

D3.4 Programmatic access and resource provisioning of services

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Abstract:

This deliverable reports on the development of a programmatic access and resource provisioning interface for connecting services to a EOSC Portal Catalogue (<https://eosc-portal.eu/>).

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1. Introduction

This document is produced as part of ongoing efforts within WP3 of the EOSC-Nordic project. The task specifically aims at creating a set of tools to support adoption of EOSC by service providers in the Nordics and Baltics and to allow accessing services as well as provisioning them in a programmatic way.

This deliverable is written during a transitional period of EOSC, before the EOSC Future is launched and EOSC Association becomes functional. Both are major factors to further evolve the EOSC ecosystem both in governance and technical level. Due to the EOSC Rules of Participation still being developed, this report builds upon best practice and knowledge gained within the EOSC-Nordic project collaboration. The reader should therefore be aware that some of the approaches taken might become obsolete or incorrect, once the future EOSC Rules of Participation are adapted. The team behind this deliverable will allow for continuous adaptations of operational actions in accordance to the guidelines set out by the EOSC Association. The EOSC-Nordic team plans to summarise the end result in the next iteration of the deliverable during the year of 2022.

It should be highlighted that the current state of affairs with respect to EOSC Sustainability is a significant blocker for adoption of the programmatic access method, as it typically incurs process change or investments by the service providers. A lack in clarity on mechanisms of EOSC resource usage compensation demotivates service providers to do so. We see clarity on EOSC Sustainability as critical for the success of both EOSC as well as regional EOSC integrators (alias pre-boarding platforms) for programmatic access to EOSC services.

1.1 Objectives and context

While EOSC processes so far have been mostly human-driven, our goal is to design processes and setup solutions that would allow us to automate typical tasks for delivering services across the border and as such create added value for the service providers. Furthermore, automation allows us to collect and present information about the status of adoption in a graphical way to better monitor regional progress towards EOSC. Finally, we see that human experts, knowledgeable about specifics of regional service providers and national infrastructures, are essential for providing a link between EOSC and as such address the building up of a regional service desk to complement a programmatic approach.

This deliverable presents the initial approach as well as progress towards implementing a system for programmatic access and resource provisioning of services. We have experienced a number of obstacles on the path towards the digitalisation, mostly of organisational characteristics. These obstacles, as well as lessons learnt, are presented in this deliverable. We are aiming at creating a solution that is synergetic with planned EOSC-Core - the set of enabling services required to operate the EOSC - and EOSC-Exchange - the set of federation services registered to the EOSC by RIs and clusters to serve the needs of research communities.

Our objectives in this deliverable are:

- To present the high level approach taken by EOSC-Nordic, creating a regional gateway platform for EOSC with initial focus on Service providers.
- To present the initial results and sketch out the plans for the further evolution.

1.2 Definitions

To stay closer to EOSC, we use the terminology adopted in Strategic Research and Innovation Agenda

(SRIA) of the EOSC. For the convenience of the reader, the main terminology is copied below.

e-Infrastructure An (inter)national or institutional infrastructure that enables research through technical hardware and digital services (such as storing, computing or connecting) for sharing and exploiting research data.

EOSC Association International Non-Profit Association (AISBL) founded in Brussels on 29 July 2020 to represent those (eligible) stakeholders wishing to formalise their role in EOSC.

EOSC-Core The basic architecture, standards and services that form the technical backbone of EOSC and are necessary to operate a Web of FAIR Data and Services.

EOSC-Exchange The value-added services that will build upon the EOSC-Core and offer its users additional functionality to perform Open Science and share and exploit FAIR (and open) data.

Research Infrastructure (RI) An (inter)national or institutional infrastructure that enables research communities to perform research.

1.3 How to read this deliverable

This document is structured as follows:

- Section 2 outlines a high level approach taken for designing the programmatic layer;
- Section 3 provides overview of the functional components comprising the programmatic layer;
- Section 4 describes processes and policies needed to support the programmatic layer;
- Section 5 summarises lessons learnt and during the first phase of the development and recommendations to EOSC for setting up a programmatic service access layer;
- Section 6 describes plans for the next period;
- and finally section 7 concludes the deliverable.

2. Top level approach

From a high level approach we consider that for services to be published and accessible in EOSC, they should first be aligned on the national level (Figure 1). Such an approach was chosen to have a more stable ecosystem that can leverage existing national processes. EOSC-Nordic WP3 effort is about supporting the transition of such aligned services to EOSC services and can be visually presented by the diagram in Figure 1.

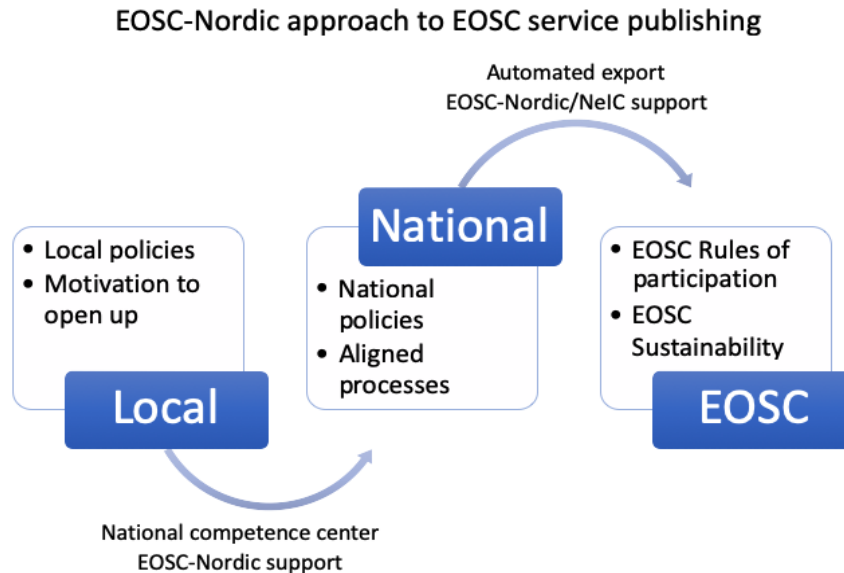


Figure 1. Top level approach to publishing of EOSC Services in EOSC-Nordic.

Initial step of opening up local services, e.g. offered at the university, starts by deciding to open up the service at least on the national level, i.e. to offer services to other entities within the same country. Once the service is at least potentially shareable inside the country, EOSC Nordic support can provide assistance in connecting to EOSC. In particular, we consider that automation and programmatic access should kick in as a step when services are already aligned with national rules - and ideally also EOSC Interoperability Framework. Automation step is intended to serve both as a pre-boarding platform for services, making it possible to collect and validate metadata according to the regional capabilities, as well as to provide common methods for ordering the services and reporting on their consumption. We recognise that some of the functionality might be duplicating options provided by planned EOSC-Core, however we believe that regional closeness and integration of other additional components as described below, will provide a significant value for the service providers that have limited effort to follow up on EOSC evolution, yet that would be willing to share services through EOSC.

On a technical side, integration with EOSC-Core and EOSC-Exchange cannot be fully done as neither of the solutions are in place - both are expected to be delivered by the INFRAEOSC-03-2020 project. We can, however, prepare for the integration by using the planned functional components of the EOSC architecture, in particular, of EOSC Supply portal (Figure 2), as well as by engaging with relevant on-going projects - EOSC Enhance, EOSC-hub - and assessing available technology. To visualise the idea, our plan is shown on the diagram below (Figure 2):

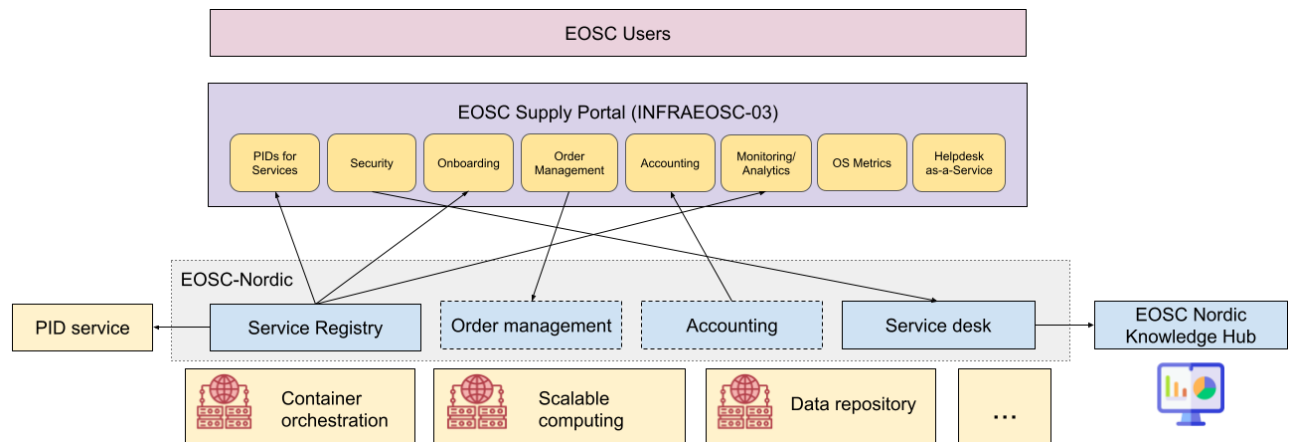


Figure 2. Mapping of EOSC-Nordic components to planned EOSC Supply Portal ones.

We rely on the availability of machine-friendly interfaces of EOSC Supply Portal for service registration and order management and are building a reference platform that integrates with EOSC in the northbound direction and actual services in the southbound. To fulfill additional EOSC requirements for Rules of Participation, we provide an integrated Service Desk - both for helping out with EOSC topics and serving as Helpdesk-as-a-Service - and PID allocation service using external tools. Such an integrated and pre-validated platform should simplify both getting listed in EOSC Portal and standardise methods for requesting service instances from the specific services.

In technical terms, when designing the technical solution, we follow the following principles: if the domain of the responsibility for a functional component is foreseen to be dynamic in terms of requirements, we would like to have more control over the component, if it is a common functionality, we prefer to use existing solutions or services. In some cases, currently known requirements do not allow to select a solution so we left it for future work, once EOSC policies become available.

Finally, we consider also the costs involved in sustaining the platform beyond the end of the project. In the total cost of ownership model we consider both costs for the technical components (hosting, licenses, support) as well as human component of helpdesk. Cost analysis is still on-going, preliminary version is provided in the Conclusion chapter with final to be provided in the next deliverable (D3.8: Programmatic access and resource provisioning of Nordic services via EOSC Marketplace) covering the final result of the programmatic access platform.

2.1 Primary use cases

To scope the development of the solution, we define primary use cases that we aim to support. They are:

- Understanding adoption of EOSC by regional service providers;
- Simplified reporting of EOSC service consumption;
- Automation of service on-boarding and lifecycle management;
- Simplification of EOSC service consumption.

The primary use cases are intended to be supported with a priority.

3. Functional components

To build a platform for programmatic access and support and to support the primary use cases, we rely on the IT tools. While there is no single solution that would fit all needs, we have selected several components that deliver required functionality and that can be integrated into a common platform.

Our criterias for selection included previous experience of project partners with tools, ability to customize solutions for the integration and cost of upkeep. All chosen components were also supposed to support GDPR requirements for operating platforms in a sustainable way.

3.1 Summary of components

Table 1 below summarises the main functional components that we have chosen for implementing the regional EOSC on-boarding and access platform. “Expected customizations” provides a subjective estimation as to what each of the chosen pieces of technology would require to be properly fit into the common platform.

Component	Description	Expected customizations	Chosen technology
Service registry	Collection and management of data about service providers and services	Adaption to EOSC Rules of Participations and rules for integration of regional service registries	Waldur
Regional service catalogue	Public facing list of regional services	Adaption of EOSC Service Profiles to visual style	NeIC.no website / Jekyll / Github
Order management	Processing of requests for services	Integration with EOSC Marketplace	Waldur
Accounting	Collection of accounting data from services	Integration with EOSC Accounting	Waldur
Service desk	Management of support issues	Configuration of designed workflows and SLAs	Atlassian Service Desk and Confluence
PID service	Allocation of persistent identifiers to services	Integration with Service Registry for transparent PID registration and metadata management	Datacite

Monitoring	Monitoring of regional EOSC adoption	Integration with Service Registry, Order management and Accounting	Elasticsearch / Kibana
AAI	Authentication and Authorization framework	Adoption of a common AAI solution	Undecided

Table 1. Functional components of regional EOSC on-boarding and access platform

In the following sections (section 3.2- section 3.8) more detailed descriptions of the listed functional components in Table 1 will follow.

3.2 Service registry

Service registry is responsible for maintaining a list of services that can be potentially offered as EOSC services to the eligible users. The list includes services that are not yet EOSC services, e.g. because of a too low TRL level, missing policies, service provider mandate or something else, that prohibits to be listed at EOSC as of now. Apart from managing the lifecycle of services and service providers, it is intended to also provide integration with EOSC Service Catalogue, at least for publishing the services.

Within EOSC-Nordic WP3, we have adopted a solution partially developed in the NeIC’s Delligr project and available at <https://share.neic.no> as a starting point and self-service for service providers willing to add their services. The metadata model was tuned to match the EOSC-Hub Service Description Template. That template was used for assessing submissions to EOSC Service Catalogue at a time and allowed to validate as a proof of concept integration approach by generating a Google Sheet document with data pre-filled based on the service metadata from share.neic.no. The generated document was used to shortcut submission to the EOSC Catalogue and get the service in with very small additional overhead. Such an approach with most of the steps being automated would allow to decouple initial discovery, validation and upkeep of services from the specific procedures of EOSC. As the proof-of-concept has shown, such a separation is valuable in a setup when some of the targets are clear (e.g. discovery of potential service providers) and some can only be predicted (final Rules of participation and technical steps for validating a service provider).

The proof-of-concept integration via the generation of Google Sheets was discarded after the EOSC on-boarding process decided to move forward with a solution developed within the EOSC Enhance project. During the writing of the deliverable, it is not yet clear if the same solution will be used for registering pre-validated services - and additional developments from EOSC Enhance would be needed - or if a different process would be chosen by INFRAEOSC-03-2020 and EOSC Association. We are following the progress and will proceed with implementation of integration of service registry with EOSC once the process is clear.

Service registry is designed to be used as a self-service, to get a better feeling about the process we provide several screenshots below:

Updating offering Fairdata IDA
Organization workspace / Public offerings / Updating offering Fairdata IDA

1. Overview 2. Description 3. Management 4. Accounting 5. Review

Name * Fairdata IDA

Description
B I U S {} x² X₂ Normal T ▼ [List icons]
 Research Data Storage Service

Full description
B I U S {} x² X₂ Normal T ▼ [List icons]

Terms of Service
B I U S {} x² X₂ Normal T ▼ [List icons]

Figure 3. Entry form for the new EOSC Nordic Service

MINEDU ORGANIZATION WORKSPACE Support Documentation Log out

Fairdata IDA
Organization workspace / My services / Public offerings / Fairdata IDA

Name Fairdata IDA Shared ✓
 Type Request-based item Billing enabled ✓
 Category Data Storage Created 2020-05-26 11:30
 State Draft

Features Support **Service classification** Plan capacity Resources

Target users	Researchers
Language	en, fi
Place	FI
Phase	✓ Production
Technology Readiness Level	✓ TRL8

Figure 4. Examples of the filled-in service metadata conforming to EOSC-Hub's Service Description Template

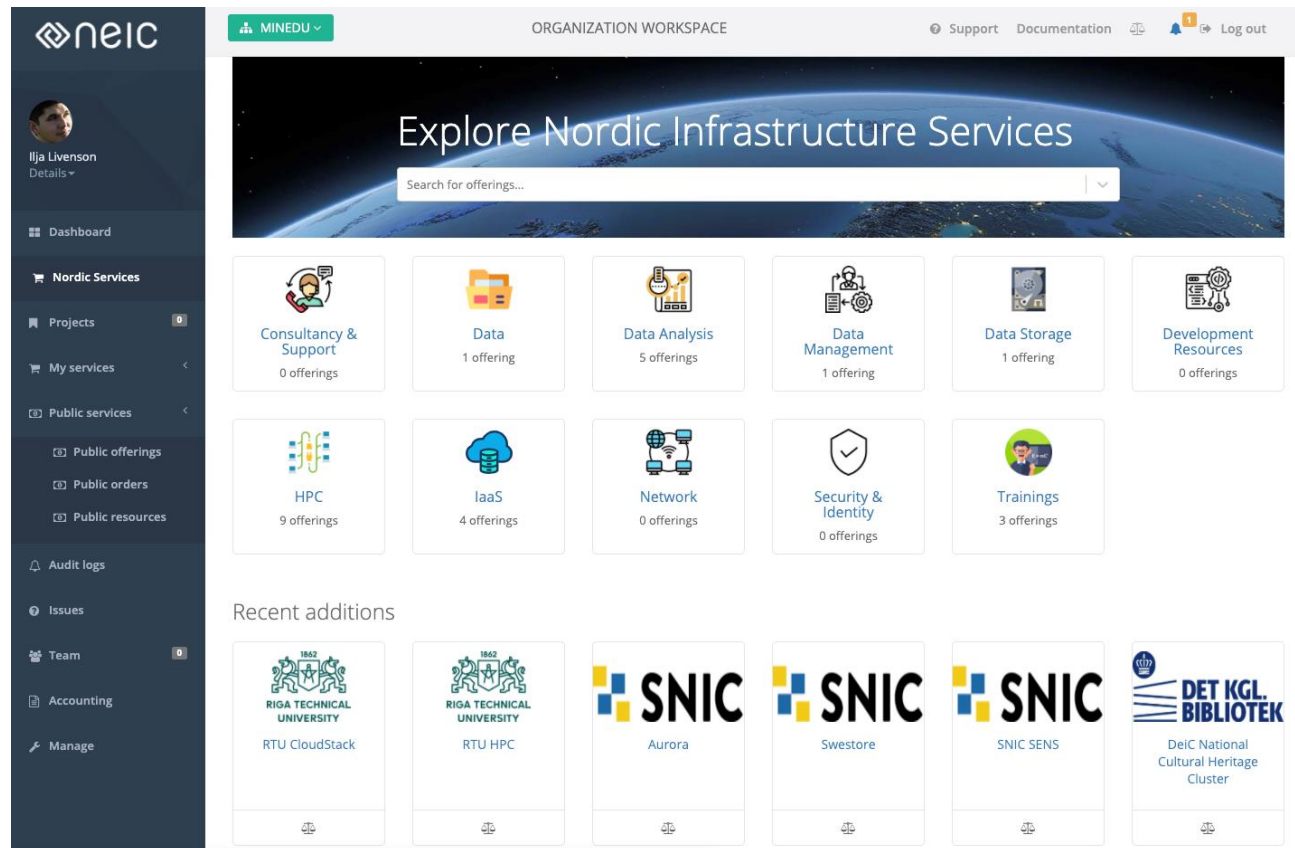


Figure 5. A summary view of all active services in the regional catalogue.

3.3 Regional service catalogue

EOSC Service Catalogue is intended to contain a high number of services, however, for the local visibility and marketing, having a separate list of services that are ready to become or already are EOSC services, a separate publicly visible catalogue is useful to have. In particular, such a local list helps to catalyse EOSC uptake in the Nordic and Baltic region by linking EOSC with an already established ecosystem of regional research activities under NeIC umbrella. Following the design of the EOSC Nordic KnowledgeHub, we have reused the existing NeIC website and created an automated export from the Service registry of service metadata.

The regional service catalogue can be seen here: <https://neic.no/services/>. Two screenshots below provide a snapshot of the state of the catalogue at the moment of writing of this deliverable.

NORDIC E-INFRASTRUCTURE SERVICES

A Nordic e-Infrastructure Service is a service fulfilling the following criteria:

1. Complies with the [EOSC Rules of Participation](#);
2. Can be accessed cross-border (in the Nordics at least);
3. Service provider, e.g. National e-infrastructure, agrees to have it listed;
4. Service delivery is either automated or could be automated.

The following list contains the Nordic e-Infrastructure Services separated into different categories. You can also search for a specific service using the search field below.

Nordic e-Infrastructure Services is a registered collection with a Datacite PID [10.23673/kpyy-1k13](#).

Search for service by name..

DATA


NIRD Archive →
Provided by SIGMA2 / doi: [10.23673/f0k7-4084](#) (stats)
The Research Data Archive is a repository of valuable research data. The Research Data Archive provides users opportunities to archive, publish and share their data openly.

DATA ANALYSIS

Chipster Analysis Software →
Provided by CSC / doi: [10.23673/gbf4-e075](#) (stats)
Chipster offers a broad range of easy-to-use analysis tools for bioscience and medical science.

Figure 6. List view of the services at NeIC web site.

neic MENU



NIRD EASYDMP

 GET ACCESS
SERVICE

STATUS: Active
PROVIDED BY: SIGMA2
PERSISTENT IDENTIFIER: doi: [10.23673/hcc7-da63](#) (stats / citing)
E-mail to support
User guide

ACCESS POLICY

Not available

PRIVACY POLICY

Not available

Figure 7. Detail view of the service generated based on the data from the service registry.

3.4 Order management and Accounting

A critical part of EOSC is actual cross-border delivery of services to new users. Components that are expected to do that are implemented in Waldur as order management and Accounting modules. Unfortunately, at the moment of writing there is still no “EOSC Marketplace API” or Accounting API that can be used for integration of regional platforms for fully automated service provisioning. In EOSC Nordic WP3 we believe that implementing such a functionality is critical for the success of EOSC and expect EOSC Future project to provide it.

Till then, we can only demonstrate the capabilities we have created as hypothesis for how this could be from the service provider point of view:

The screenshot shows the 'neic' organization workspace interface. The main heading is 'Updating offering Carpentry workshop'. A progress bar at the top indicates five steps: 1. Overview, 2. Description, 3. Management (highlighted), 4. Accounting, and 5. Review. The 'Type' is set to 'Request-based item'. A modal window titled 'User input field #1' is open, showing configuration for a numeric field: 'Internal name' is 'number_of_participants', 'Display name' is 'Number of participants', 'Description' is empty, 'Type' is 'Integer', 'Minimal value' is '0', and 'Maximal value' is '100'. There is an unchecked 'Required' checkbox. Below the modal is an 'Add user input field' button. At the bottom, there are checkboxes for 'Auto approve in service provider projects' (unchecked) and 'Auto approve in service provider projects' (checked), and a text area for 'Confirmation notification template'.

Figure 8. Configuration form for the service provider of options required for the provisioning of the service.

The screenshot shows the NEIC web application interface. On the left is a dark sidebar with the NEIC logo and user profile (Ilja Livenson). The main content area is titled "Organization workspace / Updating offering Carpentry workshop" and has a progress bar with five steps: 1. Overview, 2. Description, 3. Management, 4. Accounting (highlighted), and 5. Review. Below the progress bar, the "Plan components" section contains a form for "Component #1" with fields for internal name, display name, measured unit, accounting type (set to "Usage-based"), article code, and product code. There are also checkboxes for "Allow to enable/disable component only" and "Enable limit", with the latter being checked. Below this form is a "+ Add component" button. The "Accounting plans" section contains a form for "Plan #1" with a "Name" field set to "NelC sponsored".

Figure 9. Configuration of the accounting model for a specific service.

neic

University of Tartu

ORGANIZATION WORKSPACE

Support Documentation Log out

CodeRefinery workshop

Organization workspace / Nordic Services / Trainings / CodeRefinery workshop

3-day advanced workshops

Offering configuration

Order summary

Project *

The project will be changed for all items in cart.

Name *

This name will be visible in accounting data.

Plan *

Component name	Quantity	Unit	Price per month	Price per year
Number of participants	<input type="text" value="0"/>	N/A	BU 0.00	BU 0.00
Total			BU 0.00	BU 0.00

Description

Number of participants

CodeRefinery

Offering CodeRefinery workshop

Service provider CodeRefinery

Invoiced to University of Tartu

Price per month BU 0.00

Description Terms of service Features Support

Figure 10. User-facing form for requesting a service according to the configuration of a service provider.

3.5 Service desk

EOSC-Nordic Service desk is meant for supporting customers when they would like to use or are using a regional catalogue or if they have some general EOSC related questions. The service desk is based on Atlassian software and together with Confluence wiki platform, EOSC-Nordic support portal is a user-friendly and solution-oriented environment.

There are several ways how to ask for help from support:

- use widget, which is on the EOSC-Nordic website
- send an e-mail to support@eosc-nordic.eu
- search questions and answers from [EOSC-Nordic regional on-boarding platform knowledge database](#)
- submit a support request from the EOSC-Nordic on-boarding platform at <https://eosc-nordic.eu/knowledge-hub/services/>

Service desk uses three different support levels. These levels are based on the complexity of the issue/question.

Levels are:

- First Line - deals with general/frequently asked questions and forwards issues to upper levels

- National Line - contains one person from each Nordic and Baltic country. This level mostly deals with national related issues
- Expert Line - this level will cover the most complicated and wider EOSC related questions. This level contains some sublevels with specific domains:
 - EOSC - issues related to EOSC specific processes, e.g. Rules of Participation and Sustainability, answers from EOSC expert
 - FAIR - FAIR related issues, answers from FAIR expert

3.5.1 The workflow of the Service Desk

Figure 11 describes the basic workflow of the service desk. Tickets are created via web requests (several places for that) or by sending an e-mail. Tickets are saved in the database and forwarded to the First line. This level will decide whether tickets can be solved with minimal effort or this should be forwarded to the National line. This level representative will decide as well whether tickets can be solved quickly or these need some deeper evaluation or even escalation to the EOSC line which will deal with the most complicated issues. In all cases, if there is additional information requested from the customer and there is no reply for 3 days, the ticket will be closed.

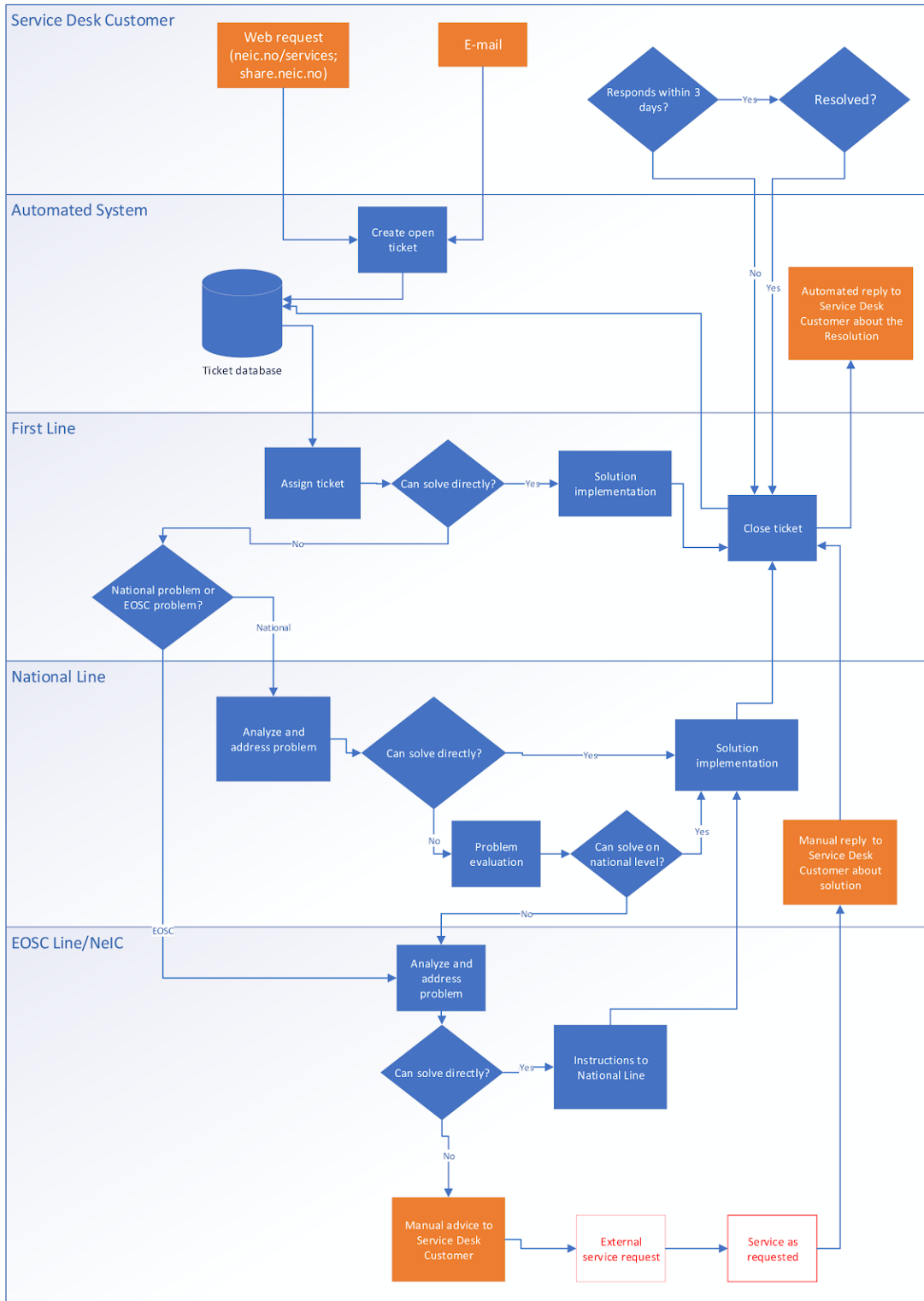


Figure 11. EOSC-Nordic Service desk workflow

3.5.2 Integration with national service desks

Atlassian Jira platform helps teams plan, assign, track, report, and manage work. It contains agile software development and customer support and provides an efficient way to manage support tickets. Administrators can create workflows and this allows them to prepare several automation rules. This will save a lot of ticket handling time. Jira is quite flexible and therefore we have the ability to connect it with the national service desks across the Nordic region. Depending on the software, which is used from the national side, the process may be easier or slightly more complicated, but still achievable. So far, EOSC-Nordic service desk is connected to the Estonian national HPC service desk and if there is a forward issue from the First line to the Estonian national line, then this ticket will appear in the Estonian ticket list. After getting the solution from the Estonian service desk, the customer will get a reply through EOSC-nordic service desk.

The same thing is planned with the Finnish CSC's service desk. It is more challenging since they are using different software and in addition to that, they are using several service desks in parallel. Additional integrations will depend on further evolution and adoption of the EOSC-Nordic service desk as a shared entity for the Nordics.

3.5.3 Regional on-boarding platform knowledge database

EOSC-Nordic service desk regional on-boarding platform knowledge database is meant for users to browse and look for solutions by themselves. It contains answers to more frequently asked questions (FAQs). These questions and answers are divided into four main categories following the stakeholder centric approach defined in section 2.2.1 of EOSC Nordic D6.2 "KnowledgeHub planning":

- FAQ for Services providers and e-infrastructures - covers users from
 - National e-Infrastructures providers & generic service providers
 - Industry / SME
- FAQ for Data repositories - covers users from "Data repositories"
- FAQ for Funders and policymakers - covers users from
 - Research councils & research funding agencies
 - Governmental agencies and ministries
- FAQ for Research communities and institutions - covers users from
 - Research Performing Organisations & research communities and researchers
 - Universities & Libraries
 - Industry / SME



Search this space

Frequently asked questions by

- [Services providers and e-infrastructures](#)
- [Data repositories](#)
- [Funders and policymakers](#)
- [Research communities and institutions](#)

Need more information?

- Visit eosc-nordic.eu to see the latest updates on EOSC.
- Send email to support@eosc-nordic.eu with your question.

Figure 12. Image of the regional on-boarding platform knowledge database front page.

This regional on-boarding platform knowledge database contains not only regional questions, but EOSC in general (e.g. how to join EOSC and what it is all about). It covers additional related fields as well, like FAIR.

One purpose of the regional on-boarding platform knowledge database is to lower the service desk workload. Otherwise, all frequently asked questions will end up in the service desk queue and then the first line support will have to write the same answer all over again several times. Now users can browse typical questions and answers by themselves and this will reduce the support's workload.

The service desk has been well received. Several real inquiries are already processed. As EOSC is stabilizing its processes and works on the explanation of the added value, we foresee a higher need for a service desk in the upcoming period.

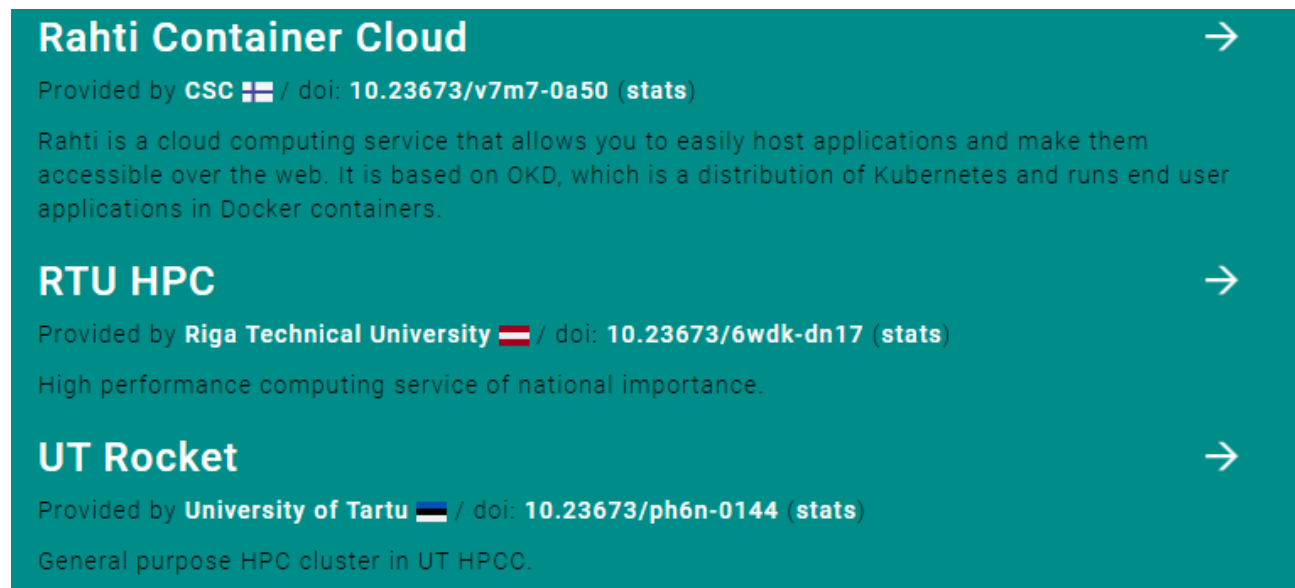
3.6 PID registration

Persistent identifiers (PIDs) are quite often used as unique identifiers for research publications, articles and other documents and files. But at the same time, they can be used for services as well. The motivation for applying a PID to service is quite simple. Its main goal is to link service registrations across different platforms, in particular between EOSC-Nordic onboarding platform and EOSC Service Catalogue. However, there are additional benefits too. Typically, EOSC services are intended to assist in research and are funded by public organizations. For publicly funded services it is always good to know, which of these services are efficient (used a lot and lead to fruitful outcomes) and which are less efficient. One way of measuring efficiency is to find out how many times this particular service is used for publications or other research

DRAFT NOT YET APPROVED BY THE EUROPEAN COMMISSION

work. So, if we assign PID to service and kindly ask to refer to that PID when using this service, then we will end up with the number in a possibly fully automated way.

In EOSC-Nordic service registry, we tested Datacite DOIs as PIDs for services and can recommend that for the future of EOSC. Datacite is widely used and has initial support for service-specific metadata, as well as good API for accessing data. When adding a service to catalogue, we automatically generate and assign Datacite PID to a service. For example, these DOIs are visible on the NeIC's [website](#) next to the service name. By that, we can quickly see the statistics about the service. Statistics currently show how many citations particular service has.



The screenshot shows a list of services on the NeIC website. Each service entry includes the service name, the provider with a flag, the Datacite DOI, and a link to statistics. The services listed are:

- Rahti Container Cloud** (Finland flag) / doi: 10.23673/v7m7-0a50 (stats)
- RTU HPC** (Latvia flag) / doi: 10.23673/6wdk-dn17 (stats)
- UT Rocket** (Estonia flag) / doi: 10.23673/ph6n-0144 (stats)

Figure 13. Services with Datacite PIDs on NeIC's website

3.7 Monitoring

The monitoring aspect of EOSC-Nordic is concentrating on adoption and impact monitoring, not technical monitoring of services. Research Infrastructures (RI) in Europe and Nordics, in particular, are offering a wide selection of services. They serve a wide variety of target users (national, regional, EU-wide or world-wide) by supporting the research process. However, at the moment there is no easy way to attribute research achievement with RI service in a generic way. We aim at piloting a generic dashboard by investigating some ideas regarding the analysis of the RI market and their influence on research.

For example, we aim at being able to visualize data about:

- Which country or service provider offers the highest/lowest number of services;
- What are the most mature services in terms of governance;
- What languages are supported by the research services;
- How much are RIs or concrete RI services attributed in published articles;

The aim is to create several dashboards addressing different stakeholders. Below there is a description of the dashboards in a more detailed way as well as several proof-of-concept visualisations that are based on partially synthetic data pulled from the EOSC-Nordic on-boarding platform.

3.7.1 Overview dashboard

The first dashboard would be aimed at providing a common high-level overview of what services are available in the region, where they are physically or virtually located and how popular they are during certain periods of time.

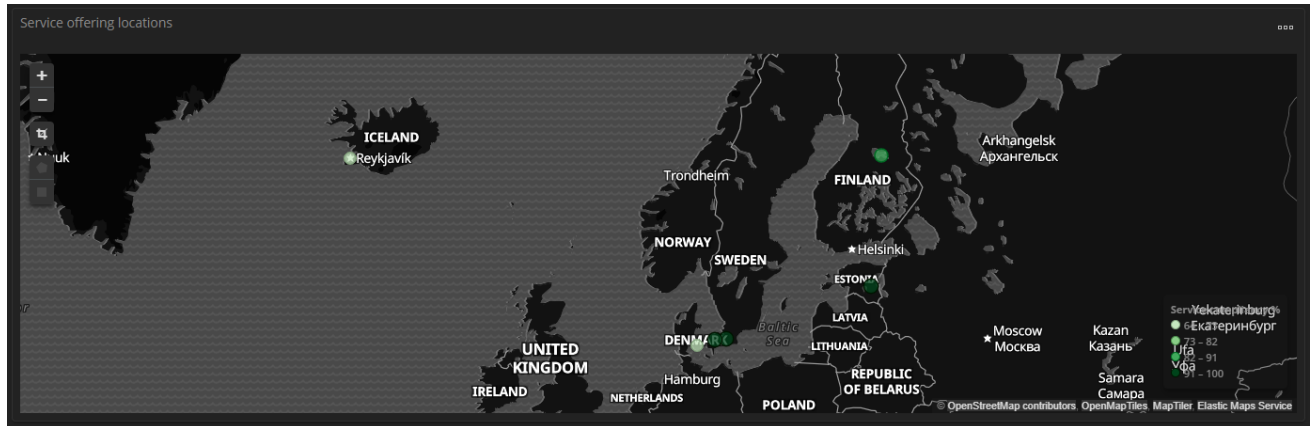


Figure 14. Map with service locations

3.7.2 Service maturity dashboard

Secondly, there is a more technical dashboard with detailed information about services descriptions, based on the EOSC Service Description Templates. Visualizations support filters to allow drilling down on a particular service or a group of them (e.g. originating from a particular country). Visualisations comprising the dashboard are currently planned to be:

- Count of times a service has been consumed by end-users (total, grouped by month)
- Count of services grouped by a specific category;
- Distribution of services by categories from different perspectives (maturity, geolocation, amount of services providers)
- Compliance level to EOSC requirements, by country and categories
- Distribution of Services by their state in the service lifecycle (now many are active, paused, archived etc.)
- Detailed information about service categories (ie under HPC we can show available/used storage space, available/used memory, available/used nodes etc)

Examples below show information about services taken from the EOSC Nordic service registry.

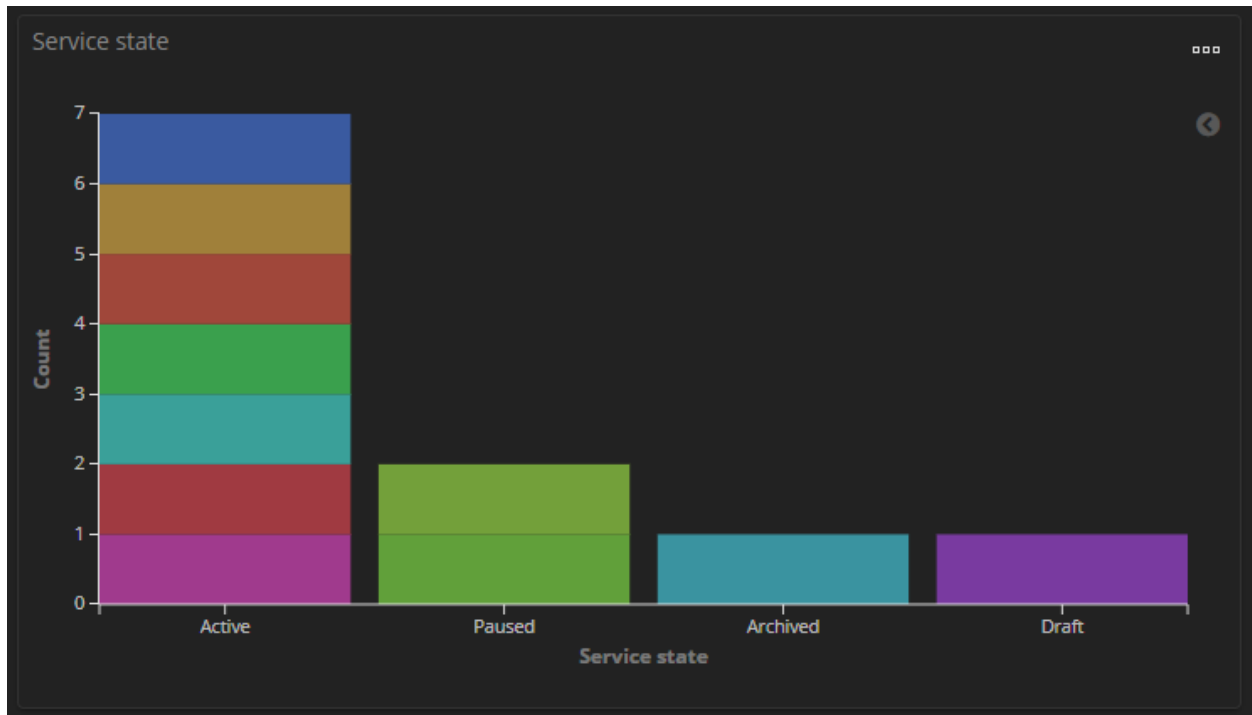


Figure 15. Services grouped by status

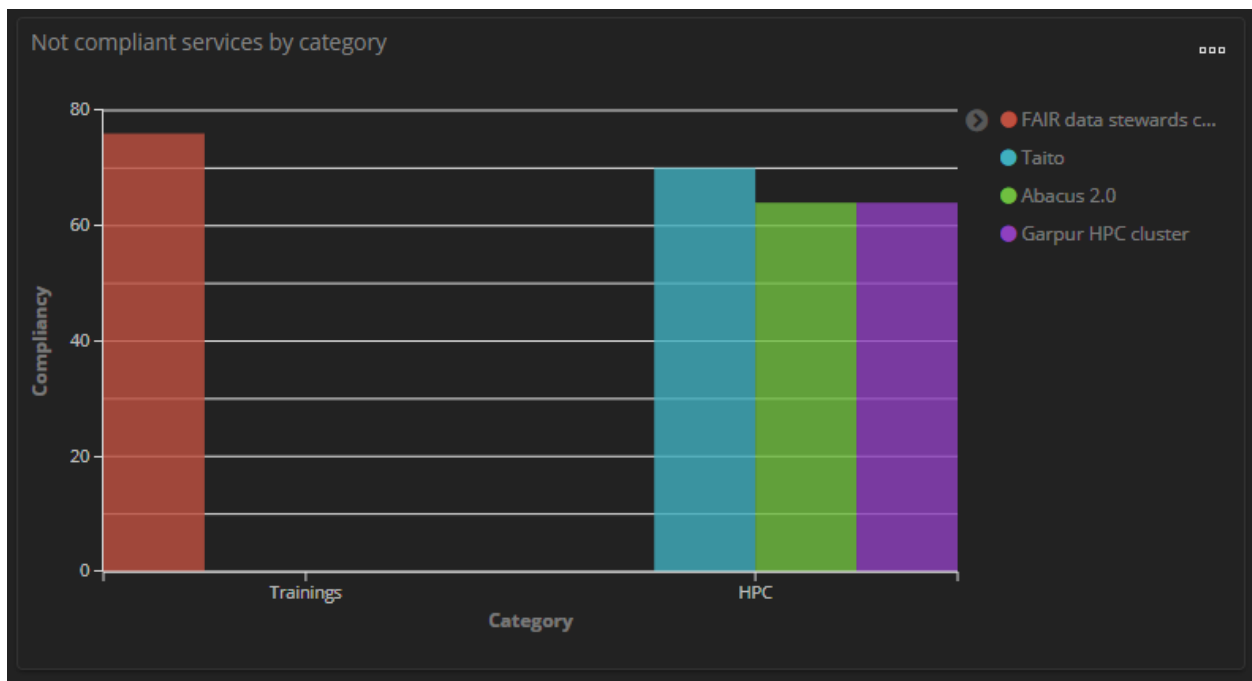


Figure 16. Services grouped by category and measured according to the level of compliance to EOSC mandatory description requirements

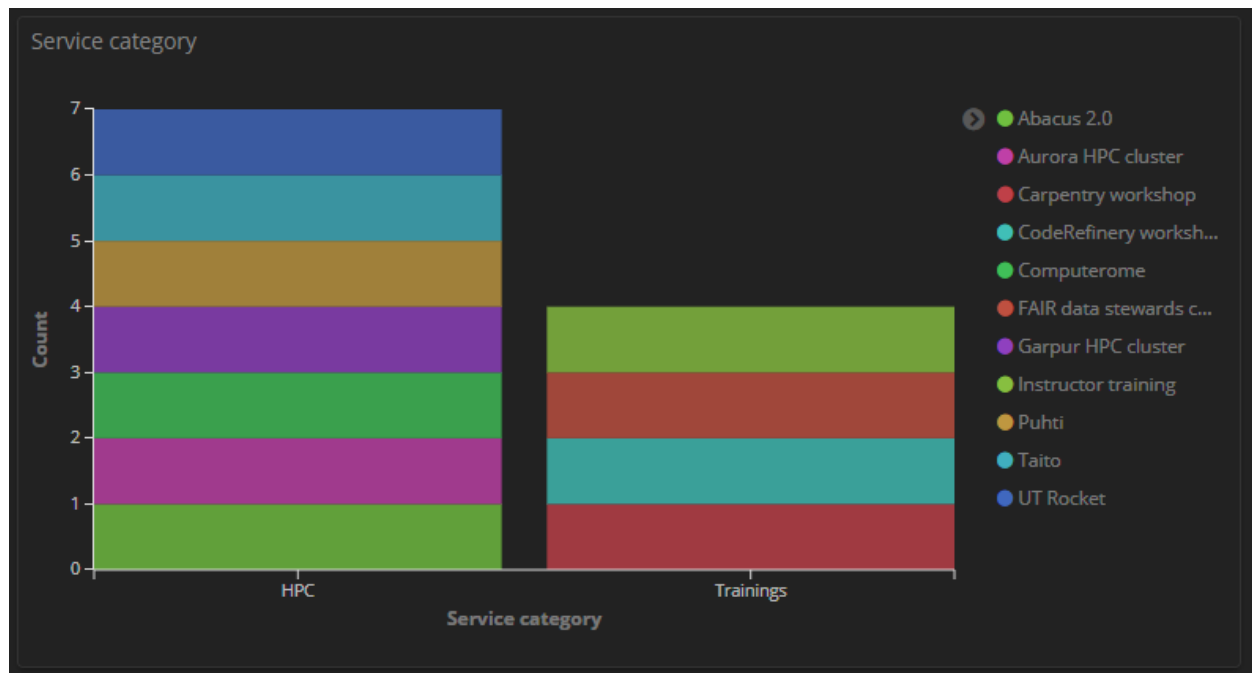


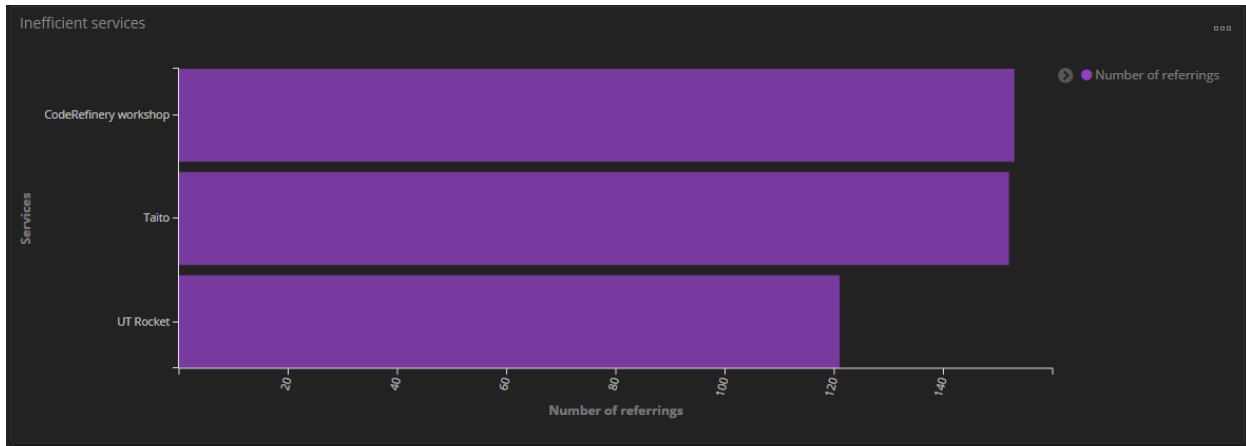
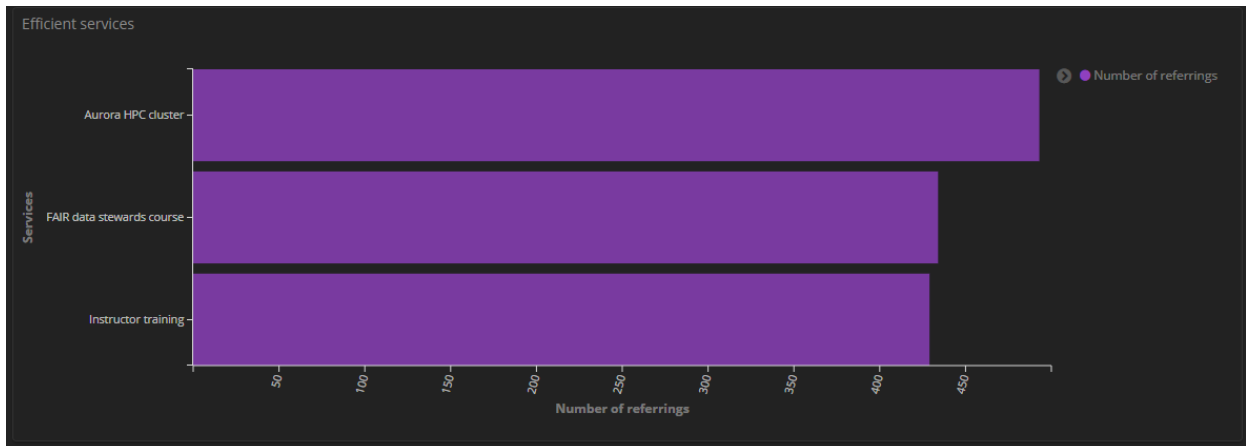
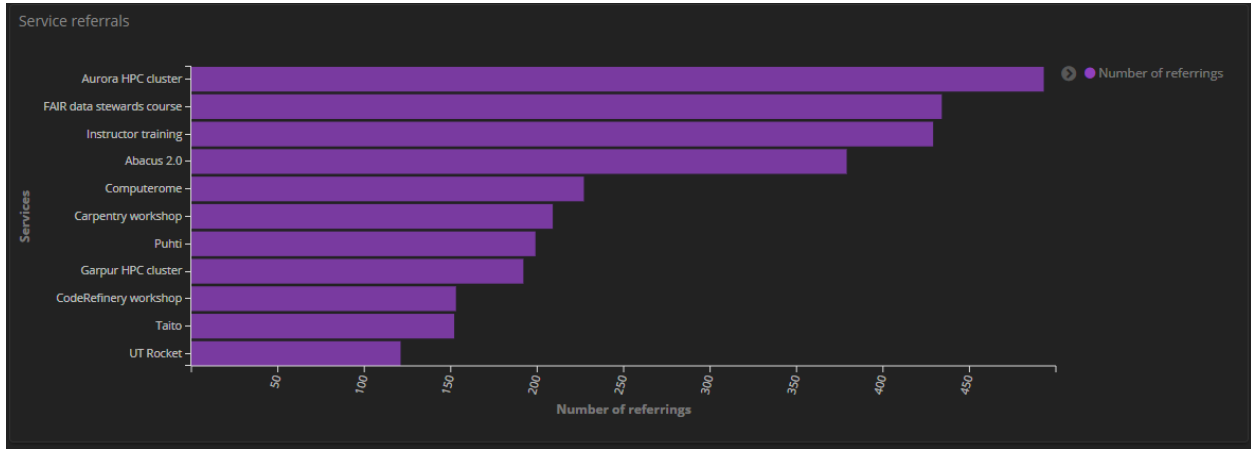
Figure 17. Services grouped by category

3.7.3 Impact dashboard

Finally, we aim at creating an impact dashboard. The impact is one of the most important aspects as it provides a clear way for rewarding and optimising RI service catalogue. We recognize that there is no “silver bullet” for impact calculation in a very general case, so addressing it by providing a number of visualizations that make sense with a more narrow scope, for example:

- Service referrals (how many times each service is used for research work and how many times it is referred);
- Analysis specific to concrete category: e.g. for training, what is the number of participants of each training service or category as a whole;
- Reach of a service (how many people/researchers are eligible to use a particular service)
- TOP of most efficient services;
- Sum of project budgets, where are particular service was used;
- Number of separate AAI identities that are used by a particular service;

For impact dashboard to be actually working, we will need more open and fine-grained data being available either through EOSC Core services or collected on a local/regional level. Some examples of the possible visualisation for impact dashboard are below, all based on mocked data.



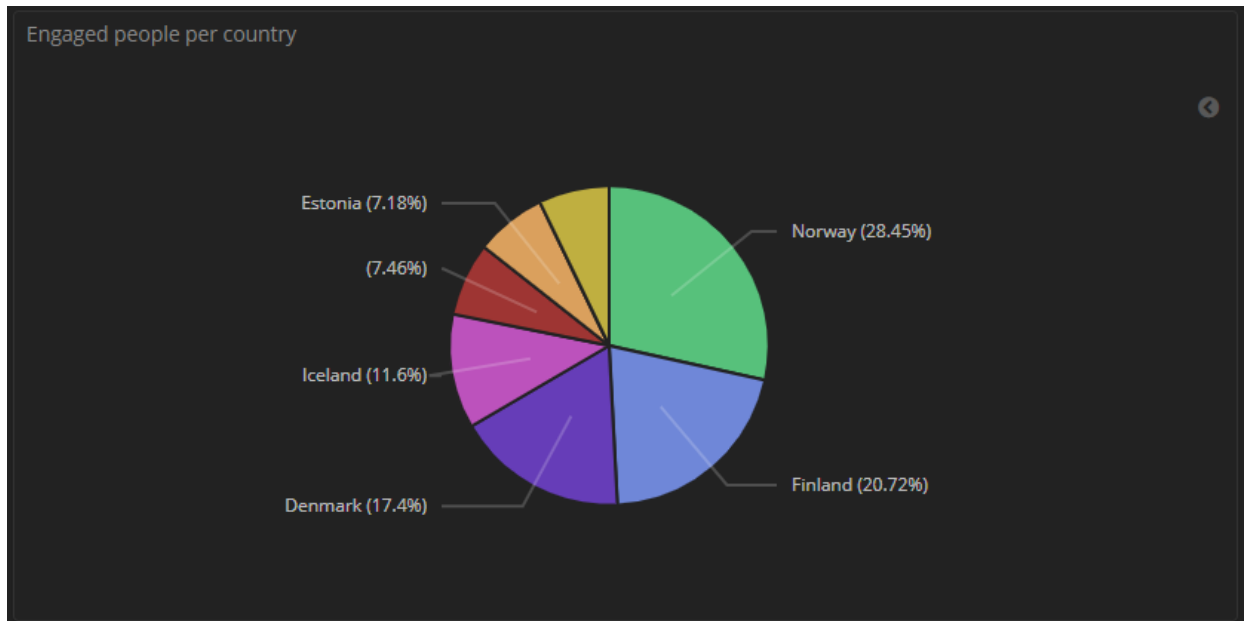


Figure 18. Example views of the impact dashboard

3.8 AAI

We recognise the complexity around adoption of common AAI solutions and advice to EOSC Association to provide guidelines and the main push for common and / or domain specific AAI systems. In our first iteration we rely on EduGain for providing access to the pre-boarding platform, however we do not go beyond that.

4. Processes and policies

Programmatic access and automation, in general, can only assist in speeding up the implementation of processes and validation of services according to EOSC Rules of Participation policies. A major constraint limiting the implementation of the platform has so far been lack of clarity of those in the context of the EOSC. In particular, the following documents are expected to affect development the most:

- **EOSC Rules of Participation** intend to provide validation criteria for service. Not having rules on the level that allows operational decisions (e.g. “should services without affiliation to a legal person be allowed in”) leads to the situation when we cannot automate validation and auditing of services and increase the “technical debt” that needs to be carried by humans.
- **EOSC Sustainability** principles are expected to provide mechanisms for cost recovery for the service providers. Lack of such mechanisms reduces the motivation for service providers to adhere to Rules of Participation, including potentially providing access to accounting data as well as supporting programmatic access to services.

In EOSC Nordic we have decided to rather contribute more to the development of common procedures of EOSC, instead of inventing our own, to avoid wasting resources. The drawback of the approach is that the delay caused by adoption of EOSC policies affected development of the procedures in EOSC Nordic.

We estimate that 2021 is a critical year for getting out the tangible policies of EOSC and plan to address them accordingly in EOSC Nordic.

From the point of view of the EOSC Nordic regional platform, procedures are documented in a EOSC Nordic KnowledgeHub's knowledge database of Service Desk and are currently visible to involved support personnel.

5. Recommendations for programmatic access and resource provisioning of EOSC services

Over the course of the first phase of automation, we have been trying out several approaches that have also led to some of less trivial results. We summarise them below.

1. The main drawback for adoption of EOSC by Service Providers is a lack of clear incentives. Policies and amount of documentation that is currently needed to become part of EOSC is relatively high and unless there is a funded effort to do that, service providers do not understand why extra effort should be spent.
2. In many countries there are already local catalogues of services that could be exposed as EOSC ones. However, the quality of data in such registries is often very low (outdated and not complete), which would mean a significant effort on enriching the service descriptions to fit into the EOSC model. Without a clear business model behind EOSC, such activity would not make sense. However, such catalogues have a huge potential of simplifying service discovery of less known local services. The approaches are hence quite different for existing mature services provided by larger organizations and more niche services provided by smaller research communities and individual scientists. Prioritization of those from an EOSC perspective would allow to focus more on creating a working EOSC environment.
3. A significant issue is validation of representation rights for a service by a specific user. In particular, users can claim to provide service on behalf of a university, however the legal department of the university might not have a clue about it. Solution to such an issue is typically in more strict models of validation of representation rights, employed, for example in CORDIS or ETIS. Figuring out if information about representation rights could be synchronized with such national or European platforms could allow us to digitize this complicated subject.
4. Mandate and funding of the RI services, especially on the national level, does not allow to position them as services available to cross-border customers, at least in some countries (access for collaboration is possible in almost all cases). Clarifications of that inside the service provider organization is an effort that is hard to undertake without clarity on EOSC Sustainability.

6 Planned further work

Our work in composing and executing the analysis has led to several reflections on possible improvements and further work. These reflections lead to the following recommendations:

6.1 Strategy for aligning with EOSC development

We expect EOSC policies to take more clear form during Q2-Q4 of 2021 within EOSC Future project as well as EOSC Association. EOSC Nordic members participate in EOSC on-boarding Task Forces as well as policy discussions to both provide regional views and to understand the development trend. Our target is to establish a clear method for integrating regional on-boarding platforms into core EOSC systems and make it easy and desirable for the Nordic and Baltic service providers to be part of EOSC.

6.2 Technical plans

We have implemented a basic flow for on-boarding of a service in a regional platform, which allows services also to define methods of service provisioning, both automated and human-assisted (through a service desk). These methods however have not been adopted by larger service providers as such automation can be intrusive and implementing it must align with EOSC policies. We expect that clarification of the latter will allow us to further proceed with automatic provisioning resources in Nordic and Baltic region.

Having automated provisioning and accounting in place will allow to move several aspects of monitoring from mocked data to actual one.

We are following up on development of service PIDs and plan to see more integrations of those. We plan to proceed with the impact dashboard of monitoring, however it remains to be seen the level of adoption we can achieve within EOSC Nordic.

6.4 Common EOSC-compliant access layer

We take into consideration guidelines from the D3.3 Service interoperability framework as well as further development of the EOSC Interoperability Framework and aim at providing an easy way for Research Infrastructure service providers to expose their services to EOSC users. Our current strategy is to offer some of the functional components of the programmatic access platform as a service to service providers. Exact components will be decided upon with the evolution of EOSC Core components in EOSC Future.

7. Conclusions

During the first phase of the automation of access to services and provisioning of service instances, we have established the main components of the Nordic platform and performed initial tests to understand the feasibility of such a solution. Furthermore, we have done initial analysis of the costs associated with such a platform to provide input for the sustainability analysis. The analysis has been discussed at the EOSC Nordic Executive Board with overall consensus that it should be reviewed later in 2021 when more information about EOSC Sustainability as well as EOSC Association progress becomes available.

Cost estimations below for sustaining the EOSC Nordic platform assume cost for upkeep of the technical platform as well as 2 experts on EOSC and FAIR with 20% load.

Component	Service	Cost per month in EUR (approximation)		
Hosting	Regional portal	150	Total tools	1600
Upkeep	Regional portal	300	Total people	3200
Hosting	Monitoring dashboard	50		
Upkeep	Monitoring dashboard	200		
Hosting	Service desk	100		
L1	Service desk	600		
Country link?	Service desk	200		
Specialist (FAIR)	Service desk	1600		
Specialist (EOSC)	Service desk	1600		
Total		4800		

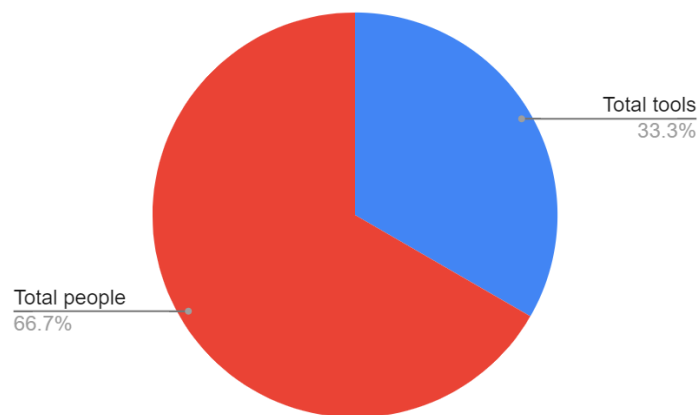


Figure 19: An overview of the distribution of resources; tools vs. human man power.

We observe a national pre-boarding trend from some of the regional 5b projects (fx. NI4OS), however, it is not possible to foresee if this is the future to come, at this point in time.

We foresee a future need of reverse integration from a centralised EOSC service catalogue and a proper uptake by research communities. The service support provided from a regional level will ensure faster adaptation towards the actual needs in the surrounding communities, due to already well established collaborations between different stakeholders (i.e. NeIC, EOSC-Nordic, NCM, etc)

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Based on the experience so far, the regional platform for on-boarding and resource access to/from EOSC, seems to be a more reliable approach to adoption of EOSC in the countries. To fully validate it, however, EOSC policies should be put to work. In particular, EOSC Sustainability and Rules of Participation are of extreme importance for the implementation of such a solution.