



## D7.1: Guidelines and Recommendations for the Technical Integration of Resources and Services in the EOOSC

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### Deliverable Abstract

The main goal of this document is to provide information about the activities performed by T7.1 to support the integration of services and their onboarding into an EOOSC catalogue.



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## TERMINOLOGY

<https://eosc-portal.eu/glossary>

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## Executive Summary

This deliverable describes the activities performed within EOSC-Pillar task T7.1 to collect information about needs for support to integrate services, either from the project use cases and services (WP6, T7.4) or from other actors, i.e. the partners involved in the project as well as the national or thematic infrastructures in the EOSC-Pillar countries.

The collection of this information has been conducted in various ways: through a direct interaction with WP6, through the WP3 survey on national initiatives and through a set of interviews with representatives of national infrastructures in participating countries.

This document reports all these findings, in terms of need for support to integrate services or to onboard them into the EOSC Catalogue but it also contains the guidelines and procedures released in milestones MS31 (Integration and Federation Guidelines) and MS32 (Procedures to Include National Services in EOSC).

In addition, this document describes the steps national or thematic catalogue operators should follow to make it interoperable with the EOSC one.

# 1 Introduction

The EOSC-Pillar project involves partners from five different European countries (Austria, Belgium, France, Germany and Italy) with quite different situations regarding national e-infrastructures and services as well as participation to international initiatives and projects.

The goal of this document is twofold: provide technical guidance and recommendations to support the integration of services with the so-called EOSC core services as well as support the onboarding of services and resources into an EOSC catalogue, which is the primary tool to connect demand (researchers) and supply (service providers) sides.

The guidelines and recommendations are based on the requirements gathered about the Work Package 6 use cases, the Work Package 7 ready to use services and a set of interviews performed from April to June 2021; these are illustrated below.

Within the EOSC-Pillar project, several relevant use cases have been identified during the project preparation and their activities are part of the project within Work Package 6, with a specific task (T6.1 to T6.9) for each of them. Additional use cases have been identified during the course of the project, through an open call to communities managed by task T6.10. The results are reported in Appendix I.

As one of the activities of task T7.4, some “ready to use services” from project partners have been collected and made available to the use cases in order to support their development. The results are reported in Appendix II.

A Transversal Task Force (TTF) has brought together efforts carried out by different EOSC-Pillar’s tasks<sup>1</sup> to gather information via interviews about national initiatives and services relevant at national level in order to identify the level of support needed for onboarding the services into the EOSC catalogue. The activities of the TTF are reported in Appendix III while the results of the interviews are summarized in Appendix IV.

One of the important activities of EOSC-Pillar is to define specific guidelines to help the partners involved in the project to support the integration of the EOSC-Pillar abovementioned services with the EOSC federating core services whenever appropriate. A specific focus is on the integration of Authentication and Authorization Infrastructure services (AAI) which are the basic pillars for the connection of national resources and services to a service federation as the EOSC aims at being. In chapter 2 the results of the activity to define guidelines to support the integration of the so called EOSC core services are described.

Supporting the onboarding of the relevant national services into the EOSC is another activity foreseen in the EOSC-Pillar project that leads to the need of a definition of a clear path and the

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<sup>1</sup> The Transversal Task Force involves EOSC-Pillar experts contributing to different areas of activity, i.e. Concertation with the EOSC governance and related EOSC initiatives (task T2.2), Policy and legal framework (task T4.1), Consolidation of national initiatives (task T4.3), Business models definition (task T4.5) and Guidance and procedures for integrating services (task T7.1)

associated processes for the inclusion of the national resources either into the EOSC Catalogue and Marketplace or into national or thematic catalogues.

In each country there are various scientific communities active in national and international scenarios. This variety, and the commitments the research communities have due to their scientific and projects activities, may impose some constraints to the operations, management and use of the services of their interest.

This is the reason why one of the first important activities of EOSC-Pillar task T7.1 has been a survey to understand which are the existing procedures at both national and international level, to onboard resources into the EOSC Catalogue and Marketplace. By resources here we mean every kind of mature services, including data repositories. Onboarding datasets into a repository is currently out of the scope of this document.

A model for a national registry of resources has been created and implemented as one of the activities of task T4.4. The national registry aims to be interoperable with the EOSC Portal<sup>2</sup> catalogue. This means allowing a simple and automatic transfer of information between the catalogues. While the technical interoperability between the national catalogues and the central one will be ensured by the work of the T4.4 team jointly with the EOSC Portal developers and operators within EOSC-Enhance<sup>3</sup> and EOSC-Future<sup>4</sup> projects, the definition of the onboarding procedures is responsibility of task T7.1.

The goal of this document is to help harmonize the existing or prospective procedures and guidelines to onboard resources into a catalogue at both national and thematic levels with the procedures currently in use at the EOSC level, e.g. the onboarding procedure defined and managed by the EOSC-hub<sup>5</sup>/EOSC Future projects in a joint effort with the EOSC-Enhance project.

Chapter 3 illustrates the activity of definition of guidelines and recommendations to onboard resources both in the EOSC central Catalogue and in the national catalogues. We expanded this activity by considering the option to onboard services into a national, regional or thematic catalogue and defined a set of steps to operate a national catalogue interoperable with the EOSC one. This is reported in Appendix VII.

The requests for support collected during the aforementioned activities are reported in Appendix V, Appendix VI reports the guidelines to integrate the INDIGO-IAM service.

Chapter 4 provides some conclusions and recommendations for future work.

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<sup>2</sup> <https://eosc-portal.eu>

<sup>3</sup> <https://eosc-portal.eu/enhance>

<sup>4</sup> <https://eoscfuture.eu>

<sup>5</sup> <https://www.eosc-hub.eu>

## 2 Guidelines to Support the Integration of Core Services

### 2.1 Overview

The definition of federation is quite vague and there is no agreement about it in the countries participating to EOSC-Pillar. This is indeed a general problem within EOSC, because it does not aim at building a unique e-infrastructure at European level. Several different infrastructures (research infrastructures or e-infrastructure) already exist in Europe (and beyond) to address specific needs and it is likely that many more will be set up in the future. Each of them is based on its own concept of federation which typically relies on a set of common and shared services.

To this respect, thanks to the work performed within several EC-funded projects and by the EOSC Governance Working Groups<sup>6</sup>, the concept of EOSC-core services was elaborated; it is intended to include the basic services needed for the federation of resources.

A general description of the main elements of the EOSC ecosystem, including EOSC-core, is available in the Fair Lady document<sup>7</sup> delivered by the EOSC Governance Sustainability working group.

Within EOSC-Pillar the activities are driven by the user communities and their specific needs (use cases), so the first step was to analyse them. The starting point was the use cases defined in WP6, then the T7.4 “Ready to use services” were considered and finally information was collected at a wider scope, through surveys and interviews to the main actors in the countries participating to the project (through the aforementioned Transversal Task Force). The work done to gather the needed information as well as the analysis of the achieved results is reported in Appendix I (analysis of the use cases defined in the work package “EOSC in action: Use cases and community-driven pilots” - WP6) and Appendix II (services offered by the “Services ready to use” activity - task T7.4). The activities of the Transversal Task Force are described in the Appendix III and the results of their work are reported in Appendix IV. The above mentioned activities result in identifying services that have expressed interest or have explicitly requested support for integrating the Authentication and Authorization Infrastructure service, one of the core services offered by the EOSC. All these services are listed in the table of services identified for EOSC-Pillar support reported in Appendix V. None of the services that were analysed expressed the interest in integrating other core services offered by the EOSC.

### 2.2 Integration Guidelines

In order to avoid reinventing the wheel, information has been collected about the guidelines already available within the projects which foresee activities to support the service integration at European

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<sup>6</sup> <https://www.eoscsecretariat.eu/eosc-working-groups>

<sup>7</sup> <https://op.europa.eu/it/publication-detail/-/publication/581d82a4-2ed6-11eb-b27b-01aa75ed71a1>

level as well as at national level. It is important to notice that for some services we will consider interoperability, instead of integration: typically integration refers to application services which are to be integrated with general core services such as AAI, while interoperability refers to the interaction between services which deliver the same capabilities e.g. a central monitoring/accounting service and a local/thematic one.

Information and guidelines for the integration with the EOSC core services are described in section 2.2.1.

According to the results of the assessment done within WP6 and T7.4, the only service identified which requires support for integration is Authentication and Authorization system (AAI).

INDIGO-IAM<sup>8</sup>, one of the EOSC core AAI services, has been selected as the baseline AAI service for the EOSC-Pillar project. INDIGO-IAM is an Identity and Access Management Service for distributed applications and resources. It is based on open and standard protocols and provides an homogeneous management layer for identities, enrolment, group membership and other attributes and authorization policies. For the integration of this service specific guidelines have been developed which are described in Appendix VI.

### 2.2.1 Guidelines for the integration with other EOSC core services

One of the most relevant EOSC implementation projects was EOSC-hub, (January 2018 - March 2021) which relied on the outcomes of the two main e-infrastructures at European level (EGI and EUDAT) and of the main software development project, INDIGO-DataCloud. Its main follow-on project, EOSC Future, started on April 1<sup>st</sup> 2021.

Among other things, EOSC-hub did several activities to support the integration of services, specifically with the so-called EOSC core services and this activity is supported by several specific documents made available through a dedicated wiki page<sup>9</sup>.

In the frame of the EOSC-Pillar project, currently no specific requirements with regards to the integration of the EOSC core services were addressed since the services involved in the project haven't expressed any interest in integrating any of them. Therefore the documents about the EOSC core services as well as the guidelines for their integration produced in the frame of the EOSC-Hub project are taken as reference because they are the most recent integration guidelines while waiting for updates from EOSC Future. Additional specific documents to support integration with further services will be produced and made available according to the needs which may emerge in the course of the EOSC-Pillar project.

In this section we aim to shortly present some of the consolidated core services offered by EOSC and the references to the existing documentation about their integration with applications. This list is not exhaustive because the set of EOSC core services is evolving in accordance with the outcome of the discussions at the EOSC Association level as well as within the EOSC Future project.

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<sup>8</sup> <https://indigo-iam.github.io/v/current>

<sup>9</sup> <https://wiki.eosc-hub.eu/display/EOSC/Documentation+for+Federation+Services>

#### 2.2.1.1 *ARGO Messaging Service (AMS)*

The ARGO Messaging Service is a Publish/Subscribe Service implementing the Google PubSub protocol. Instead of focusing on a single Messaging API specification for handling the logic of publishing/subscribing to the broker network the API focuses on creating nodes of Publishers and Subscribers as a Service. It provides an HTTP API that enables Users/Systems to implement message oriented service using the Publish/Subscribe Model over plain HTTP.

Detailed information about ARGO Messaging Service as well as guidelines about interoperability can be found at the following links:

- <https://wiki.eosc-hub.eu/display/EOSC/ARGO+Messaging+Service++AMS>
- <https://wiki.eosc-hub.eu/display/EOSCDOC/Monitoring>

#### 2.2.1.2 *EGI Accounting*

EGI Accounting is a service for collecting, storing, aggregating, and displaying usage information coming from various services offered by EGI, such as Cloud, HTC and storage services. It works thanks to a network of message brokers that transfer usage data from the host to a central repository of information. The data is handled securely and can be consulted online through the EGI Accounting Portal<sup>10</sup>.

Detailed information about EGI Accounting service as well guidelines about interoperability can be found at the following links:

- <https://wiki.eosc-hub.eu/display/EOSC/Accounting>
- <https://wiki.eosc-hub.eu/display/EOSCDOC/Accounting>

#### 2.2.1.3 *Application Database*

The EGI Applications Database (AppDB) is a central service that stores and provides to the public information about software solutions in the form of native software products and/or virtual appliances, publications derived from the registered solutions and the programmers and the scientists who are involved. Using the VMops Dashboard provided by this service is also possible to deploy and manage Virtual Machines to the EGI Cloud infrastructure.

Detailed information about AppDB service as well guidelines about interoperability can be found at the following link:

- <https://wiki.eosc-hub.eu/display/EOSC/Application+Database+User+Documentation>

#### 2.2.1.4 *Configuration database (GOCDB)*

Configuration database (GOCDB) is the official repository for storing and presenting EGI and WLCG topology and resource information. It is a definitive information source, intentionally designed to have no dependencies on other operational tools for information. Because GOCDB is a primary data-input source, the portal applies a range of business rules and data-validations to control input. It applies a comprehensive Role-based authorization model that enables different actions over

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<sup>10</sup> <https://accounting.egi.eu>

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different target resources. The Role model allows communities to manage their own resources where users with existing roles can approve or reject new role-requests.

Detailed information about GOCDB service as well guidelines about interoperability can be found at the following link:

- [https://wiki.egei.eu/wiki/GOCDB/Documentation\\_Index](https://wiki.egei.eu/wiki/GOCDB/Documentation_Index)

### 2.2.1.5 Helpdesk

The EOSC-hub Helpdesk is a ticketing system/request tracker for issues concerning the available EOSC services, which allows users to submit their requests through a single-entry point. The unified system acts as first level of support, which automatically forwards tickets to the appropriate underlying support system.

Detailed information about Helpdesk service as well guidelines about interoperability can be found at the following links:

- <https://wiki.eosc-hub.eu/display/EOSC/Helpdesk>
- <https://wiki.eosc-hub.eu/display/EOSCDOC/Helpdesk>

## 3 Guidelines and Recommendations to Onboard EOSC Services

### 3.1 Overview

The EOSC ecosystem is composed by various activities and services; one of the most relevant services being the Catalogue (and the associated Marketplace<sup>11</sup>) which is intended as the tool to help connecting the demand side (users looking for resources and services to address their scientific needs) and the supply side (service providers willing to make their resources and services available to user communities).

The EOSC Catalogue and Marketplace are available through the EOSC Portal, developed by EOSC-Hub in 2019 and improved by EOSC Enhance projects, and leverages previous activities such as the ones of eInfraCentral<sup>12</sup>, EOSCPilot<sup>13</sup> and OpenAire-Advance<sup>14</sup>.

The EOSC-hub project defined specific procedures to onboard services/resources in the EOSC Catalogue and this activity has been taken over by the EOSC Future project.

One of the activities carried out by EOSC-Pillar's Transversal Task Force and described in the Appendix III was to identify services relevant at national level with respect to onboarding them into the EOSC. These services are listed in the table of services identified for EOSC-Pillar support reported in Appendix V.

In addition to the EOSC catalogue, various other catalogues/registries exist or are planned, so one of the first activities in EOSC-Pillar was devoted to understand which other catalogues/registries, and their onboarding procedures, already exist in the global EOSC ecosystem. Then the project activities have been devoted to support the onboarding of services into whatever catalogue/registry, not only the one available in the EOSC Portal, and the result of all this is described in this chapter.

### 3.2 Onboarding Guidelines and Procedures

During the first half of the EOSC-Pillar project the only Catalogue and Marketplace relevant to the EOSC-Pillar partners were the EOSC ones which have been jointly developed and operated by EOSC-hub and EOSC-Enhance projects and these activities have recently been taken over by the EOSC

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<sup>11</sup> a catalogue is a database/repository where information about services is collected, while the marketplace is the user facing tool which exposes the information stored in the catalogue to the external world

<sup>12</sup> <https://www.einfracentral.eu>

<sup>13</sup> <https://eoscpilot.eu>

<sup>14</sup> <https://www.openaire.eu>

Future project. So, the first version of the EOSC-Pillar onboarding guidelines and procedures, described in the Milestone MS32<sup>15</sup>, referred to the EOSC Catalogue and Marketplace only.

However, as a result of a survey conducted in Autumn 2020 to understand which are the existing catalogues or plans to implement them at national level, it emerged that the need for a national catalogue exists in various countries, although with different flavours. In addition, task T4.4 is defining a model for national catalogues which has been tested and delivered in June 2021.

Therefore, in the following chapters we will describe the guidelines and procedures to onboard services into the EOSC catalogue (3.2.1) and the guidelines to define appropriate onboarding procedures into either national or thematic catalogues (3.2.2).

### 3.2.1 EOSC Portal Onboarding

The procedures to onboard services into the EOSC catalogue were defined by the EOSC Portal Onboarding Team (EPOT) according to the Rules of Participation (RoP) defined by the RoP Working Group<sup>16</sup> set up by the EOSC Governance in 2019. These procedures evolved over time and were adapted to the new release of the EOSC Portal launched in October 2020 by EOSC Enhance which significantly improved the Catalogue and Marketplace through the definition of appropriate profiles for different types of resources and automated some steps of the onboarding procedure thus simplifying the process.

The onboarding process is described here<sup>17</sup> and shown in fig. 1

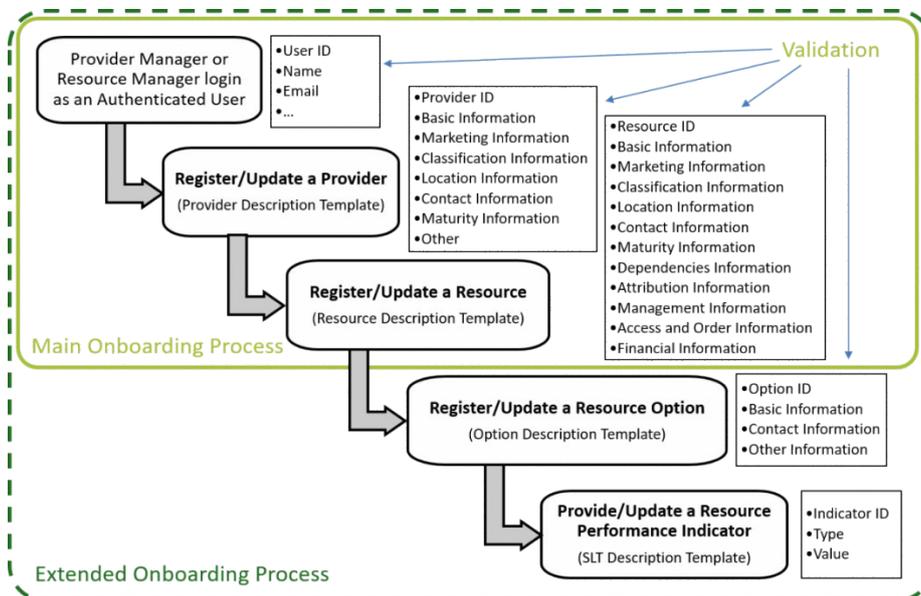


Fig. 1: The onboarding process

The onboarding process is structured in 3 phases:

<sup>15</sup> <https://doi.org/10.5281/zenodo.4283424>

<sup>16</sup> <https://www.eoscsecretariat.eu/working-groups/rules-participation-working-group>

<sup>17</sup> <https://eosc-portal.eu/providers-documentation>

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1. Provider registers itself into the EOSC Portal.
2. Provider fills in (and updates) the Provider information.
3. Provider onboards (and updates) the Resources offered by the Provider by filling in appropriate forms.

As soon as each phase is concluded (approved or rejected by the EOSC Portal Onboarding Team), the user is notified to proceed accordingly. If the three-phase onboarding process is successful, then the Provider is registered to the EOSC Portal and the associated Resources become publicly accessible.

Before starting the process, candidate service providers have to self-assess if they are compliant with the EOSC provider inclusion criteria<sup>18</sup>, which have been defined by the EOSC Portal Onboarding Team in accordance with the already mentioned EOSC Rules of Participation.

To become a provider, the general requirements are the following:

- Services should be at Technology Readiness Level<sup>19</sup> 7 or more
- Service providers should be a legal entity; non legal entities such as a consortium and other similar entities may be onboarded as service provider if a legal entity (e.g. one of the consortium members) accepts to be accountable on its behalf (acting as 'hosting legal entity')
- The service is accessible by users outside its original community.
- The service is described through a common template focused on value proposition and functional capabilities.
- At least one service instance is running in a production environment available to a scientific community.
- Published Research data is Findable, Accessible, Interoperable and Reusable.
- Release notes and sufficient documentation are available.
- Helpdesk channels are available for support, bug reporting and requirements gathering.
- Providers onboarding a resource must assert that they are able to ensure the resource is delivered by them or their collaborators and agree to remove resources which are no longer operational or available.

In addition, services must meet at least one of:

- The service must be targeted to EOSC and EOSC communities
- The service must build on or leverage EOSC capabilities to serve some other community

For the registration phase, service providers have to connect to the EOSC Portal using appropriate credentials: most research institutions IDPs are supported, so that service providers can use the credentials issued by their own institution.

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<sup>18</sup> <https://eosc-portal.eu/providers-documentation/eosc-provider-portal-inclusion-criteria>

<sup>19</sup> [https://ec.europa.eu/research/participants/data/ref/h2020/other/wp/2018-2020/annexes/h2020-wp1820-annex-g-trl\\_en.pdf](https://ec.europa.eu/research/participants/data/ref/h2020/other/wp/2018-2020/annexes/h2020-wp1820-annex-g-trl_en.pdf)

Then they have to register as service provider (phase 2) by filling in an appropriate template which is based on the EOSC Provider's profile<sup>20</sup>.

At present only services can be onboarded, although it is foreseen that this may change in the future and additional types of resources, such as training, software, etc., could be onboarded, too.

After the service provider request has been submitted, the EPOT will validate it and either approve or reject it.

From this point on, the service provider can start onboarding one or more resources (phase 3) by filling in the resource template, defined in accordance with the EOSC resource profile<sup>21</sup>. As for the service provider entry, the candidate resources have to be validated by the EPOT.

As soon as either the service provider's or resource entries have been successfully validated they are automatically published in the EOSC Portal Marketplace (for resource publication a minimum Technology Readiness Level of 8 is required).

This procedure will be continuously improved in order to cope with additional needs and feedback collected through various channel by the EOSC Enhance project and from November 2021 on by the EOSC Future project.

### 3.2.2 National Catalogues Onboarding

The procedure to onboard services and other types of resources into national catalogues has not been defined yet in the realm of EOSC-Pillar countries.

The only procedure available concerns the French CatOpidor catalogue<sup>22</sup>, a catalogue for an optimization of sharing and interoperability of research data, which is not a national reference catalogue for the time being, although it may aspire to become so in the future.

As a consequence, T7.1 decided to start defining general guidelines to set up appropriate onboarding procedures for national or thematic catalogues in order to ensure compliance with the EOSC Portal procedures. The main goal is to pave the way to achieving the interoperability among national/thematic catalogues with the EOSC Portal one and this requires, in addition to the technical interoperability, mutual compliance between the general principles for onboarding (the so called Rules of Participation) and the practical criteria derived by them as well as interoperability at the technical/operational level.

These guidelines are intended as a practical instrument to help the national/thematic catalogue owners and operators to set up their own structure and procedures before starting the definition of a specific agreement with the EOSC Portal operators which is foreseen to happen in the frame of the EOSC Future project.

The practical steps foreseen for onboarding resources in a national or thematic catalogue are described in a specific document prepared within EOSC-Pillar and released by the T7.1 team in June

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<sup>20</sup> <https://eosc-portal.eu/providers-documentation/eosc-provider-portal-provider-profile>

<sup>21</sup> <https://eosc-portal.eu/providers-documentation/eosc-provider-portal-resource-profile>

<sup>22</sup> <https://opidor.fr>

2021<sup>23</sup>; this document will be updated after collecting feedback from the other regional projects as well as from external interested parties.

The eleven steps foreseen in the Guidelines are:

1. Identify all actors involved in the operation of the catalogue and their role;
2. Define the scope and goal of the catalogue, the specific needs it aims at addressing;
3. Define the metadata profiles which will be used to describe the resources to be onboarded into the catalogue;
4. Analyze the differences between these profiles and the ones currently used in the EOSC Portal and define a compatibility matrix;
5. Investigate the consequences of the differences and possible ways to guarantee compatibility at least for the mandatory information;
6. Discuss with the current (EOSC Future) and future projects operating the EOSC Portal the formal agreement to be established to activate the overall interoperability among the catalogues
7. Define how the resource providers can onboard their resources into the catalogue, through appropriate interfaces;
8. Define the criteria, back-office procedures and tools and validation process to deal with the incoming requests
9. Appoint the teams which will be in charge of the onboarding procedure;
10. Publish all the relevant information about the catalogue, inclusion criteria and onboarding procedures to let service providers know what they are supposed to do to onboard their resources;
11. Test the available tools (specifically the EOSC API) to implement the interoperability of the catalogue with the EOSC one in cooperation with the projects currently developing and operating the EOSC Portal (EOSC-Enhance and EOSC Future).

Each step, as it appeared in the document version as of September 2021, is thoroughly described in Appendix VII

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<sup>23</sup> <https://repository.eosc-pillar.eu/index.php/s/o8H6LGbGDd3fpZF>

## 4 Conclusions and Future Work

Support for onboarding activities and integration with EOSC core service activities is being done through specific documents like the milestones MS31 and MS32 and this present document. The contributions resulting from the work described in this document to the above mentioned support activities are different: first of all the presented guidelines, result of the study of the state of the art and the specific needs collected in the frame of the EOSC-Pillar project. Then the gathering in a single place, this document, of references to technical documentation developed by different projects in different time about the federating or core services offered by EOSC. Finally, the links with other active projects involved into EOSC in order to facilitate communication regarding some specific aspects have been highlighted. This is the case of the support for the onboarding of services into the EOSC catalogue requested by some services that essentially consists in facilitating the connection with the project in charge of this (EOSC Future) and its procedures. Some of the above presented documents will be updated after collecting feedback both inside and outside the EOSC-Pillar project as well as in accordance with the evolution of the situation at European and national levels.

One of the activities carried out in the EOSC-Pillar project by the T4.4 team is the development of a prototype of national catalogue interoperable with the EOSC Catalogue. This activity has highlighted the need for including, among the support activities, besides the support for onboarding resources in the EOSC Catalogue, also the support for the onboarding of resources in thematic/national catalogues. The aim of EOSC-Pillar in this regard has been to facilitate the definition and establishment of appropriate onboarding procedures for national/thematic catalogues interoperating with the EOSC catalogue. This has been achieved with the guidelines reported in this document (Appendix VII). These guidelines, though, are not exhaustive as the support for the onboarding of services into a national/thematic catalogue obviously depends on the type of catalogue of interest and are going to be stated according to the different use cases. This first version of the Guidelines for operating a national/thematic catalogue will be updated after collecting feedback by the main actors involved in the catalogue operation activities in Europe. In addition, the agreements among the national/thematic catalogue operators and the project in charge of operating the EOSC catalogue (EOSC Future) should comply with some general rules, defined in appropriate templates, which are currently being defined within EOSC Future (task T2.2) with the involvement of most relevant actors, even external to the project, in Europe.

Another important outcome of the work described in this document is the identification of both national or thematic services and services developed through the EOSC-Pillar project that have expressed interest or have explicitly requested support for onboarding into the EOSC catalogue or for integrating the Authentication and Authorization Infrastructure service, one of the core services offered by the EOSC. Some of the identified services are not mature enough to be integrated with the federating or core services nor to be onboarded into a catalogue. These services have been taken into account anyway as support from EOSC-Pillar to connect them with the EOSC may be required at a later stage. This list of identified services is reported in Appendix V and will be used by the T7.2 team to plan and organize their support activities.

D7.1: Guidelines and recommendations for the technical integration of resources and services in the EOSC

In conclusion the need for support for both service onboarding and service integration will for sure continue after the end of EOSC-Pillar. For this reason it is very important for EOSC-Pillar to pave the way towards an autonomous connection of the relevant actors in the countries involved in the project with the appropriate actors related to these activities, like the EOSC Future project and the EOSC Association, also through the new Working Groups and the new Task Forces established in the frame of the EOSC-Pillar project.

## Appendix I. Analysis of the WP6 Requirements

The D6.1 deliverable document<sup>24</sup>, where requirements for WP6 use cases are collected, was taken as the basis to identify which services to be integrated are needed by the single use cases.

From the use case analysis templates the following fields were taken into account:

- Need of Use Cases in terms of compute power
- Auxiliary applications
- Gap Analysis/Missing pieces

The following fields from the single use case templates were considered to collect further information:

- Infrastructure needs
- Capacity needs
- services currently missing

Some answers do not refer to services but only to generic needs that are not already carried out by the current services involved in the use cases, while others mention the need of connectors between some already identified services, or point to thematic services or already identified specific services (e. g. the INDIGO-DataCloud service for UC6.6).

Other required services are those related to CPU or GPU resources, virtual machines or storage space.

None of the so-called EOSC-core services is mentioned, apart from AAI.

Explicit references about AAI services are in UC6.2, UC6.4, UC6.6, UC6.7 and UC6.8 use case templates. UC6.4 and UC6.8 already have an AAI system. The UC6.2 development is divided in two parts and each one will require user's authentication and authorization to have access to the computer resources (computing, memory and storage). AAI services will be developed accordingly to the specific requirements of each part and for the first step they foresee to take advantage of a VRE mechanism such as D4Science for that purpose. UC6.7 identified B2Access as AAI service for their use case while UC6.6 will be integrated with INDIGO-IAM.

For a further analysis of WP6 use cases requirements on AAI services, the results of a specific survey about this theme managed by task T7.2 were examined. According to the responses, all the communities or research infrastructures involved in the WP6 use cases already use AAI solutions for their use cases. None of them think they lack information about federated identity management and expressed any need for material to inform their organization about federated access nor for a support relating to AAI services.

The set of the above mentioned scientific use cases has been expanded through an open call for participation carried out as one of task T6.10 activities in order to identify additional services to be supported by EOSC-Pillar.

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<sup>24</sup> <https://zenodo.org/record/4442383>

The open call closed at the end of February 2021 and collected eight proposals for new services. Two applicants were rejected as respectively the presented applications did not fit the scope of the call and the development stage of the proposed service was not mature enough. A preliminary questionnaire<sup>25</sup> was prepared and a workshop event was organized in order to collect specific information about the other six proposed services to better understand their needs and determine the kind of support that could be provided by the project .

In the preliminary questionnaire there was a set of questions concerning AAI to investigate if the proposed service has an Access Management Mechanism already in place and if the applicant is interested to interface its service with an INDIGO-IAM instance<sup>26</sup>, the AAI solution proposed within the scope of the EOSC-Pillar project. The responses indicate that three services<sup>27</sup> already have an AAI system in place but still at a development phase, one<sup>28</sup> has a controlled access for some web pages but lacks an actual AAI service, one<sup>29</sup> has a local AAI service and one<sup>30</sup> has a completely open access and therefore is not interested in an Access Management Mechanism. The three services mentioned above which have a prototype AAI system expressed, in the questionnaire as well as during the workshop event, their interest to be supported with the integration of the INDIGO-IAM service.

None of the applicants is interested in integrating other EOSC-core services while an applicant is interested in experimenting the integration of some ready-to-use services offered by T7.4.

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<sup>25</sup> <https://repository.eosc-pillar.eu/index.php/s/8s9rQ3rZ8tfrXrb> (PDF), <https://repository.eosc-pillar.eu/index.php/s/p9oRdzmPq4f4Wqa> (.docx)

<sup>26</sup> <https://iam-pillar.cloud.cnaf.infn.it/login>

<sup>27</sup> ReadMetrics (<https://ezmeasure.couperin.org/>), AstroODA ([https://www.astro.unige.ch/cdci/astrooda\\_/](https://www.astro.unige.ch/cdci/astrooda_/)) and Phaidra Institutional Repository (<https://phaidra.univie.ac.at/>)

<sup>28</sup> EMM Survey Registry (<https://ethmigsurveydatahub.eu/>)

<sup>29</sup> Thoth (<https://thoth.pub/>)

<sup>30</sup> SIMBAD service from Strasbourg astronomical Data Centre (CDS) (<http://simbad.u-strasbg.fr/simbad/>)

## Appendix II. Results of the T7.4 Services Inventory

In order to understand among the services of interest of task T7.4, which ones need support for their integration, a survey has been conducted among the different user communities behind the T7.4 services.

They are:

- Pico2 (Pilot for COncecting COmputing centres)
- VIP (Virtual Imaging Platform)<sup>31</sup>
- BDSS (Business Decision Support System), Materials Modelling Marketplace and VIMMP<sup>32</sup> (Virtual Materials Marketplace) services
- VRE (Virtual Research Environment)
- Laniakea<sup>33</sup>
- FG-iRODS<sup>34</sup>

With respect to AAI, the result of the survey shows that two services (Laniakea and VRE) are already connected with an AAI service which supports federated identity providers (EDUGAIN) and as such they don't need support for integration with INDIGO-IAM, the reference AAI service selected for the EOSC-Pillar project.

One other service (Pico2) currently is in a prototype phase and will need support for the integration with INDIGO-IAM at a later stage, as soon as they will be consolidated.

In addition, VIP is in a prototype phase and they will have to discuss internally which AAI service can be considered for integration, either the EGI service (Check-in) or INDIGO-IAM.

Concerning "BDSS, Materials Modelling Marketplace and VIMMP services", this is a quite complex situation because these services essentially consist in Marketplace/inventory services developed in the frame of an EU-funded project for a specific community, namely the Materials Modelling community. The aim of this community is to make these services available to a broader range of users, also through the connection with the corresponding EOSC services. A common AAI service is paramount for this, but no decision has been taken yet with respect to which AAI service they may be willing to adopt/integrate with. This will be clarified after a thorough evaluation of the technical ways to make their services interoperable with the EOSC ones.

France Grilles iRODS expressed interest in getting support for the onboarding of the services into the EOSC catalogue as soon as some current issues have been fixed.

None of the respondents expressed the need to integrate other services.

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<sup>31</sup> <https://www.creatis.insa-lyon.fr/vip/>

<sup>32</sup> <https://www.vimmp.eu/>

<sup>33</sup> <https://laniakea-elixir-it.github.io/>

<sup>34</sup> <http://www.france-grilles.fr/services-catalogue/fg-irods-en/>

## Appendix III. Description of the Transversal Task Force activities

The EOSC-Pillar project has set up in December 2020 a Transversal Task Force (TTF) to coordinate a consultation process of national initiatives acting as national representatives in the context of EOSC, e.g. mandated organisations, and national thematic infrastructures, such as domain-specific, vertical research infrastructures and generic, horizontal e-infrastructures at national level that are federating national services in the context of EOSC, e.g. national nodes of ESFRI infrastructures. The goal was to gather practical information about the issues for onboarding services into the EOSC catalogue and thus offer support to facilitate the process, taking into account policy, business models and sustainability aspects of the services. The members of the TTF bring together the survey efforts carried out by different EOSC-Pillar's tasks: T4.1 on Policy and legal framework, Task 4.3 on Consolidation of national initiatives, Task 4.5 on Sustainable Business Models, Task 2.2 on Concertation with the EOSC governance and related EOSC initiatives, and Task 7.1 on Guidance on procedures for integrating services.

The TTF aimed at gathering information on:

- policy on open science and open data
- the expected role of the EOSC-Association and the EOSC related projects in the above processes
- the services relevant at national level with respect to onboarding into the EOSC
- the different ways for implementing a “federation” of services
- business models elements and issues for supporting sustainable national and trans-national data, compute and open science services

To achieve its goals, the TTF developed specific questions aimed at specific categories of respondents within the selected national initiatives or thematic infrastructures which are:

- reference contact person for the national initiative or thematic infrastructure
- responsible person for policy on open science and open data
- technical expert of e-infrastructures for onboarding/federating services into EOSC
- financial officers related to service providers (e.g. data suppliers and aggregators, enablers) relevant from the perspective of the EOSC ecosystem

In order to better target the questions to the different roles e.g. the responsible persons of mandated national organisations and of thematic national research infrastructures, two slightly different questionnaires were prepared to better reflect the needs they might have with respect to the support EOSC-Pillar can offer them. In particular, a subset of questions relevant for this document were defined to gather information useful for the integration/federation of existing services (computer based services, training services, etc.) with the EOSC services, in order to define a clear path and the associated processes for the inclusion of the relevant national services into the EOSC Catalogue and Marketplace and support for this. These questions are listed below:

1. Name and type of the infrastructure (e.g. research infrastructure, e-infrastructure, ESFRI RI)

2. Is it a national infrastructure only or part of an international one?
3. Is this infrastructure managing/operating a ICT infrastructure? If yes, is it already connected to EOSC? How? And what are the future plans?
4. Could you please provide more information about the access mechanisms? e.g., excellence-driven (access exclusively based on peer review), market-driven (paid access), membership/policy based (access by affiliation), wide (open and free access to everyone), hybrid models, etc.
5. What is the form of your infrastructure? (on a single site, distributed, virtual, human network based, partly or completely outsourced) (if not already known)
6. Are your infrastructure and its services open to other communities? If yes, how?
7. Does your infrastructure federate resources belonging to different administrative or scientific domains?
8. Do you plan to federate your services with other organizations/infrastructures and how?
9. What are the most relevant services implementations in your infrastructure which are paramount for your community? (please provide information about specific services which require support by EOSC-Pillar for integration/onboarding)
10. What is the Technology readiness level (TRL) of these services?
11. Have these services already been included into the EOSC catalogue through the EOSC Provider Portal (<https://eosc-portal.eu/for-providers>) ? Please list them.
12. Have these services already been included into a national or thematic catalogue? If yes, please provide the link to such catalogues
13. Have these services already been integrated with the so-called EOSC core services (e.g. AAI, monitoring, accounting, etc.)? Do you plan to integrate your services into EOSC core services?
14. Do you foresee the need for support to integrate these services with the core services, or any other kind of support? (e.g. guidelines for service integration, guidelines for onboarding services into EOSC catalogue)

For each country the TTF decided to consult the national/mandated organisation plus at least 4 national thematic research infrastructures, trying to cover different disciplines. Interviews started mid-April and were carried out until the end of June 2021.

The results of the consultation were summarized in an internal document that is on the basis of the recommendations and guidelines illustrated in this deliverable and will help in steering the future activities and deliverables of work packages 4 and 7.

## Appendix IV. Results of the Transversal Task Force interviews

The interviews of the Transversal Task Force revealed that all but one of the national mandated organisations do not have yet plans to establish a national catalogue or onboard/federate services into EOSC. Only the Italian ICDI answered that they already have some services with TRL ranging from 7 to 8 already included in the EOSC catalogue. These services have not been included in any national or thematic catalogue yet, but it will happen soon. Most of these services are already integrated with the EOSC AAI, and few of them also with the monitoring and accounting EOSC-core services. However, EOSC-Pillar support in terms of guidelines for service integration and onboarding could anyway be useful.

In the following the information collected through the interviews to the representatives of about 20 national initiatives or infrastructures in the five EOSC-Pillar countries is summarized

### 4.1.1 Austria

Formally, the mandated organisation in Austria is the ACONET association. The representation of the Austrian mandated organisation will be performed by the operative unit, the EOSC Support Office Austria. The involved partners are currently working on a Memorandum of Understanding that regulates the governance of the Austrian initiative and the cooperation of the EOSC stakeholders. The Austrian initiative is at this point not planning to establish a national catalogue or to onboard/federate services with EOSC.

Three other national thematic infrastructures were interviewed in Austria: AUSSDA - Austrian Social Science Data Archive, ACDH-CH - Austrian Centre for Digital Humanities and Cultural Heritage and GAMS - Humanities Asset Management System, from University of Graz. All of them were active in the social sciences and humanities research. Their services, mainly data repositories, are offered through the connection with the catalogues and services provided by three ERIC infrastructures created to support this research field: CESSDA, CLARIN and DARIAH. Their integration roadmap with EOSC services and catalogue are mostly mediated by their connection with these international infrastructures, even if one of them (ACDH-CH) is also directly involved in EOSC related projects (SSHOC and EOSC Future). From EOSC-Pillar they would appreciate a clear technical documentation about EOSC, information on Austrian-wide EOSC activities in order to avoid the duplication of work, and advice on which of the services offered are suitable for a connection with EOSC.

Moreover, several Austrian universities jointly operate the Vienna Scientific Cluster (VSC). It is a member of PRACE, and is a HPC Competence Centre of the European network EuroCC. Work is currently under way on a cross-university scientific cloud solution that will also be EOSC-compatible. VSC would become involved with EOSC if necessary.

### 4.1.2 Belgium

As a federated country, it's crucial to understand both the regions: the Fédération Wallonie-Bruxelles and the Flemish region as well as the federal government have jurisdiction over the area

of science and science policy. Belnet was selected by the Interministerial Conference for Science Policy, Belspo, as the mandated organisation for Belgium within the EOSC association. In this role, Belnet is tasked to collaborate with all regional and the federal government and administrations involved in Open Science to provide a common position at the general assembly. Since Belgium is a federated country where research is a regional capacity, coordination is established through a bottom-up process through the Open Science working group of CIS-CFS (Commission International Cooperation-Commission Federal Cooperation).

While in the Fédération Wallonie-Bruxelles, at the local level, there is no coordinated effort to be involved in EOSC at the moment, in the Flemish region, the Flanders Research Information Space (FRIS) is the regional digital platform containing information on researchers and their research, funded via public Flemish funds since 2008. FRIS has been established as close cooperation between the Department of Economics, Science and Innovation of the Flemish Government and the knowledge institutions in Flanders, i.e. Flemish universities, higher education colleges, strategic research centres, and other scientific institutions. Access to the FRIS portal is open and free under an open licence, with exception of access to confidential data. Access to data is further accessible through a consumer service which allows for access to other systems. FRIS plays an instrumental role in connecting Flemish research to EOSC. In the first place the intent is to make datasets available to the EOSC in the near future. Studies have been undertaken to see what information is necessary to make this happen. FRIS is in the process of becoming OpenAIRE compliant, meaning information on datasets will be harvested and enriched by OpenAIRE and be presented in this way to EOSC.

#### 4.1.3 France

An EOSC-France working group - also known as “Collège EOSC-France” - has been put in place in September 2020 by the Ministry of Higher Education, Research and Innovation (MESRI) to propose an entity, which will federate the French stakeholders from the higher education and research communities towards the engagement in the EOSC Association. The main purpose of the Collège EOSC-France is to coordinate the French position within the EOSC, propose the French mandated membership of the EOSC Association which will be approved by MESRI, and establish the French EOSC community. As of yet, this national initiative is not a legal entity, but is coordinated as a consortium.

EOSC-France neither provides services nor manages a federated catalogue of services. As of yet, the widely-adopted National catalogue of services dedicated to research data is CatOPIDoR<sup>35</sup>, a wiki which has been launched in October 2017 by Inst-CNRS. It's a collaborative, moderated tool which is fed/updated by services providers or end-users. There are discussions to enhance it by structuring the data model and formalizing the onboarding process, but no roadmap has been communicated at this stage.

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<sup>35</sup> <https://cat.opidor.fr/>

Other than EOSC-France, three national infrastructures were interviewed: GENCI<sup>36</sup>, DataTerra<sup>37</sup> and IFB<sup>38</sup>.

GENCI is an e-infrastructure and numerical infrastructure which was established in 2007 with the objectives to increase the use of high performance computing (HPC) and numerical simulation in order to bolster competitiveness within the French economy, across all scientific and industrial fields. There are no specific communities targeted by GENCI, which is rather a generic, distributed e-infrastructure. It essentially provides numerical simulation HPC related services (e.g. jobs scheduler, code compilation, parallel computation, data access, supervision, etc.), that are listed in the PRACE catalogue of services - as GENCI is one of its resource providers - and the FENIX infrastructure services. Most of them are in Production (TRL9), which means that the systems have gone through a validation process to ensure a high level of quality of service from various standpoints such as security or availability. These services do not need support from EOSC-Pillar because they are already supported by PRACE. They have been made available in the eInfraCentral catalogue which has fed the EOSC marketplace<sup>39</sup>. Since GENCI IT infrastructures are operated by the three National data centres (CEA<sup>40</sup>, CINES, CNRS), service level agreements have been put in place to guarantee this from a contractual point of view.

DataTerra is a very large research infrastructure that handles different types of data (spatial, in-situ, soil, experimental data) and associated services. It is a multi-site, distributed, virtual and human-network based infrastructure. It deploys a distributed platform for accessing and processing Earth System FAIR data, products and services in order to facilitate their use, develop services over the entire data cycle and implement interdisciplinary approaches. These services are operated by DataTerra clusters (one for each component of the Earth system: Ocean, Solid Earth, Atmosphere, Continental surfaces) and supported by the Data and Services centres (CDS). The CDS are attached to the Data Terra clusters and are managed by institutional partners (CNES<sup>41</sup>, IFREMER, IRD<sup>42</sup>, INRAE, etc.), thematic mesocentres, regional mesocentres and national centres (CNES, IDRIS<sup>43</sup>, etc.). DataTerra services are intended to the scientific community (Geosciences, and, in the framework of the Gaïa data project<sup>44</sup>, climate and biodiversity communities), as well as to public actors and private actors in the context of partnerships. Most services provided by DataTerra RI are integrated within the CatOpidor catalogue<sup>45</sup>, which identifies and describes French services that contribute to the management, sharing and reuse of scientific data throughout their life cycle. Some of these services are also included in catalogues of institutions such as IFREMER, CNES, etc. and in international catalogues (from international projects). These services are not integrated with the

<sup>36</sup> <https://www.genci.fr/>

<sup>37</sup> <https://www.data-terra.org/>

<sup>38</sup> <https://www.france-bioinformatique.fr/>

<sup>39</sup> [https://marketplace.eosc-portal.eu/services?service\\_id=&anchor=&sort=\\_score&q=prace](https://marketplace.eosc-portal.eu/services?service_id=&anchor=&sort=_score&q=prace)

<sup>40</sup> <https://www.cea.fr>

<sup>41</sup> <https://www.cnes.fr>

<sup>42</sup> <https://www.ird.fr/>

<sup>43</sup> <http://www.idris.fr/>

<sup>44</sup> <https://www.data-terra.org/pia-3/>

<sup>45</sup> [https://cat.opidor.fr/index.php/Sciences\\_du\\_Syst%C3%A8me\\_Terre](https://cat.opidor.fr/index.php/Sciences_du_Syst%C3%A8me_Terre)

EOSC Core services, but DataTerra plans to integrate some of them, with the help of projects in which the Research infrastructure is involved (EOSC-Pillar, Phidias, etc.). In particular, integrating and registering these services to EOSC is part of the workplan of workpackage 6 of EOSC-Pillar. A better knowledge of EOSC-Core services would be useful to support this integration. The TRL of these services isn't homogeneous.

IFB is both an e-infrastructure and a research infrastructure. It is a national infrastructure, and also the French node for ELIXIR. IFB platforms provide a direct service to biologists for their research. IFB is operating an ICT infrastructure on its own resources and in partnership with other structures (e.g. collaboration with Universities or computing/data centres). There is a strong focus on cloud activities in collaboration with France-Grilles & EGI. There is no connection with EOSC yet although there are links with EOSC-related projects (EOSC-Pillar, EOSC-Life) where developments of services are discussed. IFB does not provide any offer of infrastructure services within EOSC, but can provide an offer of scientific services associated with its research domain. These scientific services can work on different kinds of hardware services (accessible with API). E.g. with INSERM (data verse INSERM and associated computing environment). Registering IFB Galaxy services to EOSC is part of the workplan of the workpackage 6 of EOSC-Pillar.

#### 4.1.4 Germany

The German National Research Data Infrastructure (NFDI) is the mandated member in the EOSC association for Germany. The NFDI consists of a number of consortia which are associations of universities, non-university research institutions, departmental research institutions, academies, and other publicly funded information infrastructure institutions or other corresponding actors. As of this writing, 9 consortia are in operation with 18 more awaiting formal approval. Each consortium will develop and offer a service portfolio for research data management for its sub-area. Proposals and the consortia of NFDI must comply to the requirement of describing how they will connect with international developments, such as EOSC, and how they plan to ensure compliance with the FAIR principles. In addition to the scientific consortia that work on a thematic basis, project structures will be established that are primarily concerned with the construction of a horizontal technical infrastructure. The organisation of these basic services has not yet been finalised, but they will in any case link up with existing European organisations such as EOSC. Another important player in Germany is the GAIA-X project. Launched in autumn 2019, it was initiated by the German Federal Ministries for Economic Affairs and Energy (BMWi) and for Education and Research (BMBWF) with the aim of establishing a networked, high-performance, secure and trustworthy data infrastructure for Europe. The project is closely aligned with the European Data Strategy, which strives towards a genuine single market for data, as well as the EU Recovery Plan. GAIA-X is a fairly new initiative and a demonstrator-like Minimal Viable GAIA-X is expected in 2021. The project aims to build a European data ecosystem, especially for business. Soon after its inception 11 French joined the founding 11 German companies and the project became a legal entity after it was transferred into an association under Belgian law (AISBL) in 2020.

Other than NFDI representatives, one national initiative and two NFDI consortia were also interviewed: IDS (International Data Spaces led by Fraunhofer Institute for Software and Systems Engineering ISST), NFDI4Earth and NFDI4Ing.

IDS primarily aims to define the future standards for IT usage policies and protocols on an international level. Standards worked out by IDS do not interfere with infrastructure development efforts like EOSC or the German National Research Data Infrastructure (NFDI), but rather suggest certain development premises. Currently there is no connection between IDS and EOSC but they would be open for joint activities. However they do not know enough about the EOSC project itself or the concrete services EOSC offers to national initiatives to be able to declare his own expectations towards it.

NFDI4Earth (NFDI Consortium Earth System Science) is in its founding phase and will start in October 2021. The funding is for providing the glue between existing Earth Science related institutions, including infrastructures and researchers from the domain. NFDI4Earth has no direct funding for computing and storage. It will have or need access to resources (like HPC, HTC, storage, repositories, ...) provided by already existing infrastructures, including commercial clouds. GAIA-X and EOSC are clearly important candidates. However, overall it is not yet clear how NFDI will be connected to GAIA-X and EOSC.

One important service of NFDI4Earth will be a distributed/virtual/networked human support service which opens up the RDM Knowledge Base in NFDI4Earth and links to already existing support services all over Germany. Services from NFDI4Earth are of interest beyond Earth System Sciences. For many other domains, they form the “backbone” of research projects. Also, the other way around, incorporating services from other domains (e.g. biodiversity) will be important. If an “overarching layer” could be built by EOSC, GAIA-X, and can be incorporated needs to be discussed, also in context of the NFDI. Support/assistance from EOSC and its implementation projects might be of help. At this point, the following services from NFDI4Earth partners are already in the EOSC catalogue:

- Datacube (from rasdaman GmbH)
- NBI Cloud
- ENSC Climate Analytics Service
- European Galaxy Server

In addition, BlueBridge and SeaDataNet provide services for the earth sciences community that are not yet registered in the EOSC catalogue

For HPC, NFDI4Earth will rely on the 5 national computing centers in Germany and DKRZ (the German Climate Computing Centre).

NFDI4Ing (National Research Data Infrastructure for Engineering Sciences) is funded and running for one year. In total, it is funded for five years. It brings together researchers representing the communities of mechanical engineering, process engineering, material science, computer science and electrical engineering. There is currently no funding for infrastructure, but the expectation is that this will change. They think that sharing of data benefits the public society and private sector,

as shown in the Covid-19 research, so they expect that EOSC and GAIA-X be one system and no separated spheres between research and industry. In mechanical engineering, companies refuse to share data. However, there is a culture change in academia. Change in industry can be driven through education of young people that will enter the industry.

#### 4.1.5 Italy

ICDI, the Italian Computing and Data Infrastructure, was appointed by the Italian Ministry of Research as the mandated organisation in the EOSC Association. It is a collaborative framework, established through an MoU signed by a number of research organisations and universities. Besides the MoU participants, ICDI animates a community which involves most of the representatives of Research Infrastructures and e-Infrastructures of national interest. ICDI is planning to host a national distributed infrastructure called ICDI Federated Cloud serving all the Italian research and academic institutions. The infrastructure will federate resources belonging to different administrative and scientific domains and plans to federate its services with other organisations mostly using common APIs, AAI solutions, and common service catalogue. Some services operated by ICDI research organisations have a TRL ranging from 7 to 8 and have been already included in the EOSC catalogue. These services have not been included in any national or thematic catalogue yet, but there is a plan to implement a national catalogue, although no decision has been taken yet. Most of these services are already integrated with the EOSC AAI, few also with the monitoring and accounting EOSC-core services. However, EOSC-Pillar support in terms of guidelines for service integration and onboarding is considered very useful.

Other than ICDI, five thematic national infrastructures were interviewed: Area Science Park, BBRMI.it, Elettra Sincrotrone Trieste, INAF and INFN.

Area Science Park is a public research body member of the ICDI, the EOSC Association, and plans to adhere to Elixir.it. It hosts a Genomics and Epigenomics Platform, a facility dedicated to the analysis of sequences on DNA and RNA and genotyping (microarrays), and the ORFEO (Open Research Facility for Epigenomics and Other) data center, offering HPC/AI computation and storage. ORFEO hosts a OpenStack based cloud infrastructure exposing a Kubernetes cluster serving users for Area, Genomics and Epigenomics laboratory and other global users. It offers about 500 cores with up to 1.5TB di RAM per server, 4 GPGPUs, 3 PB of raw storage space served through a Ceph parallel file system for its fast (based on SSD) and standard components, with a partition of 1.5 PB reserved for long-term storage. Other than the genomics community, the infrastructure is open to the material science community and the life science community. However, on a best effort basis (no QoS guaranteed) a policy-based access to resources is open also to other communities. Privileged access is available after an agreement (accordo quadro) with the external research institutes and charged according to the QoS. Operational expenses are always charged, also for best effort access. For the industry the access mechanism is not yet defined. The ORFEO data center currently does not federate resources belonging to different administrative or scientific domains. However, there is a plan to federate with the University of Salerno data center during 2022 within the PON collaboration. It is not yet clear how to implement the federation, but the site managers are sharing their ideas in the ICDI cloud federation working group. The most relevant services in preparation

for Elixir.it are web-based services for protein family classification using the DPCfam clustering algorithm. Area Science Park is interested in becoming a service provider of EOSC and publishing web-based DPCfam related services as resources in the EOSC catalogue. Possibly these will also be included in the Elixir catalogue. DPCfam services are currently at TRL4, but are planned to evolve up to TLR7 in 7-8 months. There are no plans yet to integrate these services with the EOSC-core services, and it is not clear yet how EOSC-Pillar could help in onboarding/integrating services with EOSC.

BBMRI.it is the Italian node of BBMRI-ERIC, a European research infrastructure for biobanking. It has been established with a joint effort by the Ministry of Health and the Ministry of University & Research. It is a distributed research infrastructure including biobanks, biological resource centers (BRCs) and sample collections, located in different Italian regions. Actually BBMRI.it has no ICT infrastructure. It offers a directory with yellow pages for biobanks, working on semantic, metadata etc. These biobanks have not yet been registered with EOSC. In Italy there are 97 biobanks, located at hospitals and at Scientific Institutes for Research, Hospitalization and Healthcare (IRCCSs). There is an interest to be supported by EOSC-Pillar to be integrated with EOSC. One of the main issues is that these 97 biobanks have 34 different ICT systems. BBMRI.it federates resources belonging to different scientific and administrative domains, such as the demographic ones, and is planning to federate with other services, e.g. the COVID-19 portal. The most relevant services for the community are the repository and the access portal. Their TLR is not well defined. While BBMRI.it services are published in the national biobanks directory<sup>46</sup>, they are not yet included in the EOSC catalogue, neither are yet integrated with the EOSC-core services. It is possible that in the future they'll need some support from EOSC-Pillar for onboarding their services in the EOSC catalogue.

Elettra - Sincrotrone Trieste is an open research infrastructure, with half users from Italy and half users worldwide. It is the representative entity of Italy in CERIC-ERIC (Central European Research Infrastructure Consortium). It manages the synchrotron light source Elettra and the free electron laser FERMI, has 2 accelerators and 35 light lines. Elettra ICT infrastructure is connected to EOSC through PaNOSC and ExPaNDS projects. ICT services will be developed inside these two projects and join the EOSC catalog at the end of these projects (2022). Elettra infrastructure is located on a single site, but CERIC-ERIC is distributed. Elettra hosts data services for all partners of CERIC-ERIC. As an example, the Austrian Academy of Sciences at University of Graz loads its data in the Elettra storage servers (a 60 PB library is available for long term data preservation). Elettra services are open also to other communities, e.g. biomedical research. A scientific advisory committee selects the users with a peer review mechanism. Elettra infrastructure does not federate resources belonging to different administrative or scientific domains. It plans to federate its service with the ones of the photon and neutron community and with EOSC. Elettra is working with EGI and GEANT for the AAI aspects. The data catalogue services are paramount for the Elettra community. As an example they developed h5nuvola, a HDF5 data viewer offering cloud file browsing, data visualisation services, and selective exporting of data. All their services, which are included in the PaNOSC catalogue, are TRL 7, but plan to evolve to TRL 8 before the end of the PaNOSC project. They are not yet included in the EOSC catalogue. Concerning the integration with the EOSC-core

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<sup>46</sup> <https://directory.bbmri.it/>

services, the photon and neutron community based its AAI system on umbrellaID, developed by PSI. They are working now with EGI and GEANT for integrating umbrellaID with EGI Check-in and eduTEAMS. Elettra foresees the need for support from EOSC-Pillar both for the onboarding of the services on the EOSC catalogue and for integrating the services with the EOSC-core services.

INAF is the Italian National Institute of Astrophysics. It is a national research infrastructure collaborating with the International Virtual Observatory Alliance (IVOA<sup>47</sup>) and several other intergovernmental organisations and projects such as for example the European Southern Observatory (ESO), the Square Kilometre Array Observatory (SKAO) and the Cherenkov Telescope Array (CTA). INAF is managing two ICT infrastructures: CHIPP (Calcolo HTC in INAF – Progetto Pilota) and IA2 (Italian center for Astronomical Archive). They are not yet connected with EOSC, but there are mid-term plans to do it, when it will be more clear which services are relevant for EOSC. INAF was approved as a provider in the EOSC Portal the 11 of May 2021. The infrastructure is distributed across different INAF units, based on a human network and not outsourced. INAF developed in-house the Remote Authentication Portal (RAP), an AAI system based on IDEM allowing you to authenticate on INAF services using eduGAIN federation or some social accounts, supporting both OIDC and SAML protocols. The infrastructure currently is not open to communities outside astrophysics, simply because there was no demand. INAF does not federate resources belonging to different administrative or scientific domains. It is collaborating with the ICDI Federation working group to study the possibility to federate its resources and services with larger infrastructures, e.g. ICDI or the ones of CTA and SKA. Paramount for the community is the RAP AAI system which is mainly focused on authentication based on eduGain. However, there is not a common authorization framework yet. The TRL level of RAP is 8. Even if INAF was approved very recently as a provider in the EOSC Portal, there are two services almost ready to be onboarded. These are already part of the IVOA registry, containing all the services released under the IVOA standard. Most of them are datasets or live instances of services operating on datasets that could be therefore included in the EOSC catalogue. Part of them are also going to be included by the CDS of Strasbourg, which is currently a pending provider in EOSC. However their inclusion will not be immediate, because the work for the harmonization/integration of the IVOA registry (which is 10 years old) with the EOSC catalogue is still ongoing. It is still unclear whether these services require integration with EOSC-core services, nor whether EOSC-Pillar support will be needed.

INFN is the research infrastructure for Nuclear and High Energy Physics (HEP) in Italy. It is part of the international infrastructure supporting HEP experiments. INFN is also managing and operating a ICT infrastructure offering HTC, HPC and Cloud resources supporting not only HEP experiments but other INFN research activities. There is interest in connecting this infrastructure to EOSC as part of a federated environment supporting with similar ICT tools a variety of multi-disciplinary activities. INFN has both hardware distributed computing and storage infrastructure, but also a widely distributed human network of know-how on implementing highly distributed and scalable computing and storage infrastructures. INFN infrastructure and its services are open to other communities based on policy. In particular, INFN-Cloud infrastructure<sup>48</sup> federates cloud resources

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<sup>47</sup> <https://www.ivoa.net/>

<sup>48</sup> <https://www.cloud.infn.it>

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belonging to different administrative domains, and there are plans to federate additional external resources. Its most relevant services implementations which are paramount for its community are INDIGO-IAM, PaaS Orchestrator, DODAS. They all have TRL 8 and are already in the EOSC catalogue, so do not need support by EOSC-Pillar. These services are not included into any national or thematic catalogue. For what concerns their integration with the so-called EOSC-core services, INDIGO-IAM is one of the EOSC AAI solutions, while some of the computing and storage resources of the INFN-Cloud infrastructure (the ones made available to the EGI-ACE project) are already integrated with the EGI monitoring and accounting, so there is no need of further support from EOSC-Pillar.

## Appendix V. List of services identified for EOSC-Pillar support

<b>Service</b>	<b>Description</b>	<b>Service gathered from</b>	<b>Type of support requested</b>	<b>when support is foreseen (future means in the last part of EOSC-Pillar project hopefully)</b>
AUSSDA (Austrian Social Science Data Archive) Research Data Management Services	AUSSDA is a data infrastructure for the social science community in Austria and offers a variety of research support services. These include data archiving and management, data preparation, data access and data search as well as advice on licences and data protection for the purpose of data sharing	Transversal Task Force	they need advice on which of the services offered are suitable for a connection with EOSC	future
ACDH-CH (Austrian Centre for Digital Humanities and Cultural Heritage) Services	ACDH-CH offers a number of services for researchers ( <a href="https://www.oeaw.ac.at/acdh/tools">https://www.oeaw.ac.at/acdh/tools</a> ), which will also be offered via the EOSC Catalogue and Marketplace. ACDH-CH is involved in the EOSC projects SSHOC and EOSC Future.	Transversal Task Force	onboarding	future
ARCHE	ARCHE (A Resource Centre for Humanities Related Research in Austria) is a service for the long-term digital archiving of data and their metadata offered by ACDH-CH. This service is compliant with OAI-PMH protocol.	Transversal Task Force	onboarding. They would also appreciate a clear technical documentation from EOSC	future
GAMS (Graz Humanities Asset Management System)	GAMS is a data repository operated by the Institute Centre for Information Modelling, part of the University of Graz (Faculty of Humanities).	Transversal Task Force	onboarding. They would welcome advice on where EOSC-Pillar sees	future

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	their services can be found via CLARIN-B Centre and via DARIAH-EU. The contained data are delivered to numerous aggregations (e.g. culture pool, CLARIN VLO). GAMS is preparing the connection to OpenAIRE for this summer/autumn. It is also planned to link GAMS to EOSC.		the optimal points of connection for GAMS or for the domain of the humanities in Austria	
IFB Galaxy services	IFB is a national infrastructure and also the French node for ELIXIR. Through the Galaxy services they offers an open source, web-based platform for data intensive biomedical research	Transversal Task Force / EOSC-Pillar WP6	onboarding	now. Onboarding/integration of these services with EOSC is part of the workplan of UC6.6 of EOSC-Pillar.
Data Terra Earth system data services	DataTerra is a very large research infrastructure that handles different types of data and associated services. It deploys a distributed platform for accessing and processing Earth System FAIR data, products and services in order to facilitate their use, develop services over the entire data cycle and implement interdisciplinary approaches.	Transversal Task Force / EOSC-Pillar WP6.2	AAI integration / onboarding	now. Onboarding/integration of these services with EOSC is part of the workplan of UC6.2 of EOSC-Pillar.
HDF (Helmholtz Data Federation) AAI	HDF is an initiative founded with the direct objective of bundling efforts in data management and long term data preservation. One of the plan in HDF is to provide a common AAI infrastructure supporting several technologies in order to form the basis of standardised data management practice	Transversal Task Force	onboarding	future. The service is not in production yet
HIFIS (Helmholtz Federated IT Services)	The HIFIS project is a project funded by the Helmholtz Association. The goal of HIFIS is to create a seamless, high-performance, community-wide IT infrastructure in the	Transversal Task Force	onboarding	future

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	<p>Helmholtz association to provide reliable networked services that are findable through a portal which lists services that have gone through a well-defined onboarding process.</p> <p>A federated services and cloud-oriented platform is being built on a high-performance network infrastructure, complemented with a federated AAI.</p>			
GAIA-X	<p>GAIA-X is a project for the development of an efficient and competitive, secure and trustworthy federation of data infrastructure and service providers for Europe, which is supported by representatives of business, science and administration from Germany and France, together with other European partners.</p>	Transversal Task Force	onboarding	<p>future.</p> <p>A demonstrator-like Minimal Viable GAIA-X is expected in 2021</p>
NFDI4Earth (Consortium Earth System Science) Services	<p>NFDI4Earth is a consortium in NFDI (German National Research Data Infrastructure) founded for providing the glue between existing Earth Science related institutions, including infrastructures and researchers from the domain. Some services from NFDI4Earth partners are already in the EOSC catalogue. In addition, BlueBridge and SeaDataNet provide services for the earth sciences community that are not yet registered in the EOSC catalogue.</p>	Transversal Task Force	onboarding	<p>future. The consortium is now in its founding phase</p>
ICDI (Italian Computing and Data Infrastructure) Services	<p>ICDI is a collaborative framework, established through an MoU signed by a number of research organisations and universities. ICDI research organizations operate different services.</p>	Transversal Task Force	onboarding/integration	<p>future. Not specified which of the services and what kind of support</p>

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	Some of these services have a TRL ranging from 7 to 8 and some of them have been already included in the EOSC catalogue or are already integrated with some EOSC Core services.			
ICDI (Italian Computing and Data Infrastructure) Federated Cloud	ICDI is planning to host a national distributed infrastructure called ICDI Federated Cloud serving all the Italian research and academic institutions. The infrastructure will federate resources belonging to different administrative and scientific domains and plans to federate its services with other organisations mostly using common APIs, AAI solutions, and common service catalogue.	Transversal Task Force	onboarding	future
web-based DPCfam related services from Area Science Park	Area Science Park is a public research body member of the ICDI, the EOSC Association, and plans to adhere to Elixir.it. The most relevant services in preparation for Elixir.it are web-based services for protein family classification using the DPCfam clustering algorithm.	Transversal Task Force	onboarding	future. Their current TLR is 4, but plan to achieve TRL 7 in December 2021
National biobanks directory from BBRMI.it	BBMRI.it is the Italian node of BBMRI-ERIC, a European research infrastructure for biobanking. The most relevant services for the community are the repository and the access portal with yellow pages for italian biobanks	Transversal Task Force	onboarding	future. Their TRL is now not well defined
Elettra - Sincrotrone Trieste services	ICT services from Elettra - Sincrotrone Trieste have been developed for the photon-electron community in the context of PaNOSC and ExPaNDS projects. They are data catalogues, computing and storage services. An example is h5nuvola, a HDF5 data viewer offering cloud file	Transversal Task Force	onboarding / integration with EOSC - core services	future. Services are already TRL 7 and included in the PaNOSC catalogue. They plan to evolve to TRL 8 before the end of the

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	browsing, data visualisation services, and selective exporting of data.			PaNOSC project (2022).
INAF Services	Between the services offered by INAF there is the Remote Authentication Portal (RAP), an AAI system based on IDEM allowing you to authenticate on INAF services using eduGAIN federation or some social accounts, supporting both OIDC and SAML protocols; other services almost ready to be onboarded are already part of the IVOA registry. Most of them are datasets or live instances of services operating on datasets that could be therefore included in the EOSC catalogue.	Transversal Task Force	onboarding	future. The work for the harmonization /integration of the IVOA registry (which is 10 years old) with the EOSC catalogue is still ongoing
TEXTCROWD	TEXTCROWD is a NLP package used for text mining of heritage-related text files. The tool has already been developed in previous projects and tested in a cloud environment in EOSCpilot, without involving so far the scientific datasets. The aim of the EOSC-Pillar use case related to this tool is porting a TEXTCROWD version which has already been tested for archaeological data in the ARIADNE project (for English and Dutch) and in EOSCpilot for Italian, to new languages	EOSC-Pillar T6.9	onboarding	now
ReadMetrics	ReadMETRICS is a solution for: monitoring transformative agreements, including before and beyond; analyzing usage across disciplines and consortia; assessing value of publishing spend; enabling comparative citation analysis. It is based on the already	EOSC-Pillar T6.10 open call	AAI Integration	now

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	existing and field-tested ezPAARSE and ezMESURE Free and Open Source tools, extending and including features inspired by the National Library of Luxembourg's transition to Open Access.			
AstroODA	AstroODA is a service that allows users to leverage cloud-based scientific data analysis workflows of astrophysical observatories/experiments: INTEGRAL and POLAR missions (with further resources under development), providing verified publication-ready results.	EOSC-Pillar T6.10 open call	AAI Integration	now
SINBAD from CDS (Strasbourg astronomical Data Centre)	The CDS is an astronomy data centre that plays a unique and essential role in astronomy by adding value to published and reference data. The CDS develops services. One of them is SIMBAD, the reference database for the nomenclature and bibliography of astronomical objects (outside the solar system). The services is provided on-line where it can be accessed via interactive tools and web interfaces, as well as by programmatic interfaces conforming to international standards	EOSC-Pillar T6.10 open call	onboarding	now
Phaidra Institutional Repository	Phaidra is an institutional repository that serves numerous research disciplines and is based on the open-source repository Fedora. With Phaidra, the University of Vienna is expanding Fedora with additional functions so that researchers can use the repository for self-service and upload their data easily.	EOSC-Pillar T6.10 open call	AAI Integration	now
EMM Survey Registry	The Ethnic and Migrant Minorities (EMM) Survey	EOSC-Pillar T6.10 open	onboarding	future. The service is

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	Registry is a tool that brings together and improves visibility of previously scattered information about existing quantitative surveys undertaken with ethnic and migration minority (EMM) (sub)populations. It is designed to serve as a single access point or one-stop-shop for users to discover and learn about existing quantitative surveys on EMMs' integration.	call		currently running in a 'beta' version.
Pico2	Pico 2 is a testbed by INRA for converging to common deployment tools to facilitate code circulation and mobility between different infrastructures (HPC, HTC)	EOSC-Pillar T7.4	AAI Integration	future. The service is currently in a prototype phase
VIP (Virtual Imaging Platform)	The Virtual Imaging Platform (VIP) is a web portal for medical simulation and image data analysis. It leverages resources available in the biomed Virtual Organisation of the EGI e-Infrastructure to offer an open service to academic researchers worldwide.	EOSC-Pillar T7.4	AAI Integration	future. The service is in a prototype phase and they will have to discuss internally which AAI service can be considered for integration
Materials Modelling Marketplace and other material science services	In the Marketplace projects Fraunhofer co-develops a Materials Modelling Marketplace (MarketPlace) as a platform for collaboration and online materials modelling laboratories. These technologies are of interest for multiple communities, e.g., optimisation of health, climate, production and other resources.	EOSC-Pillar T7.4	AAI Integration, onboarding	future. A common AAI service is paramount for this, but no decision has been taken yet
Laniakea	Laniakea is a prototypal PaaS service designed to be deployed on any scientific or commercial Cloud infrastructure in order to	EOSC-Pillar T7.4	Support is foreseen to update the current version of	future, as soon as they finish the implementation of the new

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	<p>provide a “Galaxy on demand” Platform as a Service (PaaS). Laniakea’s its foundations on the INDIGO-DataCloud middleware that has been developed targeting a large number of scientific communities and is therefore deployable on multiple hardware and provisioned over hybrid (private or public) e-infrastructures. The end user interacts with Laniakea through a front-end that allows a general setup of the Galaxy instance, then Laniakea takes charge of the deployment both of the virtual hardware and of all the software components, finally providing a production-grade, but still fully customizable, Galaxy virtual instance. Laniakea’s many features include support to the deployment of plain or cluster backed Galaxy instances, shared reference data volumes, encrypted user data volumes and rapid development of novel Galaxy flavours, that is Galaxy configurations tailored for specific tasks, through Ansible recipes.</p>		<p>the service already onboarded in EOSC Catalogue with the new version developed in the context of EOSC-Pillar project</p>	<p>version</p>
<p>FG-iRODS</p>	<p>The France Grilles iRODS service offers to users storage space based on the iRODS software, which provides virtualised storage. Among other things, this service allows to:</p> <ul style="list-style-type: none"> <li>• create collections of data and manage them easily;</li> <li>• ensure high data availability via data distribution or replication over several</li> </ul>	<p>EOSC-Pillar T7.4</p>	<p>onboarding</p>	<p>future, some issues have to be solved first</p>

	<p>locations;</p> <ul style="list-style-type: none"> <li>organise the data catalogue independently from the physical placement of the data on the storage servers;</li> <li>search for data sets via a metadata catalogue which dynamically keeps track of the data file information and the file description;</li> <li>implement a fine-grained access control;</li> <li>ease the management of large datasets by automatically applying rules for data access and management which can be defined individually for each user; this procedure facilitates administrative task and reinforces the security and the integrity of the data;</li> <li>access the data remotely, from desktops, grids and clouds.</li> </ul>			
<p>Software source code preservation, reference and access (Software Heritage)</p>	<p>solution for the preservation of massive collections of software source code (billions of files with links to publications) into EOSC eTDR service (European Trusted Digital Repository).</p>	<p>T6.4</p>	<p>INDIGO-IAM-integration</p>	<p>already done</p>

## Appendix VI. Guidelines for the Integration of the INDIGO-IAM AAI Service

INDIGO-IAM (<https://github.com/indigo-iam/iam>) is an Identity and Access Management Service providing a layer where identities, enrolment, group membership and other attributes and authorization policies on distributed resources and applications can be managed in a homogeneous way. INDIGO-IAM supports identity federations and other authentication mechanisms, such as X.509 certificates and social logins.

The IAM service has been successfully integrated with many off-the-shelf components like OpenStack, Kubernetes, Atlassian JIRA and Confluence, Grafana and with several key Grid computing middleware services such as FTS, dCache, StoRM. IAM can also be easily integrated with applications thanks to its adoption of industry standards such as the OpenID-Connect protocol, the OAuth protocol and JSON Web Tokens, or JWT.

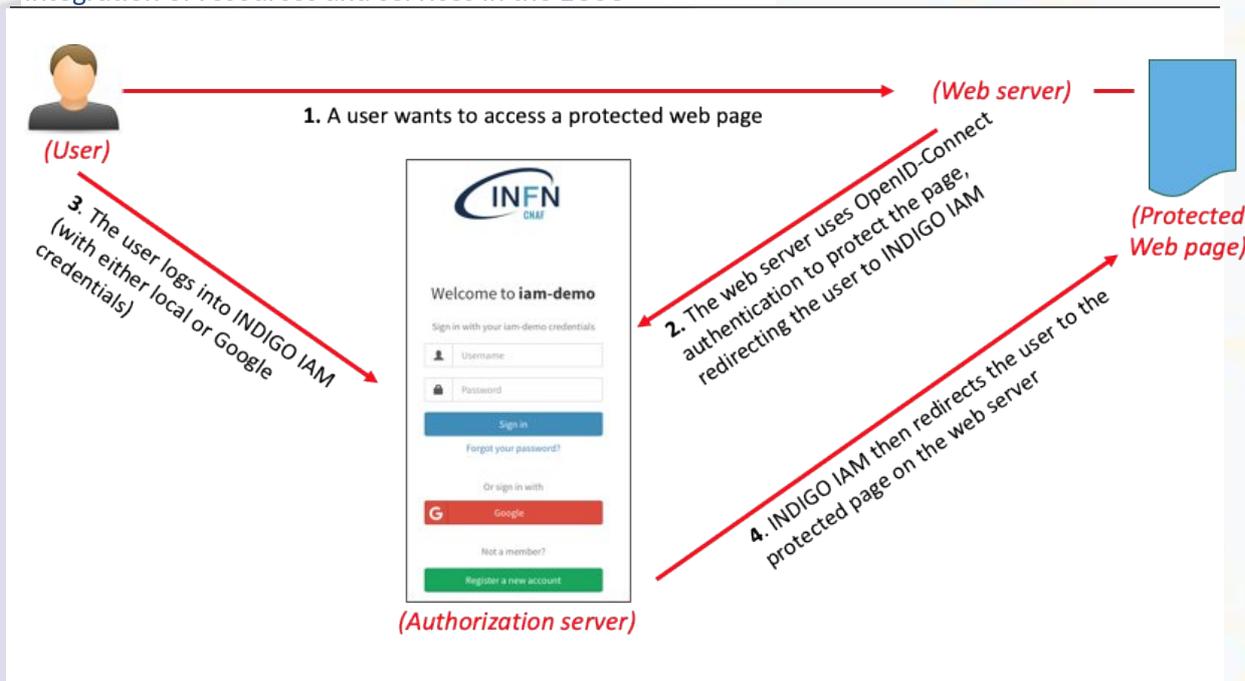
The adoption of these technologies, which are standard and widely used in the industry, allows the reuse of existing knowledge and tools, reduces integration complexity through off-the-shelf libraries and components, provides an authentication-agnostic mechanism, and scales thanks to the distributed verification of access and identity tokens.

This paragraph shows a sample integration example and provides pointers to the general integration of INDIGO-IAM into applications.

In summary, some the key features that make it worthwhile and easy to integrate an application into INDIGO-IAM are the following:

- Simplicity, thanks to the use of open standards.
- Support of an enrolment and registration service, allowing users to submit membership requests to a given organization.
- Linking of various credentials or authentication methods to a single identity.
- Flexibility, possibly granting administrator privileges to users, adding users to groups, managing membership requests, editing user registration information.
- Expose or manage user and group information, so that it could be consumed by applications through programmable interfaces.
- Support of full auditing to keep track of all interesting security events.

In order to show a sample integration of an application, we will show how a standard web server could be modified, so that access to that server goes through INDIGO-IAM first. This is a general picture of this scenario:

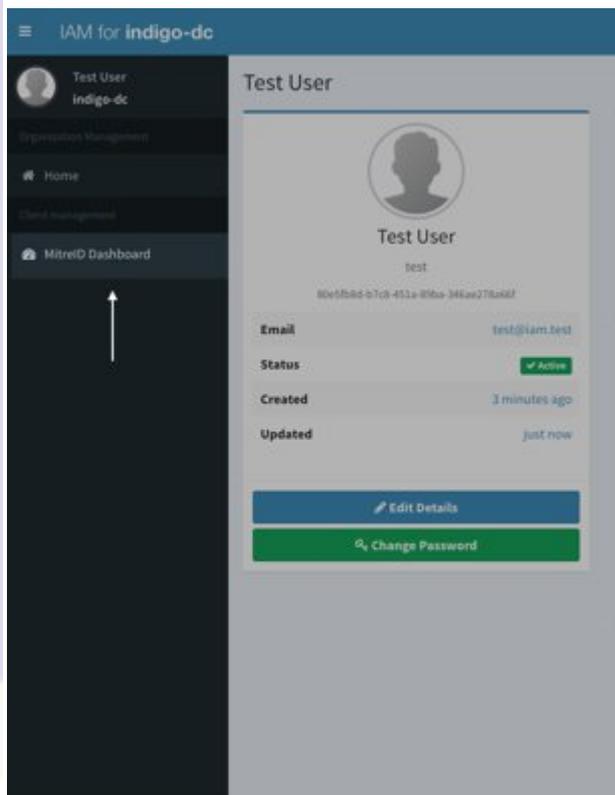


INDIGO-IAM natively uses OpenID-Connect to talk to applications. The application in our use case is a web server; we'll use the popular Apache server, so we need to enable OpenID-Connect authentication in Apache. We will use containers to make the entire process easily reproducible.

The steps that need to be followed are:

- Register a "new application" in INDIGO-IAM. We will need to tell INDIGO-IAM the public IP address and port of the web server.
- Create a sample index.html file for a sample web home page.
- Create the configuration file for the web server.
- Create a Docker file which will build the container, installing all necessary packages and copying the html file and the configuration.
- Run the container.

In order to register an application with INDIGO-IAM, one needs to log in to an INDIGO-IAM instance with administrator privileges and click on MitreID dashboard on the navigation bar:



From the MitreID dashboard, select Self-service client registration and Register a new client.

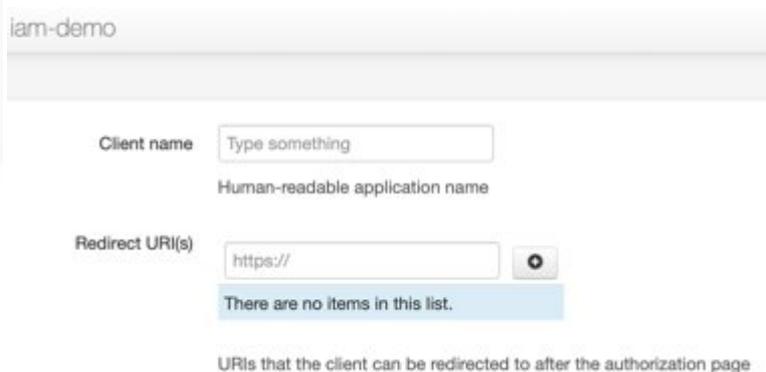
We now need to give INDIGO-IAM information about the application to be integrated. In the Client name field, write a descriptive text, e.g. “Test Web Server”.

In the Redirect URI(s), one should put this:

`http://<public_ip_address>:<port>/redirect_uri`

Where <public\_ip\_address> is the IP public address of the web server, and <port> is the port under which the web server runs. If https is used, replace http with https.

The other fields can be left to their default values.



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If one now clicks on **Save** to register the application, INDIGO-IAM will generate the client credentials. These are **needed** for the web server configuration; in particular, the **Client ID** and the **Client Secret** must be noted down.

For the sake of this example, we will create a very simple home page in html format for the web server. Create the following index.html file:

```
<html>
<h1>Welcome to an OpenID-Connect protected page!</h1>
This is a sample web server home page.
</html>
```

We now need to configure Apache, and this is where the integration with the INDIGO-IAM instance happens. Create a file called default.conf with the following lines:

```
<VirtualHost *:80>
  ServerAdmin webmaster@localhost
  DocumentRoot /var/www/html
  OIDCProviderMetadataURL https://<indigo-iam_ip_address>/well-known/openid-configuration
  OIDCClientID <put the Client ID here>
  OIDCClientSecret <put the Client Secret here>
  OIDCRedirectURI http://<public_ip_address>:<port>/redirect_uri
  OIDCCryptoPassphrase <put a random password here>
  <Location />
    AuthType openid-connect
    Require valid-user
  </Location>
  ErrorLog ${APACHE_LOG_DIR}/error.log
  CustomLog ${APACHE_LOG_DIR}/access.log combined
</VirtualHost>
```

Note that in the configuration file above **<indigo-iam\_ip\_address>** must be the IP address of the INDIGO-IAM instance where we are integrating our web server.

We will now create a Dockerfile to generate a Docker image containing our Apache web server, properly configured to connect to INDIGO-IAM and with our very simple home page:

```
FROM ubuntu
RUN apt update
RUN apt install -y apache2 libapache2-mod-auth-openidc
COPY index.html /var/www/html/
COPY default.conf /etc/apache2/sites-enabled/000-default.conf
EXPOSE 80
CMD ["apachectl", "-D", "FOREGROUND"]
```

At this point, we can generate the image, calling it e.g. web\_server\_oidc:

```
docker build -t web_server_oidc .
```

We can now run the image, instantiating a new web server connected to INDIGO-IAM:

```
docker run -d -p 80:80 web_server_oidc
```

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Opening a web browser to the page `http://<public_ip_address>:<port>/` should now redirect to the INDIGO-IAM service.

One could now log in to INDIGO-IAM with Google credentials, with a IAM local user name or with other federated identities (if configured in the INDIGO-IAM service) and, if the authentication is successful, be automatically redirected to the home page on the web server, thus implementing the full flow described in the use case architectural picture shown above.

For more information:

- Full tutorial on integrating Apache into INDIGO-IAM: <https://github.com/andreaceccanti/iam-tutorial/tree/master/apache-integration-demo>.
- General information about integration possibilities with INDIGO-IAM: <https://indigo-iam.github.io/docs/v/current/>.
- A complete webinar on INDIGO-IAM: <https://indico.in2p3.fr/event/21072/>.

## **Appendix VII. Guidelines for operating a national/regional/thematic catalogue which should be made interoperable with the EOSC catalogue**

### **Purpose**

The purpose of this document is to provide a guide to all prospective owners and managers of a national/regional/thematic catalogue (in the rest of this document we will call it simply “catalogue” or “local catalogue”) aiming to achieve interoperability with the EOSC catalogue. It is intended to provide general and practical help to set up the technical and operational procedures which obviously should be adapted to the specific context of the local catalogue.

The main goal of interoperability is the possibility to automatically transfer the information stored in a local catalogue into the EOSC one and vice versa.

This has to take into account:

- the technical implementation of the EOSC catalogue, specifically the data schema (resource profiles, provider profiles, controlled vocabularies, etc.), the API and the data fetching/publishing protocol currently in place;
- the organisational and operational policies driving the EOSC catalogue development and operation, e.g. the current procedures to onboard services into it, the inclusion criteria (“who” is allowed to add entries, “what” should be onboarded).
- the technical implementation and the operational procedures of the local catalogue if already existing

The features of the existing or prospective catalogues are of course important as well as their specific needs, but they will not be considered here because this guide aims at being general and provide advice on the practical steps to be done in order to set up appropriate technical solutions and operational procedures to operate a catalogue without compromising the compliance with the EOSC catalogue procedures.

Besides the EOSC integration aspects, it is also important that the sustainability of the catalogue and onboarding operations be considered from the beginning, to ensure that the operational structure which will be set up will be sustained in the medium-long period. These aspects, however, fall outside the scope of this document and will not be further dealt with in the following.

The whole process described here is initiated by a prospective Catalogue Owner, namely the entity (e.g., a National Initiative) affirming the willingness to create an instance of the catalogue. Such catalogue will include resources of relevance at the national/regional/thematic level: in the following we will focus on the subset of these resources which may possibly be considered for onboarding in the EOSC catalogue.

The operational steps to be performed by the Catalogue Owner willing to operate a catalogue interoperable with the EOSC one, are summarized here and further discussed below:

1. Identify all actors involved in the operation of the catalogue and their role;
2. Define the scope and goal of the catalogue, the specific needs it aims at addressing;
3. Define the metadata profiles which will be used to describe the resources to be onboarded into the catalogue;
4. Analyze the differences between these profiles and the ones currently used in the EOSC Portal and define a compatibility matrix;
5. Investigate the consequences of the differences and possible ways to guarantee compatibility at least for the mandatory information;
6. Discuss with the current (EOSC Future) and future projects operating the EOSC Portal the formal agreement to be established to activate the overall interoperability among the catalogues
7. Define how the resource providers can onboard their resources into the catalogue, through appropriate interfaces;
8. Define the criteria, back-office procedures and tools and validation process to deal with the incoming requests
9. Appoint the teams which will be in charge of the onboarding procedure;
10. Publish all the relevant information about the catalogue, inclusion criteria and onboarding procedures to let service providers know what they are supposed to do to onboard their resources;
11. Test the available tools (specifically the EOSC API) to implement the interoperability of the catalogue with the EOSC one in cooperation with the projects currently developing and operating the EOSC Portal (EOSC-Enhance and EOSC Future);

In the following sections all these steps will be described in-depth.

### **1. Identify all actors involved in the operation of the catalogue and their role**

Before starting, it is very important to identify all the actors which should be involved, not only at local but also at the European level, so that the rest of the steps envisaged above are properly addressed.

At the European level, the actors to be involved are teams/projects developing the EOSC catalogue (currently, the EOSC-Enhance project and EOSC Future from the end of 2021 on) and operating it (currently, the EOSC Future project).

At the local level, the roles which should be played are listed below. Note that different roles might be played by the same team, depending on the local needs.

- the catalogue owner, i.e. the entity who is accountable for the catalogue service;
- the developers of the technical solution adopted to implement the national/regional/thematic catalogue: these are not necessarily at the local

(national/regional/thematic) level, but could as well be external, like developers of an open-source solution;

- the support team of the catalogue instance. They may or may not be the same as the developers, especially when an open source solution is chosen. They are typically a team of people with expertise of the software solution but also of the specific configuration/adaptation of the solution for the specific environment where the catalogue service has been deployed, and have deep understanding of the issues related to interoperability of the EOSC catalogue with the technical solution adopted;
- the operators of the catalogue instance: these are the people in charge of operating the catalogue instance, who should take care of all the operational activities as well as to provide first line support for issues and problems which may arise. They should escalate the issues related to configuration or bugs to the appropriate specialized team (supporters or developers);
- the management/policy team: they should define the general goal of the catalogue, its scope and requirements it should fulfil in order to address the needs at national/regional/thematic level. They should also periodically monitor the status and effectiveness of the service and its compliance to the general goal
- the onboarding team: this is a crucial team because it has the duty of deriving concrete onboarding criteria from the high level requirements (among which the rules of participation, i.e. the general principles driving the inclusion/exclusion of resources in the catalogue) which will be used to assess the eligibility of the resource to be onboarded into the catalogue. This team is accountable and responsible for the onboarding process and should define and implement all the steps of the procedure, including how to perform the validation, and organize it in an effective and sustainable way;

## 2. Define the scope and goal of the catalogue, the specific needs it aims at addressing

As pointed out in the previous step, this is the responsibility of the management/policy team in accordance with the catalogue owner mandate. It consists of the definition of:

- the general goal of the catalogue, i.e. its target audience and the expected outcome;
- the scope: what are the resources to be included into the catalogue, their maturity level and any other information necessary to drive the setting up of the catalogue;
- the level of interaction/exchange of information with the EOSC catalogue, including the data that should be kept at local level only;
- the general policy of the catalogue, e.g. the Rules of Participation (RoP) from which the practical criteria for inclusion/exclusion of resources in the catalogue should be derived;
- Any other information useful to set up the catalogue so that it is fit for purpose.

**3. Define the metadata profiles which will be used to describe the resources to be onboarded into the catalogue**

The different types of resources to be onboarded into the catalogue have to be described by means of some information the service providers have to provide through the catalogue onboarding interfaces.

Which information is needed to produce suitable resource descriptions depend on the scope and specific needs of the catalogue and should be defined by the catalogue operators in accordance with the policy defined by the management/policy team.

However, to ease achieving the interoperability of the catalogue with the EOSC catalogue it is strongly recommended to take the EOSC Portal profiles as baseline to define the local profiles and extend them to address the local needs, if possible.

The EOSC Portal operators defined, at time of writing, two different profiles, for the service provider and for the resource.

In the EOSC Portal, the first step consists in the onboarding of the service provider (SP), then, as soon as the SP has been approved, the resources can be onboarded. This choice to split the onboarding in two steps is the result of about two years of onboarding experience by the EOSC Portal Onboarding Team (EPOT) and aims at avoiding asking for the same information multiple times.

Of course the national/thematic catalogue operators can make a different choice if deemed necessary.

Currently the EOSC Portal supports one type of resource only, i.e. services, although it is already planned to support other types of resources in the future, e.g. training materials, data repositories, etc. The catalogue operators can define appropriate profiles for other types of resources but of course these cannot be transferred into the EOSC catalogue for the time being.

It is highly recommended, however, that the definition of additional profiles for other types of resources is aligned with similar activities in EOSC Future, specifically in Work Package 3, and future teams/projects in charge of the EOSC Portal profiles evolution.

In essence, to ease and guarantee the interoperability with the EOSC catalogue, it is recommended to have local profiles that are compatible with EOSC Portal profiles and this compatibility is guaranteed along the time since EOSC profiles are likely to evolve.

**4. Analyze the differences between these profiles and the ones currently used in the EOSC Portal and define a compatibility matrix**

The first analysis that has to be performed is if the defined profiles and the ones currently used in the EOSC Portal have macroscopic differences in terms of general approach and structure. Two possibilities may occur:

- profiles in the catalogue are an extension of the ones used in the EOSC Portal: local profiles can be more detailed and with additional fields as compared to the EOSC ones or local catalogues can support further types of resources. If this case occurs, it is possible to proceed without defining a compatibility matrix
- the approach used in the local catalogue is totally different from the EOSC catalogue one. In this case a mapping activity between the different profiles has to be performed

A more detailed analysis can be performed on the fields in common between the profiles of the local catalogue and the ones of the EOSC portal. Fields structure and content should be taken into account. In this phase analysis concerns differences about:

- Whether the fields are optional or mandatory;
- validation limits
- used standards, controlled vocabularies, taxonomies or any other tools for creating a structured classification of resources. Using the same standards for both the catalogues results in coherent outcomes of filtering and research operations between them.

#### 5. Investigate the consequences of the differences and possible ways to guarantee compatibility at least for the mandatory information

During this phase the impact of the differences pointed out in the previous step on the foreseen automatic transfer of information between the local catalogue and the EOSC one has to be investigated. In case this impact is evaluated as significant, technical and/or organisational solutions to guarantee the interoperability between the catalogues have to be put in place.

In the case of a prospective catalogue, if the level of interaction/exchange of information with the EOSC catalogue defined at step 2 can't be guaranteed due to the differences between the profiles, a very first approach can be the rethinking of the choices performed during the previous steps in order to bridge the detected gap.

If the gap between the different profiles or approaches can't be solved or in the case of already existing catalogues with a predefined structure, the level of interaction with the EOSC catalogue may be reconsidered and some resources can be excluded from catalogues' interactions and kept at the local level. If this scenario occurs, the resources that have to be kept local have to be clearly defined as well as the means to identify and tackle them, which need to be different from those relevant to the resources that can be propagated to the EOSC catalogue.

Aspects related to these choices that can affect the following operational steps (e.g. the implementation of the user interface or the definition of the onboarding procedures) have to be deeply analyzed in order to put in place suitable technical solutions to keep an appropriate separation between these two different kinds of resources.

Some practical examples of differences that may occur are:

- profiles in the local catalogue have more fields than the ones in the EOSC catalogue: in this case, if the mandatory fields of the EOSC catalogue's profiles are respected, no noteworthy consequences for a correct interoperability are foreseen. Only common fields should be considered for the catalogues' interactions
- different validation criteria or thresholds for some fields: resources that don't reach the minimum requirements to be accepted in the EOSC catalogue can be kept locally until they will meet the requested criteria
- additional types of resources in the local catalogue: these types of resources should be excluded from catalogues' interactions for the moment; possible new interactions will be considered if in the future the EOSC Portal will support other types of resources.

**6. Discuss with the EOSC Future team (as well as future teams/projects operating the EOSC catalogue) the formal agreement to be established to activate the overall interoperability among the catalogues**

In order to allow the data exchange between the EOSC catalogue and the local one, technical interoperability has to be achieved first. But then a formal agreement among the operators/managers of both catalogues has to be established.

The formal agreement should define:

- the requirements for the data exchange between the catalogues
- the conditions to be fulfilled regarding different aspects, such as the onboarding and validations procedures, specifically their mutual compliance, etc.
- the type of data the two catalogues must exchange and the filtering level needed
- the operational agreement for the interoperation of both catalogues
- any other aspect relevant for the catalogues interoperation

At the European level, the definition of the agreement about the interoperation of the EOSC catalogue with other catalogues will be discussed and defined, at time of writing, within Work Package 2 of the EOSC Future project, specifically in task T2.2. Therefore the catalogue operators should establish a contact with T2.2 team to discuss the terms of the agreement, specifically on the sharing of metadata as well as onboarding and validation procedures.

**7. Define how the resource providers can onboard their resources into the catalogue, through appropriate interfaces**

This step involves the management/policy team as reference point for the contents, the operators of the catalogue instance in order to define the requirements for the catalogue backend (how data collected by the interfaces should be structured and managed) and the supporters of the catalogue instance with the task of identifying the most suitable technical approach.

The very first aspect to define is if the information, at least for the first steps, will be collected, evaluated and validated manually or automatically as it deeply affects the technical decisions to be made in the interfaces developing process.

At this point the most suitable kind of interface for onboarding the services (an user interface, an Application Programming Interface or both) has to be determined according to technical and management needs.

The interfaces should be designed following the principle of clearness regarding the requested information, in order to prevent any misunderstanding and help users filling in the different fields, and clearness regarding why some information is requested and how it will be used, in order to better increase the accuracy of the responses.

If there are different profiles, users have to be guided in choosing the more suitable one for their needs depending also on the type of resource they want to onboard and be redirected accordingly to the correct one.

The user interface has to clearly point out the validation rules for every field and if it is mandatory or optional. In the case of API (Application Programming Interface) validation rules and optionality of the different fields have to be clearly explained in the API description. In order to facilitate the validation procedures and the process of collecting the correct information, it is recommended to implement ad hoc solutions like, for example, automatic validation of the input data in case of forms. Errors presented to users should also be detailed and self-explanatory to guide the user in the correction of the wrong input.

Tutorial or user guides can be foreseen, if necessary. It has to be considered how and in what phase of the process of providing the information they have to be presented to the users.

A support channel for onboarding operations (e.g. helpdesk) should be defined and presented to the user in a precise way. The user has to have clear ideas on where and in which way to communicate doubts, requests for clarification or technical issues that may arise. Support lines might be different according to the requested expertise field and, in that case, the different contact points with the related area of responsibility have to be communicated to the user in a clear and effective way.

#### **8. Define the criteria, back-office procedures and tools and validation process to deal with the incoming requests**

First of all, the policy team must define the criteria to validate the requests, derived from the local rules of participation and to be used by the onboarding team.

Differences between the EOSC criteria and local criteria should be taken into account as these will have an impact on the interoperability with the EOSC catalogue.

To deal with incoming requests from resource providers, preparatory work should be performed so that procedures are defined and the tools to be employed are identified and put in place.

The catalogue operators must define a workflow describing all the steps of the procedure to deal with incoming requests, as well as the tools needed for this, which should then be performed by the onboarding team.

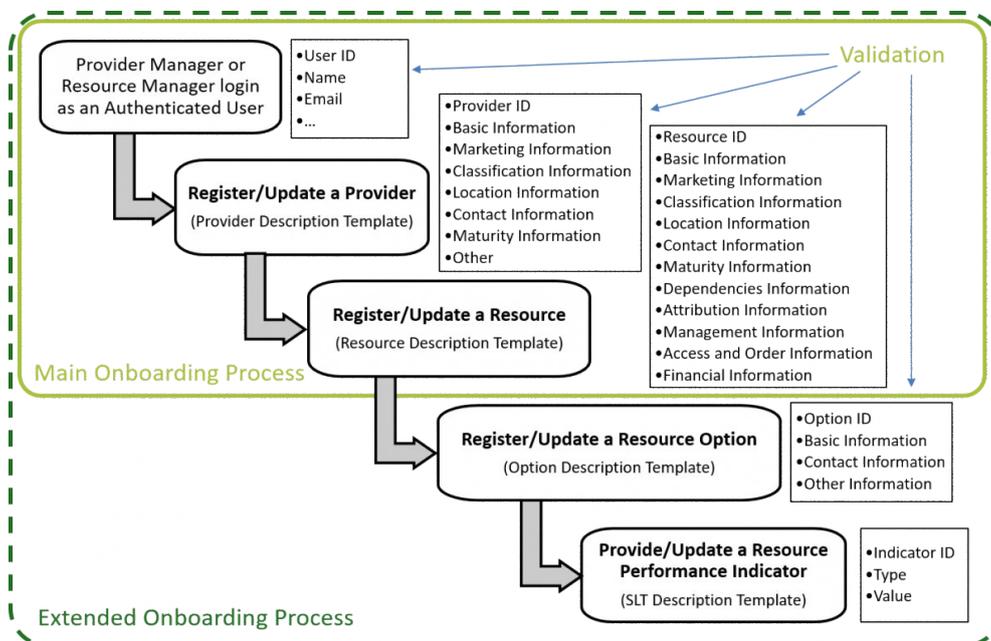
This workflow should cover the analysis of the incoming requests, their validation, their classification into different service request lines (for example according to expertise fields) and when and how to contact the requestor, also specifying whether the single steps will be performed automatically or manually.

This workflow should be sound and iterative, so that the onboarding team and the service providers can interact with each other until the validation is successful.

As a reference, the EOSC onboarding procedures are published in the EOSC Provider Portal Basic Guide. These are currently structured in 3 different phases divided into 10 steps:

1. Provider registers into the EOSC Portal;
2. Provider onboards the provider information;
3. Provider onboards the resources offered by the provider.

At the end of each phase the user/provider is notified of approval or rejection.



The EOSC procedure may be used as a general guideline to help define the local procedure.

In order to set up things in a professional and effective way, the adoption of a service management framework as well as an IT Service Management System (SMS) support tool is suggested.

EU and in particular some EOSC Projects (EOSC-Hub, EOSC-Pilot) often recommended (and use themselves) an incremental and lightweight approach to service management like **FitSM**. This document recommends the usage of FitSM, but does not exclude the usage of different management tools which are deemed fit for the same purpose.

FitSM was originally an output of an EU-funded FP7 project called FedSM, and provides a baseline and achievable ITSM (IT Service Management), targeting from SMEs and start-ups to large enterprises, up to federated environments in which different organisations cooperate to manage services. FitSM is structured into several numbered parts, published under Creative Commons licenses.

To illustrate this step, we refer here to the Incident and Service Request Management (ISRM) of the FitSM structure, which targets incoming user service requests.

In particular, organizations who decide to implement FitSM can follow a 7-step approach:

1. Define the rationale and scope for implementing service management
2. Identify/assign roles and responsibilities for planning/implementation
3. Ensure training and awareness
4. Perform an initial maturity assessment
5. Define a service management plan with overall goals and milestones, including selection of initial tools
6. Start defining policies, activities and procedures for each process
7. Re-assess progress through formal reviews or audits (e.g. annually)

For more information please refer to the FitSM website <https://www.fitsm.eu/>. Also, training sessions on the subject are organized by organizations involved in the EOSC materialization.

**9. Appoint the teams which will be in charge of the onboarding procedure**

The required roles for the onboarding procedure described in the previous step have to be bound by the management/policy team to specific teams, i.e. the set of persons that will follow the procedure and perform the envisioned activities should be identified and appointed. This includes the assignment of people to the different support lines and the definition of internal and public contact points. The teams' internal organizational details such as communication tools and operators' on-duty shifts must also be defined. Moreover, adequate and ad-hoc training for the involved people are essential.

- 10. Publish all the relevant information about the catalogue, inclusion criteria and onboarding procedures to let resources providers know what they are supposed to do to onboard their resources**

This step is meant to engage potential service providers, and aims at providing clarity beforehand of the steps involved in order to have a service registered in the catalogue, as well as of the benefits thereof.

The relevant information should be presented via the catalogue user interface.

Since the recipients of this information will likely be of at least two types, a managerial profile and a technical profile, for the sake of clarity and effectiveness it would be useful to keep the relevant information flows distinct, so that everyone involved could quickly get to the interesting parts, given their profile. One possibility could be to group information according to the following structure:

- **Why:** this part should be completed by catalogue managers and include:
  - the overall goal of the catalogue
  - links to the more technical sections describing Rules of Participation (general principles) and **Inclusion criteria** and the **Onboarding procedure**
  - the benefits of being included in the catalogue (e.g., visibility of research, establishment of links with other research communities, sharing of knowledge about technical solutions)
  - The connection/interoperability of the catalogue with the EOSC one and the differences between them, a sketch of the additional requirements brought by the EOSC catalogue and of the involved procedure
  - This section could also be complemented by the presentation of concrete use-cases
- **Inclusion criteria:** this section should be completed by catalogue managers and the onboarding team, and would include (for each of the supported resource profiles):
  - the Rules of Participation and their rationale
  - the inclusion criteria, derived from the RoPs, which may be both technical and operational (e.g., minimum TRL, etc.): these may reference online documents in the portal itself or external documents
- **Onboarding procedure:** this information should be completed by the catalogue onboarding team, with the aim to provide clear instructions to ensure that candidate resource providers have a comprehensive view of the workflow beforehand. This section should highlight:
  - the required roles/teams on the resource provider side
  - a diagram showing all the steps. All forms which will be used during the onboarding process need to be available in full, so prospective resource providers know what information they will need to provide, and who (at their side) will need to be involved. The wording in the forms needs to be carefully explained, to avoid ambiguities. For each piece of information, it should be clear the level of visibility (whether it would be visible to the onboarding team only, or also to general users of the catalogue)
  - the means by which candidate resource providers will be able to track progress or raise alarms for lack thereof

- **Contacts**

- Contact point for the onboarding team to ask for technical support for the onboarding or more information about the onboarding procedures or criteria
- Contact points for the different support lines

Moreover, in order to make communication more effective, a FAQ section should be maintained, addressing questions most frequently raised by potential service providers.

11. **Test the available tools (specifically the EOSC API) to implement the interoperability of the catalogue with the EOSC one in cooperation with the projects currently developing and operating the EOSC Portal (EOSC-Enhance and EOSC Future)**

From the point of view of the local catalogue there can be two different types of interoperability with the EOSC one in accordance with the direction of the stream of information:

- the local catalogue fetches the resources from the EOSC catalogue
- the local catalogue propagates its resources to the EOSC catalogue

The former can be implemented in an automatic way on the local catalogue side by harvesting methods integrated and/or developed by the support team of the local catalogue according to the catalogue structure and needs. Currently this method has not been implemented yet in the EOSC Portal, but it may be considered in the future.

Concerning the latter method implementation, the EOSC catalogue already provides a specific API (Application Programming Interface) that can be used from the support team of the local catalogue for this purpose. The complete EOSC catalogue API documentation is a living document, generated using frameworks compliant with OpenAPI Specification; the technical documentation for developers is available as well as an API tutorial.

The support team of the catalogue instance should contact the EOSC Portal developers team responsible for the API management to have more detailed information as well as to be informed about the future API improvements or updates. The EOSC Portal team has to be contacted also to request for a personal API token for the secured methods needed to operate with the EOSC APIs.

All the potential organizational or technical issues and all the specific needs that may be encountered during this API testing phase should be discussed with the dedicated teams in EOSC related projects involved in API management. An example of such needs is the push of the providers' profiles from the local catalogue to the EOSC catalogue, as, at the moment, the EOSC API supports only the creation and update of resources.

A special attention when EOSC catalogue APIs are integrated has to be paid in finding and developing suitable technical solutions to guarantee the right management in the cases in which not all local resources have to be propagated to the EOSC Portal (as discussed in step

5) or not all local resources can be propagated using EO SC APIs (i.e. the providers' profiles mentioned above).