change on Biodiversity and Ecosystems in Europe	<ol style="list-style-type: none"> 1. EOSC-Core AAI, monitoring, accounting -Integrating with the appropriate EOSC-Core technical (layers security, monitoring, AAI) 2. EOSC-Core catalogues and marketplace -Onboarding resources 3. Horizontal service resources (computing & storage) -Computing resources

ENVRI-FAIR	Dashboard on the State of the Environment	<ol style="list-style-type: none"> 1. EOSC-Core AAI, monitoring, accounting -Onboarding in the EOSC portal 2. EOSC-Core catalogues and marketplace -Virtual common platform for ENVRI-FAIR data and services 3. Horizontal service resources (computing & storage) -Computing resources 4. Cluster scientific service resources -Front-end of the ENVRI-Hub
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From M12 onwards, the T6.2 team has used a “**Service Integration Roadmap**”, developed in close liaison with the Science Clusters and the Science Projects (T6.3) and based on their service integration requirements. These requirements were further iterated in a series of meetings. During these meetings, the service integration needs, and integration readiness of the EOSC-Core and Research Services were reviewed to produce a prioritised list of potential integrations per Research Service.

This prioritised list was then mapped to each of the **three phases of the “Service Integration Roadmap”**:

- **Phase 1 (M12-M18):** Review EOSC-Core Services Factsheets and collected Science Project Templates, organise meetings with Science Clusters, agree and undertake the first lot of 10 integrations.
- **Phase 2 (M19-M24):** Review and update D6.2 based on Service Integration Roadmap Phase 1, agree and undertake the second lot of 10 integrations.
- **Phase 3 (M25-M30):** Review and update D6.2 based on Service Integration Roadmap Phase 2, agree and undertake the third lot of 10 integrations.

The “Service Integration Roadmap” outlined service integration targets per phase, which was closely monitored by the Task 6.2 team, in close liaison with both the research service and EOSC-Core Service providers. It also supported the achievement of the Key Performance Indicators (KPIs) of 10 services integrations by M18 (September 2022), 20 by M24 (March 2023) and 30 by M30 (September 2023). From a technical perspective, this “Service Integration Roadmap” was also supported by a specific JIRA project [10] as part of the overall EOSC Future Technical Roadmap, which is used for tracking issues and resolving issues as part of the technical integration process. The details of the service integrations can be found in the **Service Integration Matrix**⁵.

Following the M18 review (November 2022), further emphasis on the onboarding of Data Sources was recommended. The T6.2 team therefore extended the Service Integration Matrix to provide specific support for the onboarding, indexing, and monitoring of Data Sources from the Science Clusters.

By the end of the EOSC Future Project (M30, September 2023), the final status of the Science Clusters’ service and data source integration, in relation to the testing and validation of the onboarding and integration workflows, is as follows:

- **Phase 1 (M12-M18):** 56 Research Services with “high integration potential” identified from across the Science Clusters and the Science Projects. **15 Service Integrations** have been successfully completed (KPI-1 for Phase 1 is 10 Service Integrations).
- **Phase 2 (M19-M24):** By the end of Phase 2, a total of **28 Service Integrations** have been successfully completed (KPI-1 for Phase 2 is 20 Service Integrations).
- **Phase 3 (M25-M30):** At the end of the Phase 3, over **70 Research Services** with “high integration potential” had been identified from across the Science Clusters and the Science Projects, following the reorientation of the Integration Matrix to include onboarding of Data Source and Research Products, a total of **36 Service and Data Source integrations** has been successfully completed (KPI-1 for Phase 3 is 30 Service Integrations).

For the **Science Clusters**, more specifically, this includes:

- Onboarding of data sources (9)
- Onboarding of individual research products (2)

⁵ <https://docs.google.com/spreadsheets/d/1V1VVpPpTsBwgYh2FNQ63ChlafeyAWTboGrIgVR7fU/edit#gid=0>

- Integration of Research Products (following the successful onboarding of data sources) (7)
- Accounting for research products (following their successful integration) (3)
- Advanced Monitoring of Services (2)⁶
- Help desk integrations (6)
- Order Management (2)

Additionally, **all 5 of the Science Clusters** have one or more Research Infrastructures (RIs) compatible with the EOSC AAI Federation.

In the following series of tables below (Table 3-6-Table 3-8) an overview of the status of the Service Integration Matrix at the end of each of the Phases: Phase 1 (M12-M18) (September 2022), Phase 2 (M19-M24) (March 2023) and Phase 3 (M25-M30) (September 2023) is provided.

⁶ At the request of the EOSC Future Reviewers, basic monitoring was removed from the metrics for the Service Integration Matrix.

Table 3-6: Service Integration Matrix - Phase 1

Research Service	EOSC Science Cluster	Research Infrastructure	Resource Organisation	Research Services Onboarded	Core Service AAI Federation	Core Service Accounting for Research Products	Core Service Accounting for Services	Core service monitoring	Core service helpdesk	Core service order management
SSH Open Marketplace	SSHOC	DARIAH ERIC	DARIAH	Yes	Yes	No	Maybe	Yes	Maybe	Maybe
CESSDA Data Catalogue	SSHOC	CESSDA ERIC	CESSDA	Yes	Maybe	Maybe	Maybe	Yes	Yes	Maybe
Data Management Expert Guide (DMEG)	SSHOC	CESSDA ERIC	CESSDA	Yes	Maybe	Maybe	Maybe	Yes	Yes	Maybe
ELSST – European Language Social Science Thesaurus	SSHOC	CESSDA ERIC	CESSDA	Yes	Maybe	Maybe	Maybe	Yes	Yes	Maybe
Virtual Collection Registry	SSHOC	CLARIN ERIC	CLARIN	Yes	Maybe	Maybe	Maybe	Yes	Maybe	Maybe
The European Synchrotron Radiation Facility Data Portal	PaNOSC	ESRF	ESRF	Yes	Yes	Maybe	Maybe	Yes	Maybe	Maybe
PSI Public Data Repository	PaNOSC	EXPANDS	PSI	Yes	Maybe	Maybe	Maybe	Yes	Maybe	Maybe
SeaDataNet Common Data Index (CDI)	ENVRI-FAIR	SeaDataNet	SeaDataNet	Yes	Yes	Maybe	Maybe	Yes	Yes	Maybe
WebODV - Online extraction, analysis and visualization of SeaDataNet and Argo data	ENVRI-FAIR	SeaDataNet	SeaDataNet	Yes	Yes	Maybe	Maybe	Yes	Yes	No
Argo marine floats data discovery/download web	ENVRI-FAIR	EURO-ARGO ERIC	Ifremer	Yes	Maybe	Maybe	Maybe	Maybe	Maybe	Maybe
WorkflowHub: the FAIR computational workflow registry	EOSC-Life	ELIXIR	ELIXIR-UK	Yes	Yes	Maybe	Maybe	Yes	Maybe	Maybe
Identifiers.org	EOSC-Life	ELIXIR	EMBL-EBI	Yes	Maybe	Maybe	Maybe	Yes	Maybe	Maybe
Embassy Cloud	EOSC-Life	ELIXIR	EMBL-EBI	Yes	Maybe	Maybe	Maybe	Yes	Maybe	Maybe
3DBionotes-WS	EOSC-Life	ELIXIR	CNB-CSIC	Yes	Maybe	Maybe	Maybe	Yes	Maybe	Maybe
ARIA (Access to Research Infrastructure Management)	EOSC-Life	INSTRUCT ERIC	Instruct-ERIC	Yes	Maybe	Maybe	Maybe	Yes	Maybe	Maybe

Table 3-7: Service Integration Matrix - Phase 2

Research Service	EOSC Science Cluster	Research Infrastructure	Research Services Onboarded	Core Service AAI Federation	Core Service Accounting for Research Products	Core Service Accounting for Services	Core service monitoring	Core service helpdesk	Core service order management
ESCAPE Open-source Scientific Software and Service Repository	ESCAPE	ESCAPE	No	Maybe	Yes	Maybe	Maybe	Maybe	Maybe
ESCAPE Virtual Observatory	ESCAPE	ESCAPE	No	Maybe	Yes	Maybe	Maybe	Maybe	Maybe
High Energy Physics (HEP) Open Data Portal	ESCAPE	ESCAPE	No	Maybe	Yes	Maybe	Maybe	Maybe	Maybe
ENVRI-Hub catalogue of services	ENVRI-FAIR	ENVRI	No	Maybe	Maybe	Maybe	Maybe	Maybe	Maybe
EOSC Nordic Service Gateway	EOSC-Nordic	EOSC-Nordic	No	Yes	Maybe	Maybe	Yes	Yes	Maybe
LUMI ETAIS / Regular Access	EOSC-Nordic	EOSC-Nordic	No	Yes	Maybe	Maybe	Maybe	Maybe	Yes

Table 3-8: Services and Data Sources Integration Matrix - Phase 3

Research Service Full Name	EOSC Science Cluster	EOSC resource type	Research Resource Onboarded	Research Products Integrated	Core Service Accounting for Research Products	Core Service Accounting for Services	Core service monitoring (extension)	Core service helpdesk	Core service order management
ARCHE (A Resource Centre for the HumanitiEs)	SSHOC	Datasource	Yes	Yes	Done	N/A	N/A	N/A	N/A
CERN Open Data Portal	ESCAPE	Datasource	Yes	In progress	In progress	N/A	N/A	In progress	N/A
CESSDA Data Catalogue	SSHOC	Datasource	Yes	Yes	In progress	N/A	N/A	Done - full	N/A
ESCAPE Open-source Scientific Software and Service Repository	ESCAPE	Datasource	Yes	Yes	In progress	N/A	N/A	In progress	N/A
ESCAPE Virtual Observatory	ESCAPE	Datasource	In progress	Yes	In progress	N/A	N/A	In progress	N/A
ILL Data Portal	PaNOSC	Datasource	Yes	N/A	N/A	N/A	N/A	N/A	N/A
PaNOSC Software Catalogue	PaNOSC	Datasource	In progress	N/A	N/A	N/A	N/A	N/A	N/A
PSI Public Data Repository	PaNOSC	Datasource	Yes	N/A	N/A	N/A	N/A	N/A	N/A
TextGrid Repository	SSHOC	Datasource	Yes	Yes	In progress	N/A	N/A	N/A	N/A
The European Synchrotron Radiation Facility Data Portal	PaNOSC	Datasource	Yes	In progress	In progress	N/A	N/A	N/A	N/A
WorkflowHub: the FAIR computational workflow registry	EOSC-Life	Datasource	Yes	In progress	In progress	In progress	N/A	N/A	N/A
COVID-19 Knowledge Graph: A semantic resource embedding biol	EOSC-Life	Research Product	Yes	Yes	Done	N/A	N/A	N/A	N/A
Monkeypox Knowledge Graph: A semantic resource embedding biol	EOSC-Life	Research Product	Yes	Yes	Done	N/A	N/A	N/A	N/A
3DBionotes-WS	EOSC-Life	Service	Yes	N/A	N/A	In progress	Done - basic	Done - basic	N/A
Argo marine floats data discovery/download web	ENVRI-FAIR	Service	Yes	N/A	N/A	In progress	Done - basic	N/A	N/A
ARIA (Access to Research Infrastructure Management)	EOSC-Life	Service	Yes	N/A	N/A	In progress	Done - basic	N/A	Done
ARMS WRIMS Invasive Checker	ENVRI-FAIR	Service	Yes	N/A	N/A	N/A	Done - basic	N/A	N/A
Covid-19 Structural Hub	EOSC-Life	Service	Yes	N/A	N/A	In progress	Done - basic	Done - basic	N/A
Dashboard for the State of the Environment	ENVRI-FAIR	Service	Yes	N/A	N/A	In progress	Done - basic	N/A	N/A
Data Management Expert Guide (DMEG)	SSHOC	Service	Yes	N/A	N/A	In progress	Done - basic	Done - full	N/A
ELSST – European Language Social Science Thesaurus	SSHOC	Service	Yes	N/A	N/A	In progress	Done - basic	Done - full	N/A
ENVRI Catalogue of Services	ENVRI-FAIR	Service	Yes	N/A	N/A	N/A	Done - basic	N/A	N/A
ESS Labs	SSHOC	Service	Yes	N/A	N/A	N/A	N/A	Done - basic	N/A
Language Resource Switchboard	SSHOC	Service	Yes	N/A	N/A	In progress	Done - basic	N/A	Done
SeaDataNet Common Data Index (CDI)	ENVRI-FAIR	Service	Yes	N/A	N/A	N/A	Done - community	N/A	N/A
SSH Open Marketplace	SSHOC	Service	Yes	N/A	N/A	N/A	Done - basic	N/A	N/A
VISA (ESRF) - Virtual Infrastructure for Scientific Analysis	PaNOSC	Service	Yes	N/A	N/A	N/A	N/A	N/A	N/A
VISA (ILL) - Virtual Infrastructure for Scientific Analysis	PaNOSC	Service	In progress	N/A	N/A	N/A	N/A	N/A	N/A
WebODV - Online extraction, analysis and visualization of SeaData	ENVRI-FAIR	Service	Yes	N/A	N/A	N/A	Done - full	N/A	N/A

4 Demonstrating the integration of research services/resources with EOSC Core services

While D6.2a focused on demonstrating the integration of the EOSC AAI with the SSH Open Marketplace [15], this new version of D6.2 presents and discusses one integration use case per Core Service, each of which can be viewed as reference implementations. Specific challenges encountered during the different integration steps are highlighted, in order to outline solutions found and lessons learned and as a result provide clearer guidelines and workflows for all EOSC-Exchange providers interested in integrating their service offer into the EOSC.

4.1 Service and data sources integration paths

One of the **major improvements** during the latest phase of the EOSC Future is the clarification established between services and data source. Although, as outlined in the EOSC resources data model developed by OpenAIRE, a data source is a subclass of service, in practice their onboarding and integration with EOSC Core services is undertaken in a different workflow. As a service, a data source can integrate with all the classic core services (e.g., Helpdesk or Order Management). However, there is also another specific Core Service which is available for data sources: the Accounting for Research Products (see section 4.5).

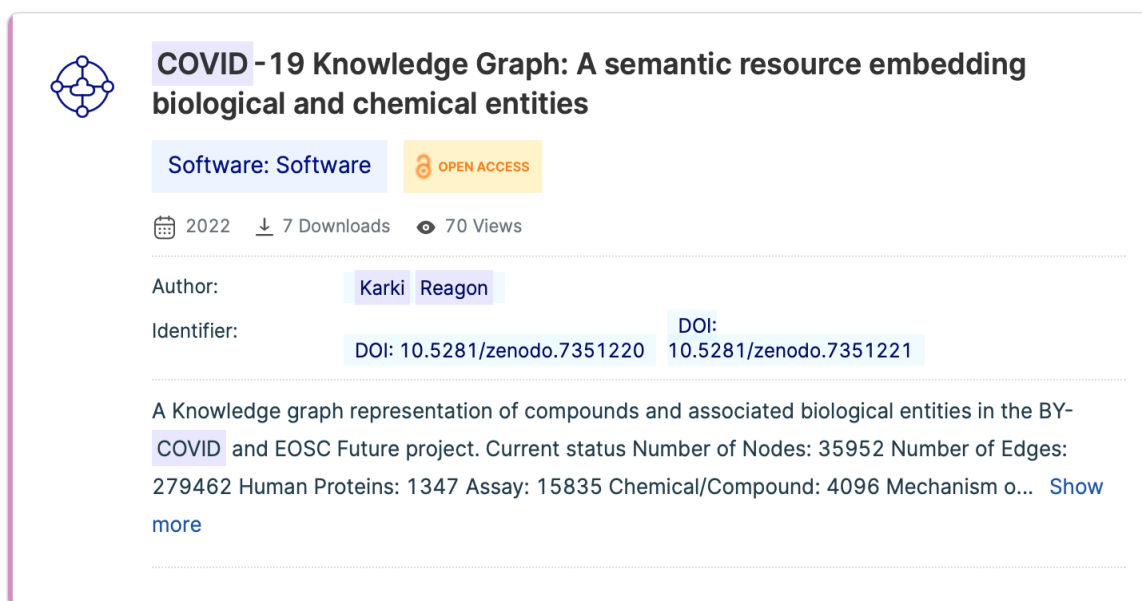
A full data source onboarding is not a trivial process. It is described by the EOSC Portal Onboarding Team (EPOT) in the [EPOT Procedure-09: Onboard data source and research products](#). Although this deliverable focuses on integration and not onboarding, it should be noted that the **identification of a data source**, and as a result distinguishing it between a service or a community catalogue so as to choose the “right” onboarding path depending on the nature of the resource, has been one of the key areas in which Science Clusters and their related Research Infrastructures required support. Such work was further prioritised when, following the M18 review (November 2022), additional emphasis on the onboarding of Data Sources was recommended. As a result, the T6.2 team extended the Service Integration Matrix to provide specific support for the onboarding, indexing and monitoring of Data Sources from the Science Clusters.

Indeed, most of the time, services from the research communities that are candidates for Exchange onboarding are complex services/environments consisting of multiple components, all of which cannot easily be subsumed under one of the existing terminologies. Thanks to the new version of [SPM Guideline-02: EOSC-Exchange Definition of resource types](#), future documentation to share with Exchange providers can be further improved.


Furthermore, it is also possible to onboard individual research products to the EOSC Catalogue. The workflow here is to use existing data sources such as Zenodo. This was tested by the [Covid 19 knowledge Graph](#) “research product” that used the following workflow, developed in the EOSC Future “META-COVID” Science project, as depicted in Figure 4.1 below.

1. the research product is a knowledge graph hosted on GitHub. By following this tutorial - <https://docs.github.com/en/repositories/archiving-a-github-repository/referencing-and-citing-content> - it is possible to archive a GitHub repository on Zenodo.
2. Zenodo being an EOSC data source, all records added there will, after a synchronisation time, be discoverable/findable in the EOSC Catalogue too.

As Zenodo is an EOSC data source, all records added there will, after a synchronisation time, be discoverable/findable in the EOSC Catalogue too.



COVID-19 Knowledge Graph: A semantic resource embedding biological and chemical entities

Software: Software  OPEN ACCESS

2022 7 Downloads 70 Views

Author: Karki Reagon

Identifier: DOI: 10.5281/zenodo.7351220 DOI: 10.5281/zenodo.7351221

A Knowledge graph representation of compounds and associated biological entities in the BY-COVID and EOSC Future project. Current status Number of Nodes: 35952 Number of Edges: 279462 Human Proteins: 1347 Assay: 15835 Chemical/Compound: 4096 Mechanism o... [Show more](#)

Figure 4.1: COVID-19 Knowledge Graph in the EOSC Marketplace

4.2 EOSC AAI Federation

By M30, September 2023, all 5 of the Science Clusters have one or more Research Infrastructures (RIs) compatible with the EOSC AAI Federation: ESCAPE AAI (ESCAPE), the Life science AAI (EOSC Life), the UmbrellaID AAI (PaNOSC), the DARIAH and CESSDA AAI (SSHOC) and EMSO-ERIC via EGI Check-in (ENVRI-FAIR). While this is a significant achievement, as each Science Cluster consists of a number of ESFRI Infrastructures, it is not always possible to convince well-established domain-specific Research Infrastructures to use a single AAI per Science Cluster. In this section, we provide an overview of the steps undertaken by one community - the ENVRI-FAIR cluster - to introduce the EOSC AAI Federation to the different Research Infrastructures within the Science Cluster as a step towards them joining the federation.

While, when exploring the AAI needs of a Science Cluster, there are several questions one should answer to assess the compatibility of its existing authentication and authorisation solutions to the EOSC AAI solution, the first question to decide upon when it comes to Science Cluster is the following: "Does your Science Cluster have one AAI or per RI AAI?". In the case of ENVRI-FAIR, 11 RIs are involved, and it has been decided that individual RIs will manage/implement their AAI. To help with this process, during the course of 2023, the EOSC-Future project designed a series of questions to **assess the EOSC readiness status of the Cluster AAI solutions**. (See also: [12], [13] & [14]).

The 7 main questions (sometimes broken down into sub-questions related to specific AARC Guidelines) were the following:

1. Does your Science Cluster have one AAI or per RI AAI?
2. Are there users in your RI that do not have access to any AAI? If so, can you briefly describe the reasons for it?
3. Does/do the AAI(s) implement the AARC Blueprint Architecture?
4. Which AARC Guidelines approved by AEGIS do you support?
5. Do users of RIs in your Science Cluster access services provided by other Infrastructures using the AAI?
6. Do users of RIs from other Science Clusters access services provided RIs in your Science Cluster using the AAI?
7. Is there a GDPR Data Controller designated for the AAI?

In the case of ENVRI-FAIR, a preparatory workshop⁷ was organised in January 2023 to introduce the questionnaire and encourage/support the 11 ENVRI-FAIR RIs to answer the questions. As a result of the workshop, it became clear that even for technical staff, it has been proven challenging as some of the questions required prior knowledge of the AARC Blueprint Architecture and Guidelines.

After the workshop, specific support was provided to individual Research Infrastructures within the ENVRI-FAIR Cluster to integrate with the EOSC AAI Federation, e.g., EMSO, LifeWatch and ICOS. Within the context of EOSC Future, priority was given to ensure that it was possible to integrate the AAI systems of one of the Research Infrastructure in the ENVRI-FAIR Cluster, to provide single sign-on access to the [ENVRI Dashboard for the State of the Environment](#) developed as part of the EOSC Future Science Project.

Following discussions within the ENVRI-FAIR Cluster, it was decided that the EMSO Research Infrastructure, which technically hosts the ENVRI Dashboard, should manage the single sign-on to the platform. This was technically implemented via the EGI Check-in Service. Within the ENVRI-FAIR Cluster further work is being undertaken to make other ENVRI Research Infrastructures compatible with the EOSC AAI Federation. Thanks to these efforts, at the time of writing this report, we can state that 5 of 5 Science Clusters have now one or more Research Infrastructures (RIs) compatible with the EOSC AAI Federation. However, the work of ENVRI-FAIR can provide inspiration for other Science Clusters.

Finally, translating the technical complexities of AAI into understandable language for non-technical experts, such as Research Services providers is an area which requires further work. This work will be taken forward, building on the achievements of EOSC Future in the AARC-TREE (Authentication and Authorisation for Research Collaboration Technical Revision to Enhance Effectiveness) project.

4.3 EOSC Monitoring

The EOSC Monitoring integration workflow is fully documented and available via the Provider Dashboard, as shown in the image (Figure 4.2) below.

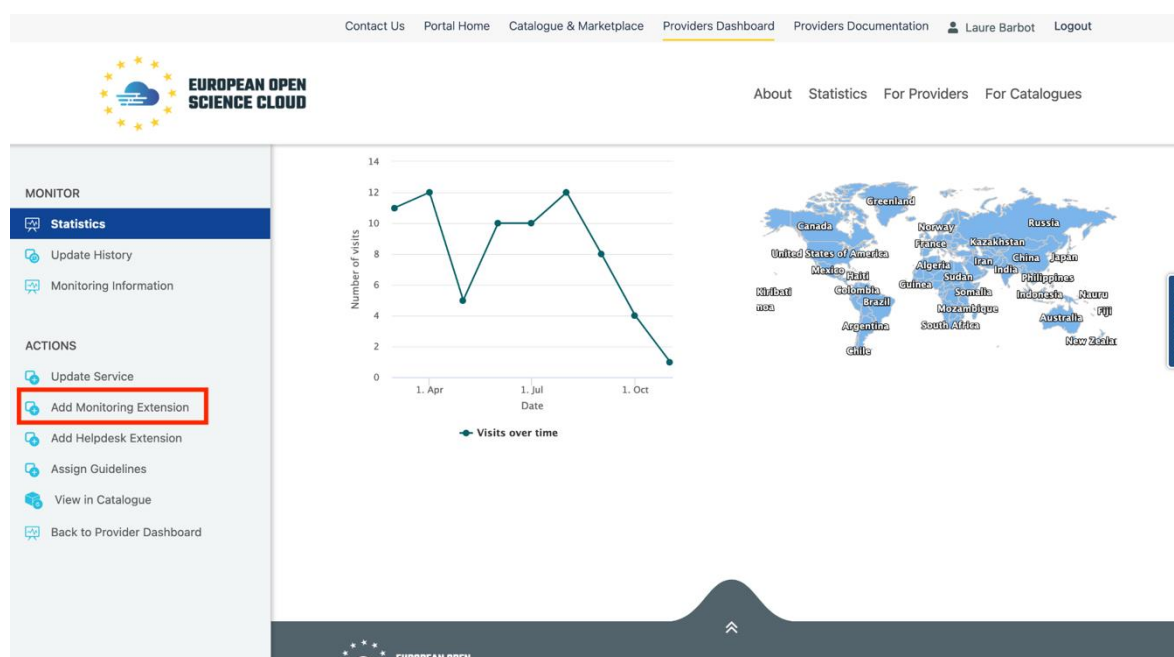


Figure 4.2: Monitoring Extension in the Provider Dashboard

As explained in the [Core services interoperability Guidelines](#) and summarised in the [Core integration factsheet](#), there are 5 main integration options for Monitoring. Over the third phase of integration in T6.3, all onboarded

⁷ The presentation from the workshop is available here:

<https://docs.google.com/presentation/d/1Aobt5MVBdOpwydiCn1PyeEahgnWyGZ-1/edit?usp=sharing&oid=115020870043056556446&rtpof=true&sd=true>

services (405 at the time of writing in September 2023) automatically benefit from the basic monitoring extension. The result of this basic integration is the addition of an “Uptime Monitoring” widget on the services entries in the EOSC Catalogue, as shown in the screenshot (Figure 4.3) below.

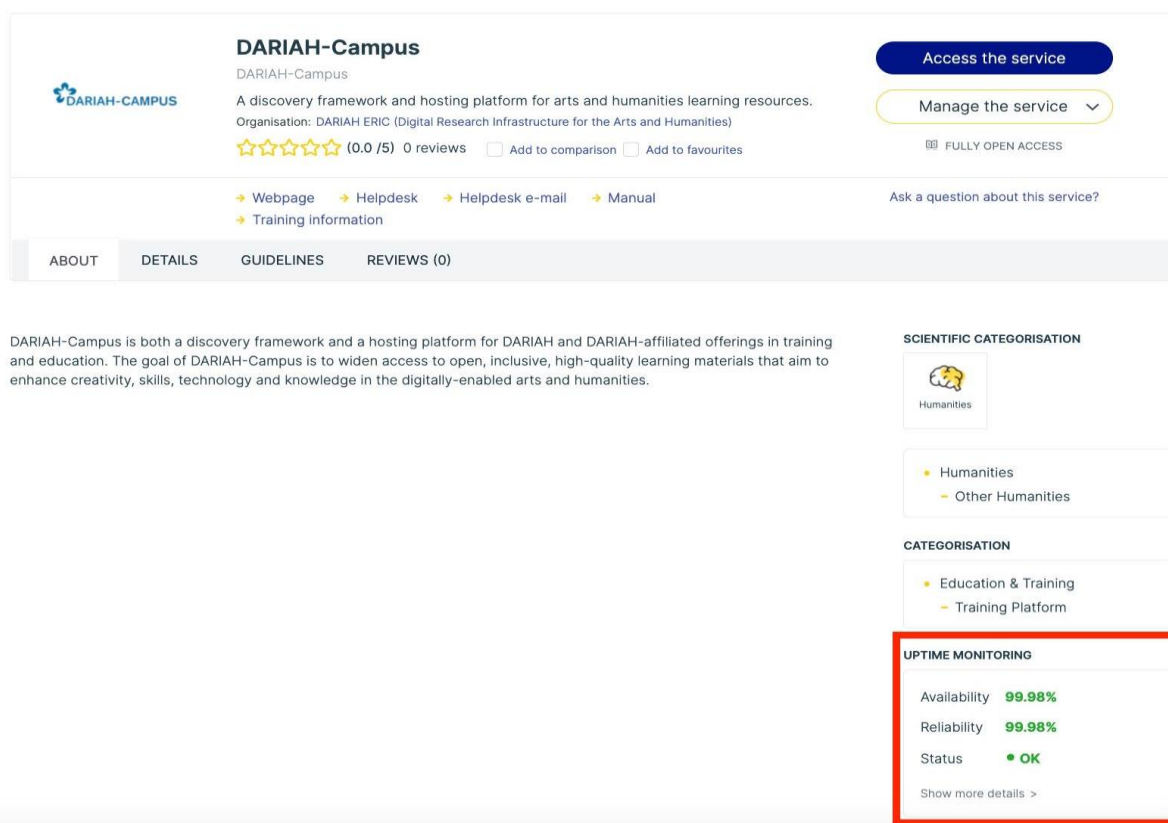


Figure 4.3: Uptime Monitoring Widget in the EOSC Catalogue

More advanced probes are also available via the other integration options and have been designed by the Core service team on-demand from the research community during this last period. That is for example what SeaDataNet has chosen to do by setting up its own monitoring dashboard – <https://monitoring.seadatanet.org/> – for its infrastructure, following EOSC Monitoring integration option 2, depicted in Figure 4.4 below.

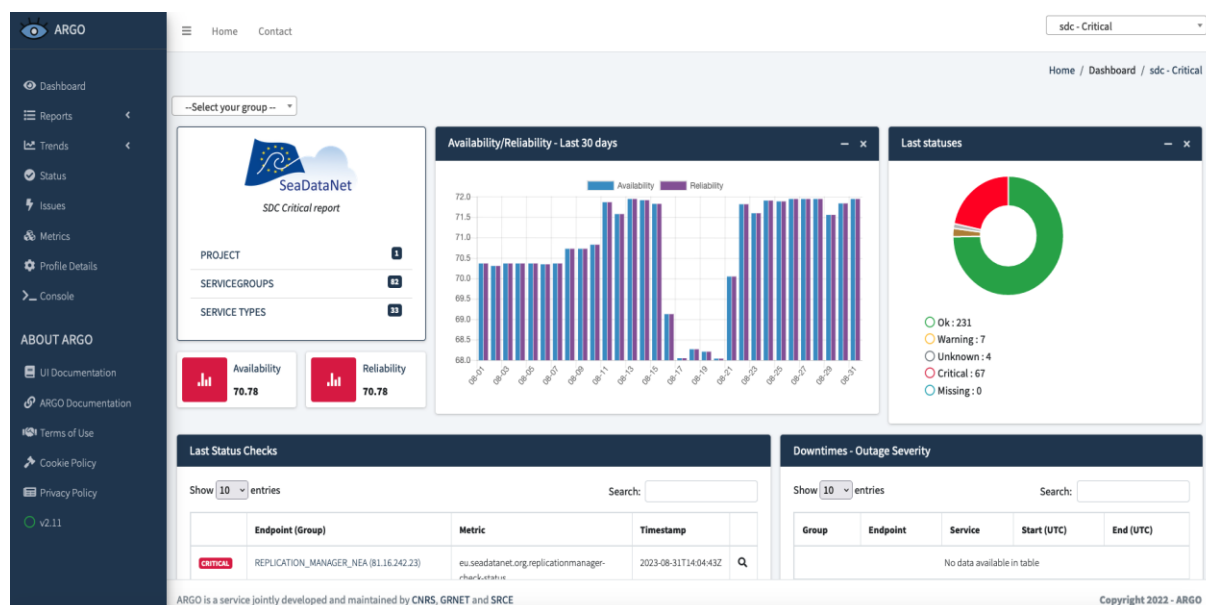


Figure 4.4: SeaDataNet Monitoring Dashboard

For example, a specific probe was developed for the CESSDA Data Catalogue to monitor the reliability of the OAI-PMH (Open Archive Initiative Protocol for Metadata Harvesting) endpoint. As this functionality was useful for other Data Source providers, it was generalised and made available via the EOSC Providers Portal (as shown in Figure 4.5 below).

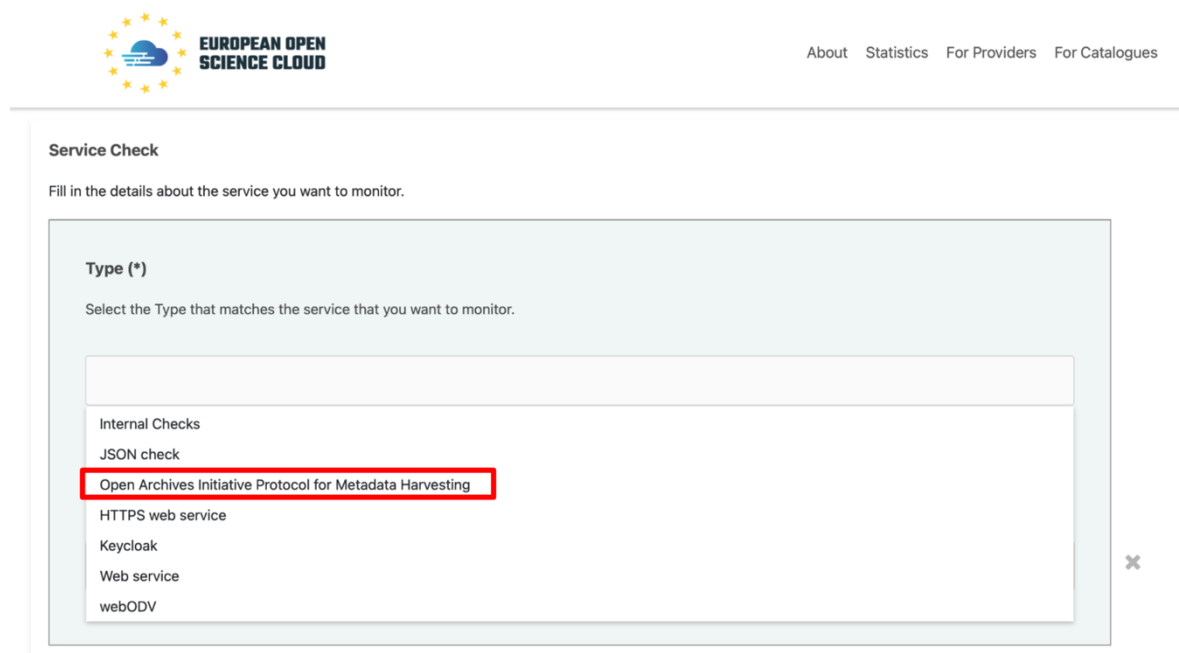


Figure 4.5: OAI-PMH (Open Archive Initiative Protocol for Metadata Harvesting) monitoring probe which has been generalised for use by EOSC Data Source providers

4.4 EOSC Accounting for services

EOSC Accounting for Services aggregates usage indicators for onboarded services requesting it. The extension to request the use of this Core Service is not yet available in the Provider Dashboard, but users can already integrate with the service via <https://accounting.eosc-portal.eu/>.

During the last phase of the project, an integration test has been performed by one of the research service providers of WP6 (CNB-CSIC) trying to integrate two services - **3dBionotes** and the **Covid structural Hub** - with the EOSC Accounting for services (see Figure 4.6 below).

Thanks to the support provided by the Core service team, CNB-CSIC was able to:


1. select a project and associate the provider to the project;
2. set up an "installation" per service wishing to integrate with accounting, as explained in the documentation here: <https://argoeu.github.io/argo-accounting/docs/api/installation/> ;
3. browse existing metrics and create new ones.

☆☆

My Providers

Show entries

Search:

Project	Provider Name	Short Name	Actions
EOSC Future	Centro Nacional de Biotechnología (CSIC)	CNB-CSIC	

Showing 1 to 1 of 1 entries

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Browse metrics

Select the different entities by starting with projects then submit to browse metrics related to these entities
 ★ The star indicates that you have the permissions to see the metrics at this level, if there isn't a star you should drill down to next level to browse

Projects

EOSC Future

Providers

EOSC Future

Centro Nacional de Biotechnología (CSIC) ★

☒ Browse all metrics
☐ Limit metrics by selecting the data range

Browse Metrics

Figure 4.6: EOSC Accounting for Services Dashboard

4.5 EOSC Accounting for Research Products

EOSC Accounting for Research Products is not available for all services, but only for data sources that are having their products harvested by the EOSC Catalogue.

As explained in the [EOSC-Exchange Definition of Resource Types](#), three different scenarios of data sources onboarding can be distinguished:

- Scenario A - data source not compliant with EOSC Research Product Profile - only metadata about the data source itself will be onboarded (= onboarding a service).
- Scenario B - data source is already harvested by OpenAIRE.
- Scenario C - data source is not harvested by OpenAIRE.

Onboarding a data source and its research products - in both scenarios B and C - starts as the onboarding of a service, like it is described in the previous section. One needs to register as a provider and add the metadata describing the data source itself (not its products). If the data source is already known in some registries – such as RE3Data or OpenDOAR – some of the metadata fields can be prefilled.

If the data source is already harvested by OpenAIRE – scenario B – no further action is needed. Research products exposed by the data source will become discoverable in the EOSC Catalogue after approval of the Onboarding Team.

If the data source is not yet harvested by OpenAIRE – scenario C – the provider needs to register it via OpenAIRE PROVIDE. The whole process is described in the PROVIDE documentation and can be summarised as follows: need for an OAI-PMH interface in your repository and compliance check with the OpenAIRE Guidelines. This

process is supported via the PROVIDE dashboard where data sources can be both registered and validated. Once this is done, the data source and its research products will become discoverable in the EOSC Catalogue after approval of the Onboarding Team.

After a successful onboarding of the data source and its research product integration into the EOSC Catalogue, it is possible to activate the EOSC Accounting for Research Products. To enable the accounting for research products, one needs to activate the Usage Count for a data source in the OpenAIRE PROVIDE dashboard. This can be done via the OpenAIRE PROVIDE dashboard. The full process is described in OpenAIRE's GitHub library: <https://openaire.github.io/usage-statistics-guidelines/#usage-counts-service-registration>

One use case of the whole workflow from the SSHOC Cluster and implemented during the last phase of the project is presented here:

- ARCHE. A Resource Centre for the HumanitiEs has been onboarded on the [EOSC-Portal](#) as a data source and its research products are also onboarded: e.g., [Darlehensbuch](#) (for the search results use this [link](#)). The accounting for research products has also been activated and is visible both in the search results and in the product detail view as shown in the screenshots (Figure 4.7 and Figure 4.8) below.



Figure 4.7: Screenshot of the search result for Darlehensbuch showing the integration of the Accounting for Research Products

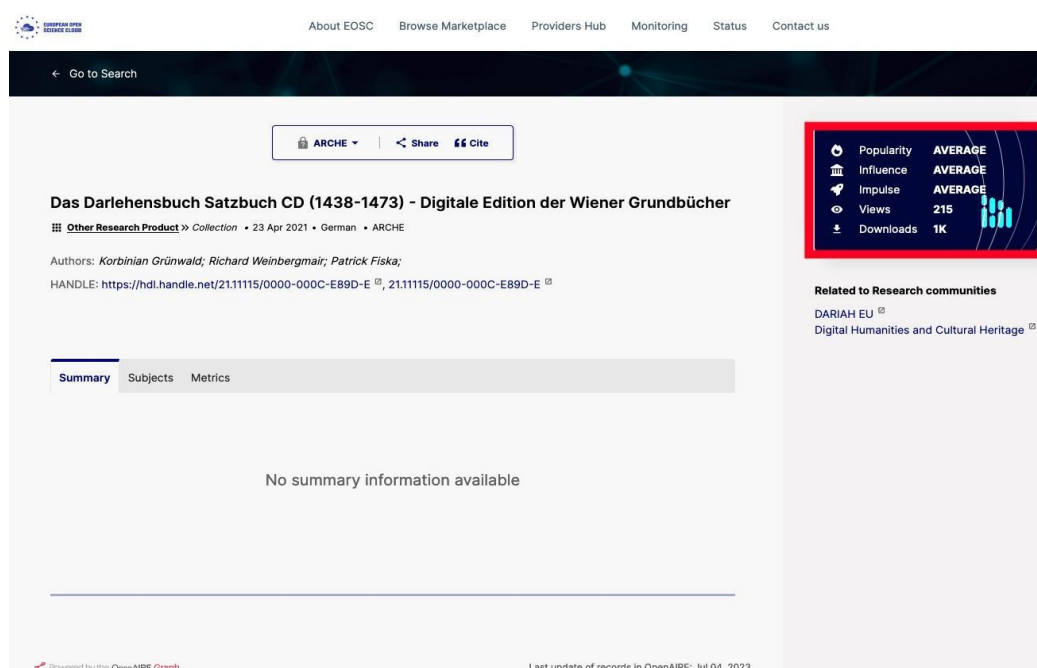


Figure 4.8: Screenshot of the Darlehensbuch item showing the integration of the Accounting for Research Products

4.6 EOSC Order Management

EOSC Order Management is a set of services, processes and guidelines to enable providers to integrate ordering and procurement of their EOSC Resources. From the user perspective, there is an integrated pathway from finding and ordering the particular service that users wish to use via the EOSC Marketplace. Also, order management is offered in a uniform way via the EOSC Marketplace. Therefore, if a user places an order for a particular service and later they wish to order another service, they will be offered a similar set of options, whichever service they wish to use.

From our work in WP6, order management is less frequently needed for Research Services provided by ESFRI Research Infrastructures or Science Clusters and more frequently for generic or horizontal services. This is because many research services are Open Access or require a user to login using the EOSC AAI. Sometimes, access to research services, such as beamtime on a synchrotron or access to a restricted dataset, do need to be requested. However, access to such services often requires submitting a proposal which will be evaluated by a scientific committee. In these cases, the EOSC order management system is less relevant.

The reference implementation that we have chosen for order management is the [EGI Notebooks service](#), as depicted in Figure 4.9 below, which offers a browser-based tool for interactive data analysis. It is a horizontal service, which means that it can also be integrated together with other horizontal services, such as EGI storage and compute services. However, it is considered as a generic service, as it is relevant for all Scientific Communities. This Notebook service is particularly interesting in the context of WP6, as a broad range of scientific communities make use of Jupyter and other types of Lab Notebooks for data analysis.

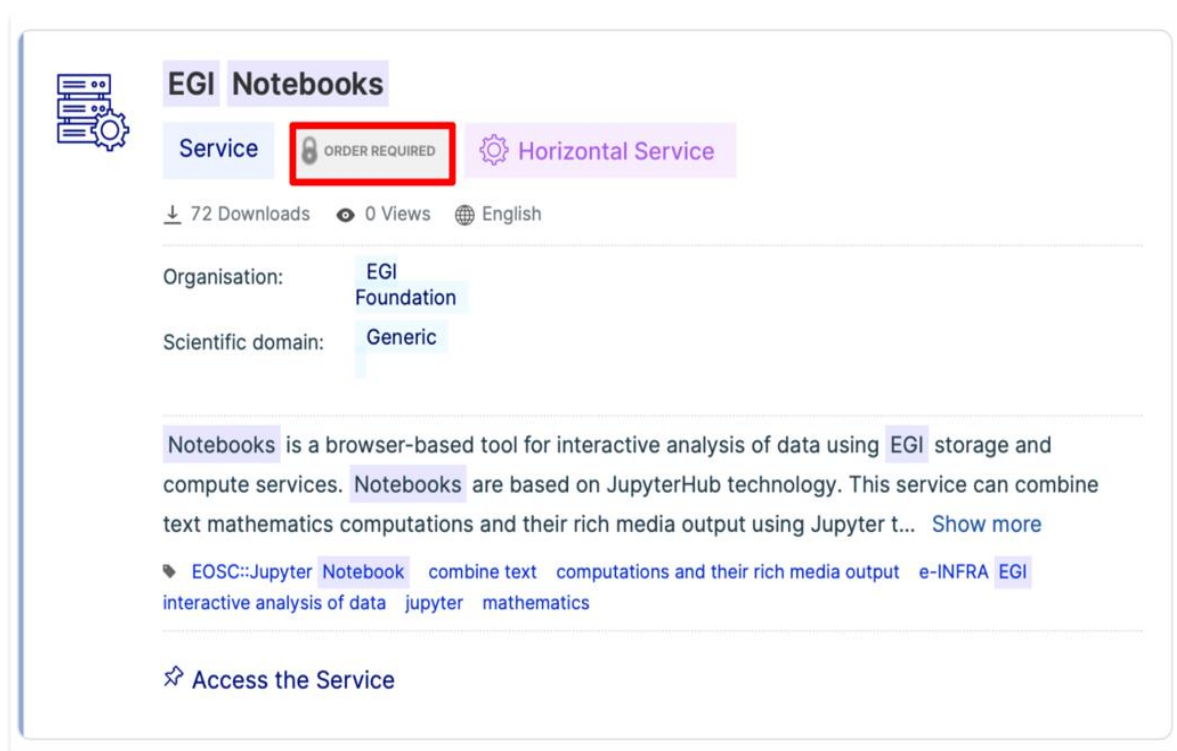


Figure 4.9: The EGI Notebooks service in the EOSC Marketplace

After clicking on “Access the Service”, the user is taken to a page where they can “select an offer” depending on their needs, such as “Notebooks for researchers” or “Notebooks for communities”, as shown in Figure 4.10 below.



Select an offer or service bundle

ORDER REQUIRED

Notebooks for researchers

Run your own notebooks with persistent storage on EGI Cloud resources.

TECHNICAL PARAMETERS

Amount of RAM	1 - 4 GB
Number of cores	1 - 4
Persistent storage	1 - 20 GB

Select an offer

ORDER REQUIRED

Notebooks for communities

Community specific deployment to provide notebooks for all the users of a community. Allows further customisation to meet the community needs (e.g. shared storage).

TECHNICAL PARAMETERS

Number of users	1 - 100
Cores per user	1 - 4
Storage per user	1 - 100 GB
RAM per user	1 - 4 GB

Select an offer

ORDER REQUIRED

EGI Notebook + B2DROP

This offer bundle consist of EGI Notebook for researchers and B2DROP for researchers

TECHNICAL PARAMETERS

Amount of RAM	1 - 4 GB
Number of cores	1 - 4
Persistent storage	1 - 20 GB

Select an offer

Figure 4.10: The "Select an offer" page for the EGI Notebooks service in the EOSC Marketplace

Following the offer selection, for example, "Notebooks for researchers", the researcher is able to configure the notebooks that they would like to order (see Figure 4.11 below), for example, how much memory, computing power and storage that they would like their notebooks to have, depending on their requirements. After which, their order is summarised (see also Figure 4.11 below) and their access request can be submitted.

EUROPEAN OPEN
SCIENCE CLOUD

CANCEL ORDER AND QUIT

Next

Offer selection Access instructions Configuration Final details

Please specify parameters. It is necessary to handle your request.

Parameters

AMOUNT OF RAM

☐ 1 GB

☐ 2 GB

☒ 4 GB

Please choose amount of RAM

NUMBER OF CORES

☐ 1

☒ 2

☐ 4

Choose number of cores

PERSISTENT STORAGE

☐ 1 GB

☒ 10 GB

☐ 20 GB

Choose amount of storage

EUROPEAN OPEN
SCIENCE CLOUD

CANCEL ORDER AND QUIT

Send access request

Offer selection Access instructions Configuration Final details

Please select a Project and review the summary below. Once you submit the order, your request will be sent to a service provider. The order status will be visible at your Project space.

Notebooks for researchers

Run your own notebooks with persistent storage on EGI Cloud resources.

PARAMETERS

Amount of RAM	4 GB
Number of cores	2
Persistent storage	10 GB

Figure 4.11: A researcher can configure the memory, computing power and storage for their Notebooks before sending their access request

Further details about the EOSC Order Management can be found in the [EOSC Order Management: Architecture and Interoperability Guidelines](#) and the [EOSC Order Management Integration Factsheet](#).

In addition to the integration of the standard order management system as demonstrated by the EGI Notebooks example, a second use case is identified when access to such research services requires submitting a proposal for evaluation, for example by a Scientific Committee, before access is granted. To respond to this use case, we could turn to the *Access Management for Distributed RIs (ARIA)* Science Project (WP6.3). This time the focus is on managing access requests to restricted datasets in the Social Science and Humanities domain, via the CESSDA Data Catalogue which has been onboarded onto EOSC. Thanks to a collaboration between INSTRUCT – as the provider of the ARIA platform – with CESSDA – as a European Consortium of Social Science Data Archives – it has been possible to integrate the functionalities of the ARIA platform - originally established to manage access to (physical) scientific resources for researchers in structural biology into the CESSDA Data Catalogue.

Firstly, the researcher finds the dataset that she is interested in accessing and **(1) clicks on “access data”** within the CESSDA Data Catalogue, which she has accessed via the EOSC Marketplace. Following which she is redirected to the ARIA platform where she can **(2) complete the “proposal details”** and once the access request is ready, **(3) submit the proposal**, which receives a persistent identifier (as shown in Figure 4.12 below).

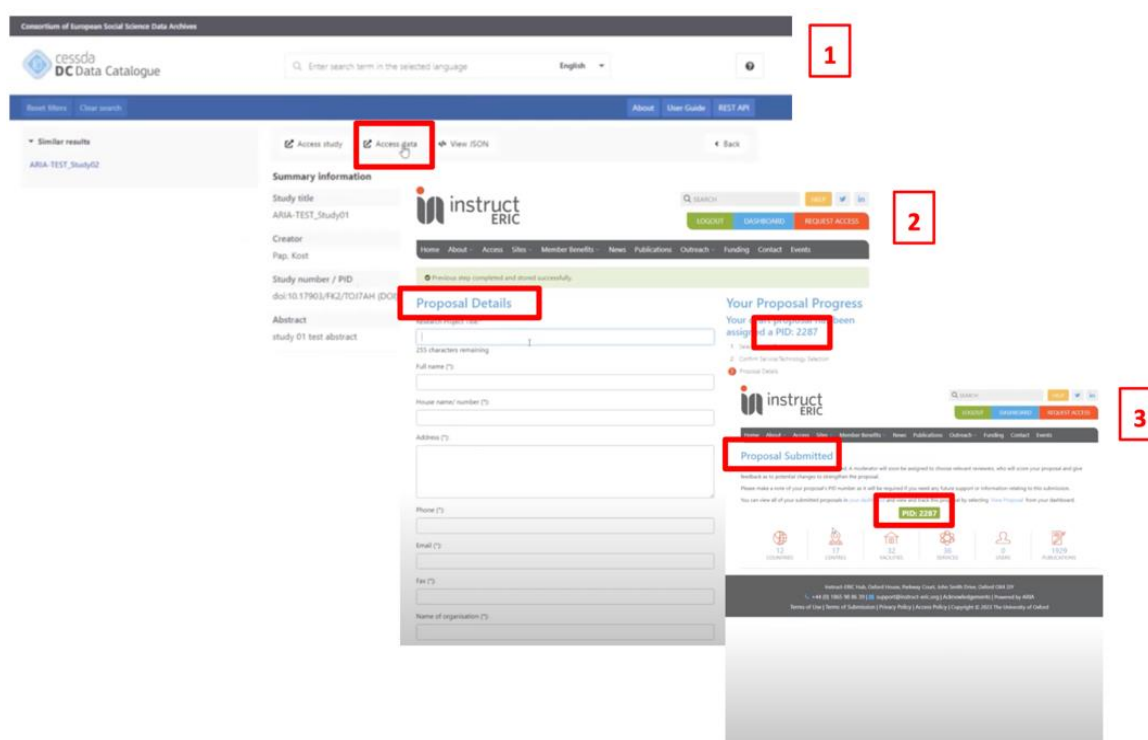
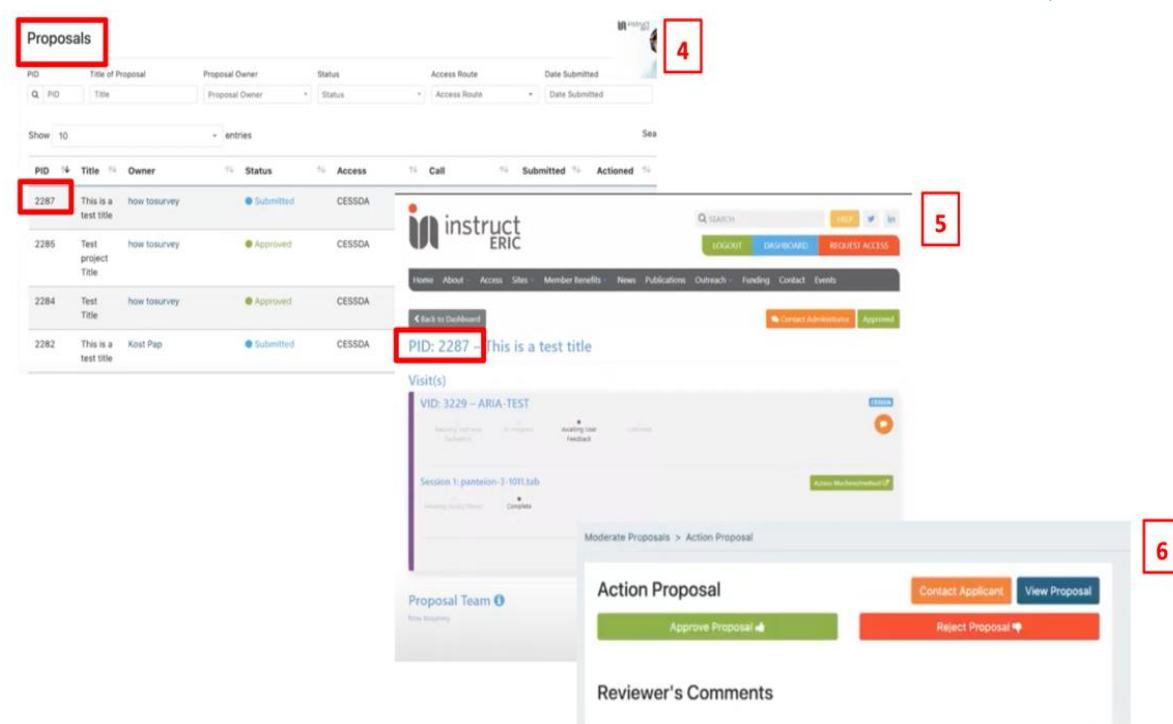


Figure 4.12: Requesting access to a restricted dataset via the CESSDA Data Catalogue using the ARIA Platform

Following the successful submission of the proposal, the publisher of the restricted dataset is notified that **(4) a new access request proposal** has been received. The relevant member of staff can then **(5) review the details of the proposal** and following the evaluation process, either **(6) approve or reject the proposal** as well as providing feedback to the requesting researcher (as shown in Figure 4.13 below).



Proposals

PID	Title of Proposal	Proposal Owner	Status	Access Route	Date Submitted
2287	This is a test title	how to survey	Submitted	CESDA	
2285	Test project Title	how to survey	Approved	CESDA	
2284	Test Title	how to survey	Approved	CESDA	
2282	This is a test title	Kost Pap	Submitted	CESDA	

instruct ERIC

Search:

[Home](#) [About](#) [Access](#) [Sites](#) [Member benefits](#) [News](#) [Publications](#) [Outreach](#) [Funding](#) [Contact](#) [Events](#)

[Back to Dashboard](#) [Contact Administrator](#) [Approved](#)

PID: 2287 This is a test title

Visit(s)

VID: 3229 - ARIA-TEST

Session 1: panteion-3-1091.kab

[Access Metadata](#)

Action Proposal

[Contact Applicant](#) [View Proposal](#)

[Approve Proposal](#) [Reject Proposal](#)

Reviewer's Comments

Figure 4.13: Evaluation process of Access Request Proposals to a restricted dataset using the ARIA Platform

4.7 EOSC Helpdesk

A helpdesk is a key component of any modern IT infrastructure. It provides an essential function that is required to establish a communication channel between user and service provider in order to resolve user requests, to provide full support for the services in the catalogue with the ultimate goal of improving the user experience and satisfaction. The EOSC Helpdesk acts as a single point of contact for all EOSC customers for requesting help, support and other requests. It provides ticket management and allows to track the inquiries related to EOSC services, resources, projects and general questions.

For EOSC users, the EOSC Helpdesk provides a uniform communication channel to address any issues in the scope of EOSC without needing the contact details of each service provider. The helpdesk effectively supports users in communicating with EOSC. For EOSC providers, the EOSC Helpdesk delivers a support solution as a service for integration in their operational processes. EOSC providers can benefit from using the EOSC Helpdesk as a service to establish user support for their services. For EOSC providers and communities, there are three levels paths to integrating the EOSC helpdesk with their service offer:

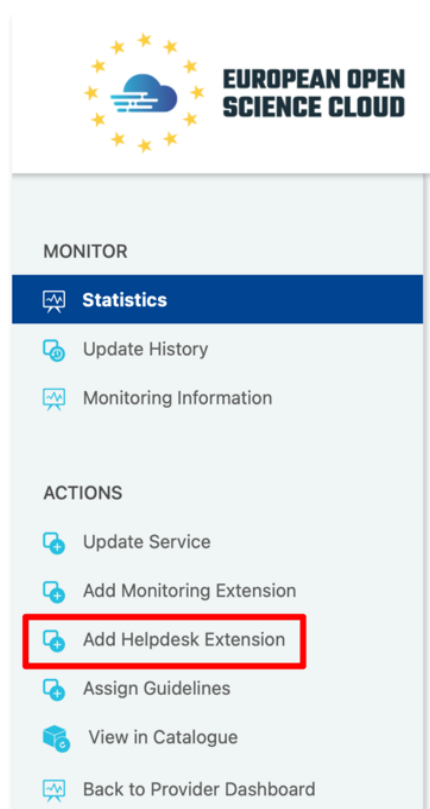


Figure 4.14: Add Helpdesk Extension in the EOSC Provider Dashboard

- **Direct usage (Helpdesk as-a-service):** in this integration the EOSC helpdesk can be used as the ticketing system for the community and their onboarded services. For service providers who choose this option, they do not need to maintain their own helpdesk and can make use of all the benefits provided by the EOSC Helpdesk to support their users.
- **Ticket redirection:** in this integration the EOSC helpdesk is to be used only as a contact point to redirect the initial request to the provider's or community mailing or existing helpdesk without further integration. This option is for communities and providers with an existing helpdesk system who would like to have only an additional channel for requests via EOSC Helpdesk.
- **Full integration:** this path corresponds to the integration with community helpdesk, which implies full bi-directional synchronisation between EOSC Helpdesk and community helpdesk. This integration can be achieved by application of a set of helpdesk REST APIs. The exact integration guidelines should be defined based on the specifications agreed with the community. This integration is useful for providers and communities with mature helpdesk systems who would like to have a tight connection with EOSC Helpdesk, so they could manage the tickets seamlessly in both systems.

Integration with the EOSC Helpdesk is seen as one of the most straightforward integrations by Service Providers. As well as the "Add Helpdesk Extension" option being directly available in the Provider Dashboard (see Figure 4.14 above), the three integration options described above seem to meet the needs of the majority of EOSC Providers.

Regarding the reference implementation for the integration with the EOSC Helpdesk, CESSDA's direct usage of the EOSC Helpdesk for their whole service portfolio is a particularly good example. In the early stages of the EOSC Future project, CESSDA made use of the basic ticket redirection where queries for CESSDA's services could be simply redirected via a simple web form to the CESSDA's support email address. However, by the end of the project, CESSDA had upgraded their helpdesk integration to direct usage making it possible to gain full benefit of the EOSC Helpdesk functionalities such as the query management dashboard, the reporting functions and single sign-on access via the EOSC AAI Federation (see Figure 4.15 below).

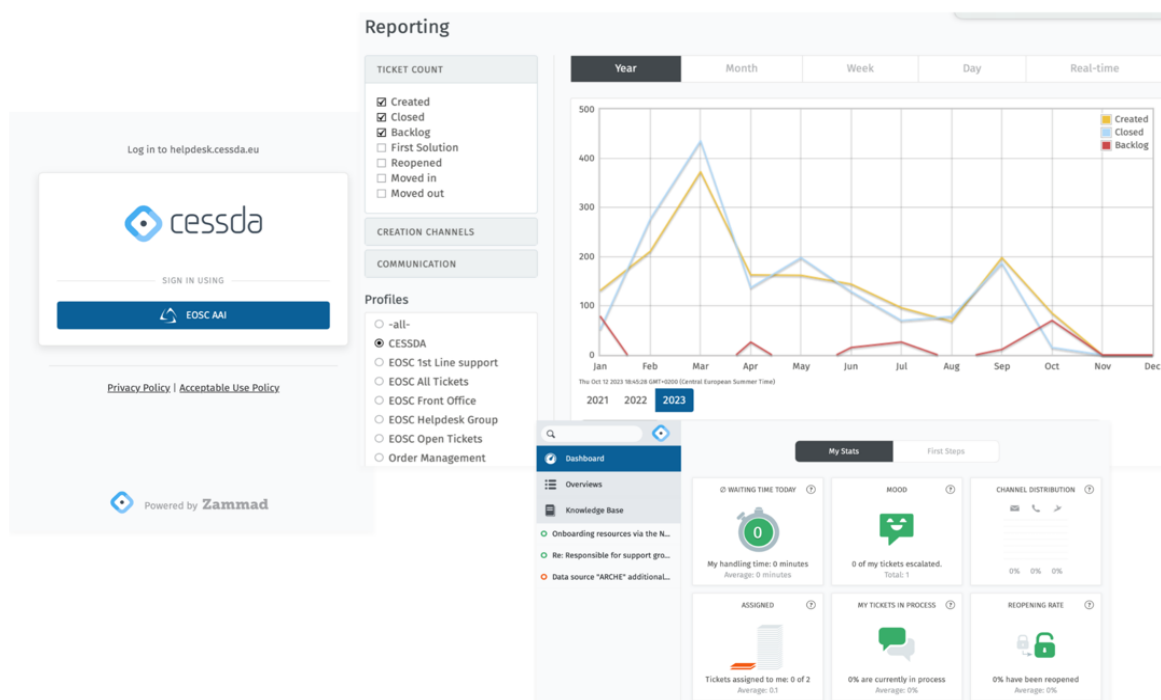


Figure 4.15: Screenshots from CESSDA's direct usage of the EOSC Helpdesk

5 Recommendations moving forward

While many ESFRI Research Infrastructures have been successfully providing professional and robust levels of service to their researcher communities, integrating these existing services into a wider pan-European system of systems such as the EOSC requires a certain level of paradigm shift from a domain-specific, even if pan-European research community, to an interdisciplinary and distributed ecosystem.

While the 15 Research Infrastructures within the EOSC Future Project (3 for each of the 5 Science Clusters⁸) can be seen as front-runners in the Research Infrastructure landscape, service and data source integration into EOSC is a gradual and evolving process. In the final phase of the project, the T6.2 team undertook an analysis of good practices and lessons learned during the development of the service and data source integration workflows with a view to shaping recommendations for ongoing work beyond the EOSC Future project. This analysis provided the basis for designing a model to assess the maturity of Service Providers within EOSC, which is described in more detail in Section 5.1 below.

Firstly, despite the fact that only 15 of the 63 ESFRI Research Infrastructures were partners in EOSC Future, already a **critical mass** of onboarded and integrated Services and Data Sources from across the Science Clusters has been achieved. This has been thanks to the creation of standardised and optimisation of procedures and workflows for onboarding and integration of the full range of EOSC Resources (services, data sources, but also publications, data, software, training materials and interoperability guidelines). This critical mass of Services and Data Sources will be used as a springboard to continue and further strengthen this work in the recently funded OSCARS (Open Science Cluster's Action for Research and Society) project. These early adopter Research Infrastructures can also mentor the newer Research Infrastructures regarding their engagement with EOSC.

With the critical mass of Services and Data Sources now onboarded and integrated into the EOSC, the value of being part of the EOSC ecosystem is starting to become clearer. The provision of metrics via the EOSC Catalogue and Marketplace for onboarding and integration by Science Cluster, by Research Infrastructure or even by Research Service Provider provide a basis to **generate useful analytics** to assess the evolution of the

⁸ From the total of the 63 ESFRI Research Infrastructures (41 Landmark (Operational) and 22 Emerging (Project-based) Infrastructures) ESFRI Research Infrastructure Roadmap 2021: <https://roadmap2021.esfri.eu/projects-and-landmarks/explore-the-map/>

European Open Science Landscape over time. By onboarding and integrating their resources into EOSC, service providers will increasingly be **able to assess their contribution** to Open Science in Europe, **benchmark** their performance against similar institutions and **measure the usage** of their resources through EOSC. This critical mass of Science Cluster resources in EOSC also enables us to undertake a comparative quality assessment of the onboarded and integrated resources. For example, the quality of the metadata and resource descriptions that have been created, including the tagging of the relevant Science Clusters, Research Infrastructures and Scientific Domains to ensure retrievability.

Finally, this critical mass is a first important step towards preparing for the “composability” of services. Ensuring the composability of data sources and services within the EOSC Exchange is a complex process, which requires both technical and data interoperability. However, to guarantee excellent science, a strong methodological layer is needed, beyond pure development of technical workflows and orchestration of services. This work will be a core focus of the recently awarded OSCARS project.

5.1 EOSC Service Providers Maturity Model

A specific achievement of this reflection phase was the development of a workflow for EOSC Service Providers to self-assess the maturity of their integration into the EOSC ecosystem. The **EOSC Service Provider’s Maturity Model** can be used by both individual ESFRI Research Infrastructures, by the Science Clusters and other EOSC Service providers. It is intended to help providers assess the current maturity of their integration into the EOSC ecosystem as well as provide practical guidance for increasing that maturity. It is anticipated that the EOSC Service Provider’s Maturity Model will become a valuable tool for strengthening EOSC as a federated system of systems, including supporting the emerging model of EOSC nodes.

Based on the support provided by the Task 6.2 team to service providers and research communities, 7 steps are identified in this model that can also be seen as an ideal integration workflow. This workflow has been modelled to fit with the SSHOC Cluster workflow format and has been published in the Social Science and Humanities Open Marketplace workflow [22], as depicted in Figure 5.1 below.

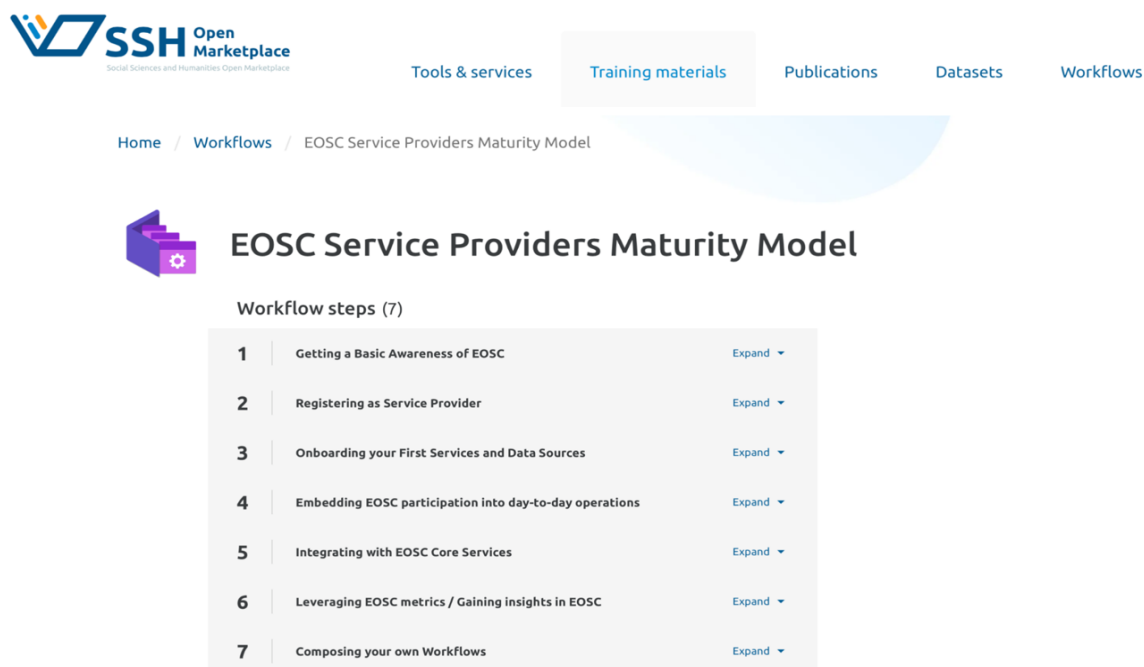


Figure 5.1: Screenshot of the EOSC Service Providers Maturity Model workflow in the SSH Open Marketplace

The seven steps of the workflow are described below:

1. Getting a Basic Awareness of EOSC

The first step in the workflow consists in knowing the European Open Science Cloud (EOSC) as an EU programme/initiative/framework, and its implementation via the EOSC Portal where the EOSC

Catalogue & Marketplace is also available. Beyond this knowledge lies the aspiration/determination to join/contribute to the EOSC. There are various ways to engage with the EOSC, as a user or as a future provider, we are here interested in how to become an EOSC Provider?

Related resource: <https://eosc-portal.eu/eosc-providers-hub>.

2. Register as Service Provider

The second step consists in registering as Provider of EOSC. Only institutions can register as providers, not individuals. An authorised representative of an organisation needs to register its organisation as a provider of the EOSC. This is done by filling in a form with information about your organisation. NB: the organisation needs to be a legal entity or to be connected to a legal entity already registered in EOSC.

Related resource: <https://eosc-portal.eu/using-the-portal/tutorial-new-providers>

3. Onboarding your First Services and Data Sources

Once registered and approved as EOSC Providers, it is possible to add resources to the EOSC Catalogue. This process is called onboarding your services to the EOSC.

There are two options to onboard resources:

- a) via the web-based Service Providers Dashboard.
- b) via the Portal Application Programming Interface (API).

Related resources:

- <https://eosc-portal.eu/eosc-providers-hub/how-become-eosc-provider/instructions-onboard-providers-and-resources-eosc>
- <https://eoscfuture.eu/wp-content/uploads/2022/11/Workshop-slide-deck-final.pdf>
- <https://eoscfuture.eu/eventsfuture/training-module-streamlining-the-onboarding-to-the-eosc-marketplace-using-apis/>

4. Embedding EOSC participation into day-to-day operations

This fourth step relates to a proactive or structured approach to EOSC Onboarding & Integration. Indeed, some institutions might already have their own service catalogue, or their own solutions to monitor their services and support their users, while other institutions are still pretty new to this service management approach. Whatever is the situation of your institution, including EOSC Onboarding & Integration into your resource management routines requires some strategic thinking and technical decisions to align with the EOSC processes.

Related resources:

- <https://www.clarin.eu/eosc>
- <https://dariahopen.hypotheses.org/1096>
- <https://www.cessda.eu/News/CESSDA-Newsitem-nid3484>

5. Integrating with EOSC Core Services

It is possible to add value to already onboarded services, by integrating them with EOSC Core Services. Here are the EOSC Core Services available for integration:

- Monitoring
- Helpdesk
- Accounting
 - for services
 - for research products
- AAI
- Order Management

Factsheets (short version) and Interoperability Guidelines (long version) are here to describe benefits and integration options available per Core Services. Once you are aware of the benefits of integrating with the EOSC Core Services and of the available integration options, concrete technical steps can be taken.

Related resources:

- <https://eosc-portal.eu/eosc-providers-hub/adding-value-already-onboarded-resources>
- <https://wiki.eoscfuture.eu/display/PUBLIC/EOSC+Core+services+integration>

6. Gaining insights through EOSC

Some of the benefits of having integrated your resources with the EOSC Core Services is that you can build on that, for example by mining the EOSC. It can help you to show how valuable EOSC is to your user community, it can help you for reporting purposes, but also provide insights into the existing Research Infrastructures EU landscape. Reusing data provided by the EOSC Core Services can help you.

Related resource: <https://eoscobservatory.eosc-portal.eu/home>

7. Composing your own Workflows

As a service and data provider, you might be interested in offering EOSC workflows to your communities. The idea, still under development, is that different data and services can be put together by the users in a seamless way to perform research. This last step will be quite straightforward for Data and Services rightfully onboarded and integrated with the EOSC and thanks to the EOSC Interoperability Framework and Guidelines.

Because this final step can be seen as an achievement of the EOSC Service Providers Maturity Model, we recommend service providers to look into the previous steps of this workflow to self-assess the maturity of their institution towards the EOSC.

Related resource: OSCARS & Science Clusters

6 Conclusions

For researchers and other EOSC users, accessing a simple and secure environment facilitating interdisciplinary and cross-domain data-driven research is being made possible because behind the scenes, research service providers have worked to onboard and integrate their service and data source offerings with the EOSC-Core.

Service and Data Source integration is an opportunity for service providers to ease the work of their users and contribute to building the EOSC as a system of systems. This deliverable details the process to establish a set of Service and Data Source Workflows for integrating EOSC-Core Services and Research Services, based on the requirements of the cross-disciplinary Science Projects. It demonstrates an understanding of research service integration with EOSC-Core Services as a socio-technological activity which needs to take into account the complex landscape of research service providers, as well as the needs of diverse, heterogeneous and multi-disciplinary research communities.





EOSC Future has taken an important step in the long-term Open Science evolution in Europe. For EOSC to fulfil the vision of a federated system of systems, a strong, ongoing and sustainable partnership with the research communities through the ESFRI Research Infrastructures and related Science Clusters is essential. The partnership needs to extend beyond pure service provision to a distributed ecosystem developed for researchers, by researchers. Within the EOSC Future project the key focus has been on the onboarding and integration of service and data source providers into the EOSC Exchange. This has resulted in a crucial partnership between the EOSC-Core and the ESFRI Research Infrastructures and the Science Clusters as essential intermediaries in this process. It is through the RIs and the Science Clusters that outreach to and engagement of the research communities will be secured and sustained.

While the reviewers point to the current lack of “composability” of services within the EOSC Exchange, the EOSC Service Providers Maturity Matrix, recognises that such composability is a demonstration of the highest level of engagement with EOSC. Ensuring the composability of data sources and services within the EOSC Exchange is a complex process, which requires both technical and data interoperability. However, to guarantee excellent science, a strong methodological layer is needed, beyond pure development of technical workflows and orchestration of services. Preparing the Science Clusters Services and Data Sources for “composability” is a core focus of the recently awarded OSCARS (Open Science Cluster’s Action for Research and Society) project. This work will be further supported by the EOSC Interoperability Registry as the ESFRI Research Infrastructures and related Science Clusters begin to understand the benefits of registering their domain-specific interoperability guidelines at the European level to facilitate the fluid exchange of data within the EOSC ecosystem.




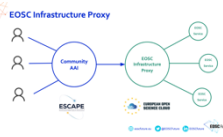

The EOSC Future Science Projects (T6.3) have successfully demonstrated the potential of EOSC for enabling cutting-edge, interdisciplinary, data-driven research using Open Science methods. The challenge is to build on this momentum to scale-up awareness of, participation in and contribution to EOSC beyond these early adopters. To facilitate this process, consideration needs to be given to how researchers can be rewarded and gain scholarly credit for contributing to EOSC. For example, through the sharing of both Open Access publications and related research data, but also for the publication of new forms of research output, including articles in data journals, publication of research software, and perhaps most interestingly, the publication of methodologically grounded, data-driven and fully documented research workflows, making use of services and data sources onboarded and integrated into EOSC. Through their onboarding and integration into EOSC, the citability of the broad range of resources (e.g., publications, data, software, services, data sources, training materials, interoperability guidelines and workflows) will be enabled. And, as a result, through partnerships between EOSC, the ESFRI Research Infrastructures and Science Clusters together with, for example, the [Coalition for Advancing Research Assessment \(COARA\)](#), the potential outreach and use by the broader scientific communities is greatly increased. To secure the benefits of such partnerships, developing networks of EOSC “Science Cluster”, “Disciplinary” or “Interdisciplinary” Ambassadors, to work closely with the research communities could be particularly valuable. This work needs to be carefully coordinated with the contribution of the ESFRI Research Infrastructures and Science Clusters [21] to provide the EOSC Onboarding and Integration teams, to both contribute domain-specific knowledge to the operations of EOSC.

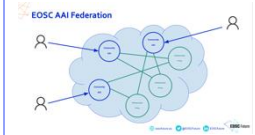





Appendix A – EOSC AAI integration with a research service

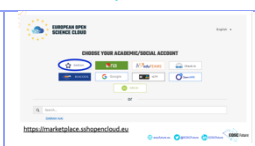





- Demonstrator video: Review version of the video: <https://youtu.be/O1sVKBMpsvY>
- Slides presented in the demonstrator video: [EOSC Future Presentation for D6.2.pptx](#)⁹
- Script of the demonstrator:

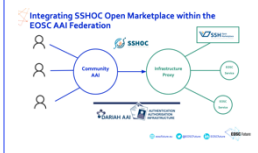

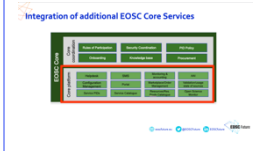

Slide #	Goal	On-screen text	Voice over script	Visual Materials
1	Welcome & Introduction	Integrating EOSC-Core Services into European Research Practice: An Introduction for Research Service Providers	<p>Welcome. In this video, we will show you how to integrate research services with EOSC-Core Services</p> <p>This screencast has been developed in the European project EOSC Future.</p>	<p>EOSC Future logo</p> <p>EU grant agreement number or logo, EOSC logo</p>
2	Setting the Context	EOSC, the European Open Science Cloud	<p>EOSC, the European Open Science Cloud – aims to provide “a federated and open multi-disciplinary environment where European Researchers of all disciplines can publish, find and re-use data, tools and services for research, innovation and educational purposes”.</p> <p>This video has been prepared for research service providers who are interested in integrating their offerings with EOSC-Core Services.</p>	<p>EOSC Portal</p> 
3	Introducing Core Concepts	EOSC Science Clusters	<p>Service providers are usually Research Infrastructures represented in the EOSC science clusters like SSHOC for the Social Sciences and Humanities, ENVRI-Fair for the Environmental Sciences or EOSC-Life for the Life Sciences.</p> <p>[Click]</p>	<p>Science clusters</p> 
4		EOSC-Core Services	<p>EOSC-Core Services are generic infrastructural components that are designed to enhance existing services, guarantee their interoperability in the EOSC ecosystem and provide additional value to the users.</p> <p>[Click]</p>	<p>EOSC-Core Services</p>  <p>The list of the EOSC-Core Services.</p>
5		AAI	<p>For instance: the Authentication and Authorization Infrastructure - or AAI - is just one example of such an EOSC-Core Service.</p> <p>[Click]</p>	<p>EOSC Core Services</p> 
6		Science Projects	<p>Enabling interdisciplinary data-driven research is one of the founding principles of EOSC. The integration of research services with EOSC-Core Services is one of the essential building blocks in this</p>	


⁹ https://docs.google.com/presentation/d/1UXp-LpuC4GQVsrn2SYEchYTNt7YrdRt/edit#slide=id.g115023628a4_o_0

			<p>process.</p> <p>To validate this process, 10 interdisciplinary Science Projects addressing pressing societal issues and complex scientific questions such as the climate crisis and Covid-19, have been selected to ensure that this service integration facilitates researchers in their everyday work.</p>	
7	Introducing AAI as a Core Service	EOSC AAI Architecture	<p>For research service providers who would like to integrate their services with the EOSC AAI, a number of steps need to be followed.</p> <p>To do this, it may be useful to understand a little more about the EOSC AAI Technical Architecture.</p> <p>[Click]</p> <p>Within the EOSC AAI Technical Architecture, there are two core components: 1) the Community AAI and 2) the Infrastructure Proxy.</p> <p>Firstly, the purpose of the Community AAI is to streamline researcher's access to services. These can be services provided by EOSC as well as services provided by other communities.</p> <p>[Click]</p> <p>Examples of Community AAI include: EGI Check-in, DARIAH AAI and the Open-Aire Single Sign On.</p> <p>[Click]</p> <p>Secondly, the infrastructure proxy enables infrastructures with a large number of services to provide access to them via a single integration point.</p> <p>For example, by connecting the Escape Community AAI to the EOSC Infrastructure Proxy, it is possible for researchers in the Escape Community to access a range of EOSC Services via this single integration point.</p> <p>[Click]</p> <p>Additionally, the EOSC ecosystem will stimulate interdisciplinary research by enabling researchers from a specific scientific domain to access research services from other domains.</p> <p>For example, researchers affiliated to the Escape Science Cluster will also be</p>	 <p>With many thanks to the EOSC AAI Team</p>
8		Community AAI		
9		Infrastructure Proxy		
10		Enabling cross-disciplinary research		

11			<p>able to use services from the PaNOSC Science Cluster or vice-versa.</p> <p>[Click]</p> <p>Cross-disciplinary access is one of the founding principles of the EOSC AAI Federation which has been set-up to facilitate interdisciplinary research, for example between the Science Clusters.</p> <p>[Click]</p>	
12		EOSC Future Wiki	<p>Further details about the EOSC AAI Core Infrastructure Proxy are available on the EOSC Future Wiki.</p>	
13	Integrating the EOSC AAI with the SSH Open Marketplace	SSH Open Marketplace	<p>To demonstrate the integration of the EOSC AAI with a research service, we will use a service from the social science and humanities science cluster, SSHOC.</p> <p>[Click]</p> <p>The SSH Open Marketplace functions as a discovery portal or a catalogue contextualising useful services and resources to support data driven research in social sciences and humanities.</p> <p>[Click]</p>	<p>SSH Open Marketplace website</p> 
14		Tools & Services	<p>For example, Tools & Services, Training Materials or Datasets and Workflows.</p> <p>However, some functionalities in the SSHOC Marketplace are only accessible to authenticated users, for example, creating a new dataset.</p> <p>[Click]</p>	
15		Sign-in	<p>To do this a researcher needs to click on 'sign in' (in the top right of the screen).</p> <p>[Click]</p>	
16		Sign-in with EOSC	<p>from where they will be taken to to the login page.</p> <p>By clicking on 'sign-in with EOSC' ...</p> <p>[Click]</p>	
17		Select Community AAI	<p>... they are then redirected to a page where they can select which</p>	

18		DARIAH AAI	<p>Community AAI they would like to use to login, for example for researchers in the Social Sciences and Humanities, this could be the DARIAH AAI.</p> <p>[Click]</p> <p>After successfully authenticating by entering their DARIAH username and password</p> <p>[Click]</p>	 <p>https://marketplace.sshopencloud.eu</p>
19		Access Granted	<p>... the researcher is then redirected back to the originating service (i.e. the Marketplace in this case), where she is granted access to the service and can create a new dataset.</p> <p>[Click]</p>	 <p>https://marketplace.sshopencloud.eu</p>
20		Login with Institutional Account	<p>Alternatively, a researcher may want to login within their institutional account such as Ghent University.</p> <p>From the 'sign-in with EOSC' page, a researcher can select her home organisation from the list</p> <p>[Click]</p>	 <p>https://marketplace.sshopencloud.eu</p>
21		Login page of home institution e.g. Ghent University	<p>After which she is redirected to the login page of her home organization, where she logs in with her institutional username and password.</p> <p>[Click]</p>	 <p>https://marketplace.sshopencloud.eu</p>
22		Social Identity Providers	<p>The EOSC AAI federation also allows users to authenticate via social identity providers like Google or ORCID. This opens up new possibilities for involving members of the general public and citizen scientists, beyond the traditional research community.</p> <p>It is important to note that despite delegating the authentication, the service provider does not give up the control over who is allowed to do what, i.e. the authorisation.</p> <p>This is governed separately directly within the service in question and the owner of the service decides who is able to do what.</p> <p>[Click]</p>	 <p>https://marketplace.sshopencloud.eu</p>
23	Setting up the	Integrating SSHOC	To integrate the SSHOC Open	 <p>https://marketplace.sshopencloud.eu</p>

	infrastructural components	Open Marketplace within the EOSC AAI Federation	<p>Marketplace within the EOSC AAI Federation it was necessary to set up a number of components.</p> <p>For example, the DARIAH AAI was selected as one of the Community AAI that could be used to login to the SSH Open Marketplace.</p> <p>The DARIAH AAI could also act as the Infrastructure Proxy for providing access to the SSHOC Open Marketplace as a Research Service within the EOSC ecosystem.</p> <p>It was decided to integrate the SSHOC Marketplace with the EOSC AAI to minimize the effort required for the researchers by avoiding the need for separate usernames and passwords.</p> <p>Additionally, this will help SSHOC as a research service provider to simplify their user management.</p> <p>[Click]</p>	
24		DARIAH Infrastructure Proxy	<p>Further details about how to register research services with the DARIAH AAI can be found on the DARIAH Wiki. [16]</p> <p>[Click]</p>	
25	AAI is just one example of a EOSC-Core Service - there are many more	Integration of additional EOSC-Core Services	<p>It is important to note that AAI is just one of the EOSC-Core Services. Once a research service is registered (or onboarded) in the EOSC Portal it is possible to integrate this service with other EOSC-Core Services.</p> <p>[Click]</p> <p>Thank you for watching this video. We have demonstrated one example of integration of an EOSC-Core Service - the EOSC AAI - with a research service, and how this has been beneficial for both users and the service provider.</p>	
26	Key Documents for AAI Integration	Key References for EOSC AAI Integration	<p>Here are a number of Key References for research service providers who would like to integrate their service in the EOSC AAI Federation.</p> <p>[Click]</p>	
27	Getting in touch with the T6.2 Team	EOSC-Core Services Integration - Contact Details	<p>If you found this demonstration useful there are other EOSC-Core Services that you may be interested in.</p> <p>Service integration is an opportunity</p>	

			<p>for service providers to ease their work and contribute to building the EOSC as a system of systems.</p> <p>If you would like to know more, please don't hesitate to get in touch. We look forward to hearing from you.</p>	 <p>EOSC Core Services Integration Contact: info@darjah.eu Helpdesk: https://www.darjah.eu/helpdesk/</p>
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