D2.9: Sustaining the coordination of EOSC national initiatives at Nordic level

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Status	Final
Version	1.0
Date	

Document identifier:	
Deliverable lead	CSC
Related work package	WP2
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Due date	30 October 2022
Actual submission date	30 November 2022
Reviewed by	Damien Lecarpentier, CSC; Gudmund Host, Nordforsk
Approved by	
Dissemination level	Public
Website	https://www.eosc-nordic.eu/
Call	H2020-INFRAEOSC-2018-3
Project Number	857652
Start date of Project	01/09/2019
Duration	39 months
License	Creative Commons CC-BY 4.0
Keywords	Key exploitable results, exploitation, impact

Executive summary

With a budget of 6 million euros, the EOSC-Nordic project aimed to establish the Nordic and Baltic countries as frontrunners in the take-up of the EOSC concept, principles, and approach. In order to achieve the above-mentioned objectives, the project focused on the following areas:

- Development and adoption of EOSC-compliant services in collaboration with well-established research communities and integration of Nordic services and resources into EOSC;
- Promotion of FAIR principles and practices in the Nordic region and creation of related competences;
- Promotion of EOSC in the region at community and policy level and mobilisation of Nordic and Baltic policy makers to pursue alignment around EOSC in the region.

The activities performed by the partners in the 39 months covered by the project allowed to generate over twenty key exploitable results that have contributed or will contribute to the EOSC advancement and uptake in the region and at European level.

Thanks to the competences of the partners and the possibility to leverage the long lasting Nordic collaboration, (the project released KERs in the following five categories:

- New and/or enhanced services and tools;
- Increased FAIR uptake and skills in the region;
- Proof of concepts;
- Increased EOSC alignment and coordination in the region;
- Direct contribution to the EOSC co-programmed partnership.

These results generated the following impact in the region and on EOSC as a whole:

- Establishment of a regional hub for consuming Nordic and Baltic services and onboarding them in the EOSC marketplace
- Development of tools used by Nordic research communities
- Increased FAIR skills and uptake in the region
- Increased Open Science and EOSC awareness in the region
- Consolidation of the collaboration among the Nordic and Baltic countries
- Contribution to the evolution and testing of the EOSC Marketplace and to the entire EOSC Co-programmed partnership
- Contribution to the development of FAIR tools
- Enhancement of services and tools that can be used by research communities beyond the Nordics.

The partners have identified exploitation paths for all the results generated by the project and an EOSC-Nordic NeIC affiliate project will be launched in January 2023 to sustain the fruitful collaboration and coordination around EOSC initiated by the project for the next year. This new project will complement the EOSC coordination activities already existing at regional level among the Mandated Organisations and EOSC national structures of the different countries and the other EOSC-related activities performed in specific areas by NeIC and NORDUnet.

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D2.9 Sustaining the coordination of EOSC national initiatives at Nordic level

Introduction

This document summarises the key exploitable results generated by the EOSC-Nordic project. While the document was originally meant to describe outputs that are relevant for policy-makers, we decided, in line with the suggestions made during the last project review, to expand this initial scope and present all the key results, for all types of stakeholders. The document also highlights the specific added value brought by the Nordic partners in the creation of such assets and analyse potential exploitation paths to sustain these outputs in the future. Finally, the document explains how the coordination around EOSC in the region initiated by EOSC-Nordic will be sustained in the future.

The document is organised in six main chapters:
- Chapter 2 provides an overview of the different outputs generated by the project. A more detailed description of the outputs is provided in Annex A where, for each of the output, we explain why the output has been created, who are the target beneficiaries, what is the added value that the consortium has brought in the generation of the output *("the Nordic added value")*, what is the *"return-on-investment"* in the Nordic region and for EOSC as a whole and what is the cost of *"maintaining"* the outputs in the future to understand how to maximise the impact of the project after its contractual end;
- Chapter 3 describes why the EOSC-Nordic consortium was the best positioned in working on those outputs, highlighting *"the Nordic added value"* brought by the project into EOSC;
- Chapter 4 analyses the impact and the benefits that the project brought to the region and to EOSC as a whole;
- Chapter 5 describes the different exploitation paths identified by the project partners for the individual project outputs;
- Chapter 6 closes the document by explaining how the fruitful coordination of EOSC activities in the region initiated by the project will be sustained in the future.

EOSC-Nordic key exploitable results

According to the Horizon 2020 lexicon, a **result** is defined as: "Any tangible or intangible output of the action, such as data, knowledge and information whatever their form or nature, whether or not they can be protected, which are generated in the action as well as any attached rights, including intellectual property rights".

A **Key Exploitable Result (KER)** is an identified main interesting result (as defined above) which has been selected and prioritised due to its high potential to be "exploited" – meaning to make use and derive benefits- downstream the value chain of a product, process or solution, or act as an important input to policy, further research or education.

In order to identify the EOSC-Nordic KERs, each EOSC-Nordic Work package leader has compiled a list of the relevant results of the work package; the results then have been prioritised according to three main criteria:

the degree of innovation of the result, the level of exploitability, and the generated or potential impact for the Nordic region and for EOSC as a whole. The prioritised list has then been discussed with the Project Management Board (PMB) and presented in several iterations to the external Executive Board for discussion and endorsement. A dedicated final workshop bringing together the key partners of the project has been organised in August 2022 to finalise the list of Key Exploitable Results and agree on the future plans.

The Paragraph below provides an overview of the EOSC-Nordic KERs. The complete and detailed description of the KERs is presented in Annex A.

EOSC Nordic KER Overview

With a budget of 6 million euros, the EOSC-Nordic project aimed to establish the Nordic and Baltic countries as frontrunners in the take-up of the EOSC concept, principles, and approach. In order to achieve the above-mentioned objectives, the project focused on the following areas:

- Development and adoption of EOSC-compliant services in collaboration with well-established research communities (WP3 - WP5) and integration of Nordic services and resources into EOSC (WP3);
- Promotion of FAIR principles and practices in the Nordic region and creation of related competences (WP4 - WP6);
- Promotion of EOSC in the region at community and policy level and mobilisation of Nordic and Baltic policy makers to pursue alignment around EOSC in the region (WP2 – WP4 - WP6).

The activities performed by the partners in the 39 months covered by the project allowed to generate over 20 key exploitable results that have contributed or will contribute to the EOSC advancement and uptake in the region and at European level.

The EOSC-Nordic KERs can be clustered in five categories as described in the picture below:
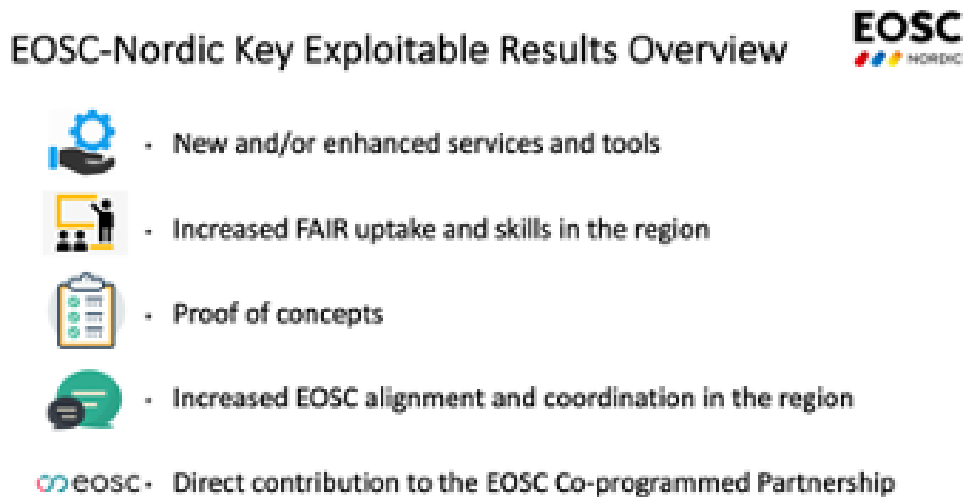

Figure 1: EOSC-Nordic KERs overview

The following table summarises the KERs generated by the project in each category and the target beneficiaries.

KER category	KER	Target beneficiaries

New and/or enhanced services and tools	Regional pre-onboarding platform enriched with HPC resources allocation functionality	Service/resource providers in the Nordic and Baltic region
	EOSC-Nordic Service compliance checklist & maturity model	Service providers in the Nordic and Baltic countries; Funding agencies
	Nordic Service interoperability framework	New service developers interested in EOSC. Maintainers of existing services that are aiming to extend the reach through EOSC
	Blueprint for mass assessment of FAIRness	Policy makers, funders, or consortiums that wish to assess and follow FAIR uptake of their members, service providers or other stakeholders
	FAIR and Trustworthy Digital Repositories (TDR) certification support model	Research data repositories in the Nordics and Baltics
	STEP-by-STEP FAIRification webinars	Managers and owners of research data repositories
	Virtual Research Environments for Nordic Language Processing Laboratory (NLPL)	NLPL community and other language processing communities
	JSON Web Token for Sensitive Data	Nordic researchers
	Galaxy Portal for FAIR Analysis	The Biodiversity and Climate communities in the Nordics
	B2Find metadata indexing for datasets	archaeology and climate science community in the Nordics; whole EOSC community
	Enhanced EasyDMP tool	Norwegian researchers; Users of easyDMP tool
	EOSC-Nordic Knowledge Hub & website	Research communities and institutions, service providers and e-infrastructures, and funders and policy makers in the Nordic region
	+700 data stewards trained in the region	Researchers, data repository managers and data stewards

Increased FAIR uptake and skills in the region	98 repositories assessed against FAIR	Managers and owners of research data repositories
	Increased number of trustworthy digital repositories	Managers and owners of research data repositories
	FAIR incentives: recommendations and FAIR archetypes	Research performing organisations, service and infrastructure providers, research funding organisations, ministries
Proof of concepts	Prototype of secure data exchange across organisations	Developers of services relying on on-line access to sensitive data, mostly from the public sector's registries
	Proof of concept of a Nordic Cloud infrastructure	Nordic research communities
Increased EOSC alignment and coordination in the region	Policy workshops & EOSC tripartite event	Ministries in charge for EOSC (Research and Education, Infrastructures, Sports and Youth, etc); Research funders; Decision makers at HEIs
Direct contributions to the EOSC Co-programmed Partnership	Open Science policy mapping	All stakeholders interested in understanding more about Open Science and EOSC policies in the Nordic and Baltic region; EOSC Steering Board members
	Analysis of cross-border collaboration models in the Nordics	Anybody interested in understanding more about cross-border collaboration models in place in the Nordic countries; EOSC Association Task Force on Financial Sustainability

Table 1: Complete list of EOSC-Nordic KERs

New and/or enhanced services and tools

12 KERs are part of this category:

1. **Regional pre-onboarding platform enriched with HPC resources allocation functionality**: Establishment of a pre-onboarding platform to facilitate the integration and onboarding of services provided by Nordic and Baltic service providers into the EOSC Marketplace[1]. Thanks to the collaboration and the strong synergies established with the Puhuri project[2], the EOSC-Nordic pre-onboarding platform has also been enriched with functionalities to

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onboard HPC resources and other infrastructure services in the EOSC Marketplace in an automated way[3];

2. **EOSC-Nordic Service compliance checklist & maturity model**: A service compliance checklist to quickly validate if a service is fit for the current EOSC Marketplace (meaning if it complies with the current onboarding rules in the EOSC Marketplace). A service maturity model to easily assess whether a service is good enough for inclusion in the EOSC Marketplace & Catalogue[4]. The secondary purpose of the maturity model is to motivate service providers to enhance the maturity of their services by providing them a model against which they can benchmark;

3. **Nordic Service interoperability framework:** Analysis and development of interoperability guidelines for service providers based on specific requirements coming from service providers based in the Nordic and Baltic countries;

4. **Blueprint for mass assessment of FAIRness:** A semi-automated assessment of FAIR uptake of multiple research data repositories. A blueprint that will allow others to follow the EOSC-Nordic approach describing the repository selection criteria, the collection of dataset identifiers, the execution of the assessments, and the analysis of the FAIR score results;

5. **FAIR and Trustworthy Digital Repositories (TDR) certification support model**: EOSC-Nordic created a model for providing one-to-one support to individual repositories in their journey to FAIRification and TDR certification using CoreTrustSeal[5]. The model was partly based on CESSDA[6] trust model but included additional elements such as support for FAIRifying metadata. Two paths of support were offered: i) assistance/mentoring on aspects of CoreTrustSeal certification (feedback on self-assessments) and ii) feedback and guidance based on FAIR assessment results (this is an effective way to raise awareness on the importance of FAIRification and often as a result to boost the FAIR score);

6. **STEP-by-STEP FAIRification webinars**: During the three years of the EOSC-Nordic project, we have tracked the FAIR maturity of the Nordic and Baltic research data repositories and supported the repositories in FAIRification. As part of this work, we organized a series of webinars that provide step-by-step guidance to research data repositories on how to make metadata more FAIR;

7. **Virtual Research Environments for Nordic Language Processing Laboratory (NLPL)**: Language processing is a computationally intensive task and usually needs to make use of HPC platforms in order to complete in a reasonable time. This makes cloud resources that usually run containers undesirable. The NLPL[7] community was interested in moving to a portable Virtual Research Environment (VRE) that could be deployed on any HPC platform. EOSC-Nordic tried a few candidates and settled on easyBuild[8] that provides a framework for building and deploying reproducible virtual research environments for language processing.

8. **JSON Web Token for Sensitive Data**: A means of determining the identity of a researcher is necessary when accessing any service. It becomes even more critical for sensitive data resources where audit trails are essential to ensure the data has been accessed in an approved manner and by an approved researcher. The project has proposed an approach for cross-border cooperation via OIDC/JWT token exchange. The aim of this proposal is to make possible the usage of resources provided by one project partner by users of the other project partners. The two main targets are: To recognize the credentials of a user in the

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[3] The platform manages the automatic allocation of those resources by resource allocators

[4] https://marketplace.eosc-portal.eu/

[5] https://www.coretrustseal.org/

[6] https://www.cessda.eu/

[7] http://wiki.nlpl.eu/index.php/Home

[8] https://easybuild.io/

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infrastructure of one of the project partners by other partners, and to create services aimed at sharing resources that accept credentials from users with different affiliation. This can be achieved in practice by implementing OIDC from the identity providers of each of the Nordic sensitive data providers, and implementing resource access via an exchange of JWT tokens.

9. **Galaxy Portal for FAIR Analysis**: The Galaxy portal was introduced into the Biodiversity and Climate communities in the Nordics and Baltics as part of EOSC-Nordic project in order to provide a platform for data analysis. EOSC-Nordic developed plugins to enable interoperation across borders with Cloud and S3-like storage;

10. **B2Find metadata indexing for datasets**: The B2Find metadata repository is a service available in the EOSC Marketplace that was chosen as the service to provide a common source for archaeological metadata harvested from Danish and Norwegian archaeological repositories. Modifications of the service were carried out as part of EOSC-Nordic in order to easily harvest and present the metadata such that it is possible for researchers to access the combined metadata in a uniform manner;

11. **Enhanced EasyDMP tool**: EasyDMP[9] is a service for creating data management plans (DMP)s. The original easyDMP produced narrative DMP documents which were impossible for a machine to consume. The goal in EOSC-Nordic was to make the DMPs more machine actionable such that they could be consumed by services for allocating resources. The Research Data Alliance (RDA) machine-actionable Data Management Plan Common Standard (maDMPCS) schema or profile was chosen as the schema for the DMP. EasyDMP was modified to produce and consume RDA maDMP CS plans. This has enabled plans produced by other tools (currently tested with the Data Stewardship Wizard) to be consumed by easyDMP and then used to allocate resources;

12. **EOSC-Nordic Knowledge Hub & website**: The EOSC-Nordic Knowledge Hub and website offer to all the stakeholders an easy way to access and navigate the results produced by the project. They have been designed with a user-centric approach making sure that the users are offered the information and services specifically matching their interests and needs.

Increased FAIR uptake and skills in the region

4 KERs are part of this category:

1. **+700 data stewards trained in the region**: NeIC has run, in the context of EOSC-Nordic, a very successful course on FAIR data stewardship in the region (in collaboration with GO-FAIR). In 2019-2020 three courses were held in the Nordics, leading to 161 trained data stewards. This is intended to broaden the competence and common understanding of FAIR among research support staff. A series of train-the-trainer events is also essential to scale the training efforts appreciatively. In EOSC-Nordic WP4, ten events were organised, covering raising awareness of FAIR, implementation of FAIR, and FAIR incentives, and having ~600 participants. The majority of events have had a practical and somewhat technical profile that have intended to support researchers and data managers in implementing FAIR in their repository. In addition, the project team has been upskilled in all things FAIR;

2. **98 repositories assessed against FAIR**: Semi-automated assessment of FAIR uptake among a sample of 98 repositories and 1000+ datasets (represented by their metadata records) has been performed by WP4;

3. **Increased number of trustworthy digital repositories**: In WP4 community support meetings were offered to data repositories that meet certain criteria. Two paths of support were offered; i) assistance/mentoring on aspects of CoreTrustSeal certification (feedback on self-assessments) and ii) feedback and guidance based on FAIR assessment results (this is an

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[9] https://easydmp.eudat.eu/

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effective way to raise awareness on the importance of FAIRification and often as a result to boost the FAIR score).

4. **FAIR incentives: recommendations and FAIR archetypes**: Based on interviews of six stakeholder groups in Nordics and Baltics (researchers, data stewards, management personnel at universities, funders, national data services, legal advisors), seven FAIR incentives were recognised and recommendations to stakeholders compiled. We also introduced two FAIR Archetypes with opposite perceptions of FAIR – The FAIR Newbie and the FAIR Master. With these archetypes, different behaviours can be showcased as examples to ultimately be able to leverage a change in how the FAIR principles are perceived in scientific circles.

Proof of concepts

2 KERs are part of this category:

1. **Prototype of secure data exchange across organisations**: EOSC Nordic WP3 deployed and evaluated adoption for R&D purposes of secure data exchange platforms deployed in Estonia and Finland for cross organisational services in different countries. X-road based services in Finland and Estonia support federation and inclusion of members from other countries. On the national level, these exchange services serve as a backbone for e-government. A feasibility assessment was conducted in collaboration with a research group at the University of Tartu, that develops an X-Road-based software project GenMed to process genomic data. Software deployment resulted in a situation where an analytical engine in one country was able to request the genomic data from the registry in another country in a safe and efficient way. Thus, adopting X-Road for real-time applications working with sensitive data has good potential in R&D;

2. **Proof of concept of a Nordic Cloud infrastructure**: The task investigated and showcased innovative platforms for making scientific tools able to discover and consume cloud computing resources, such as IaaS and Kubernetes solutions running either on premises and/or on public clouds. The solutions investigated were Sigma2's NIRD Toolkit, STACKn and FEDn from Scaleout, cPouta from CSC, SNIC Science Cloud as well as Ucloud from SDU. The goal was to provide a platform for researchers to deploy and run a variety of tools on user-selected data and cloud computing resources, giving researchers the possibility to focus mainly on research and less on tools and irrelevant tasks. Although difficult to harmonise code bases, the variety of cloud solutions developed in the Nordics proved to be valuable by addressing different sets of use cases and providing alternatives to research communities.

Increased EOSC alignment and coordination in the region

1 KER is part of this category:

1. **Policy workshops & EOSC tripartite event**: Policy Workshops have been the cornerstone of the policy work in the EOSC-Nordic project. The workshops have been held once a year and have gathered together every time over eighty policymakers and stakeholders from the Baltics and Nordics to discuss common objectives related to Open Science policies and cross-border collaborations. The policy workshops have been a good opportunity for participants to hear the latest information on Open Science updates in other countries and developments in the EOSC. In addition, the workshops were very valuable gathering points to stimulate the dialogue among the different countries and meet new partners. The workshops were also the opportunity to strengthen the relations with the policy makers. The last policy workshop supported by EOSC-Nordic was organised in collaboration with the Nordic and Baltic member states representatives, the European Commission and the EOSC

Association and represented the first EOSC tripartite regional event in the Nordic and Baltic Area.

Direct contributions to the EOSC Co-Programmed Partnership

2 KERs are part of this category:

1. **Open Science Policy mapping**: The deliverable D2.8[10] provides an overview of the Open Science and EOSC related policies in all the Nordic and Baltic countries highlighting what are the elements covered by the different national policies and how EOSC is related to them. The deliverable has been structured to collect and provide information on all the policy-related elements needed by the EOSC Steering Board members to complete the first EOSC monitoring survey launched by the EOSC Steering Board in January 2022.

2. **Analysis of cross-border collaboration models in the Nordics**: The EOSC-Nordic deliverable D2.6[11] gives an overview of the different cross-border collaboration models in place in the Nordic countries for the provisioning of services and resources to support researchers, analysing their funding models and their resource allocation structures from different perspectives: procurers vs users vs providers vs funders. The goal of the document is to provide usable recommendations and input for the future developments of EOSC.

The Nordic added value

The entire framework for Nordic cooperation is rooted in the idea that together the Nordic countries are stronger, that they can achieve more by working together, and that what they achieve will be better for the inhabitants of the Nordic countries and the rest of the world[12].

This was one of the main motivations for the formation of the EOSC-Nordic consortium. This chapter summarises the added value that the EOSC-Nordic partners have been able to bring to EOSC to advance its development and uptake in the region and beyond.

Previous experiences in the development of regional catalogues

The Nordic e-Infrastructure Collaboration (NeIC) is a regional structure established in 2004 to facilitate the development and operation of high-quality e-infrastructure solutions in areas of joint Nordic interest. One of the efforts undertaken by NeIC was the development of a regional catalogue of services[13]. The expertise matured by the partners of the project contributed to the development of the pre-onboarding EOSC regional platform that in the future can support the onboarding of Nordic services into the EOSC Marketplace.

Long-lasting collaborations focusing on sharing services and resources cross-border

Many NeIC funded projects in the past have been addressing the challenges of sharing services cross-border in the Nordic region (e.g. NeIC Dellingr[14] and NeIC Puhuri 1 and 2[15]) with a specific focus on HPC resources (especially with the advent of LUMI[16]). This expertise was fundamental for developing the pre-onboarding

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[10] https://zenodo.org/record/6503709#.Y4Cm74JBwbZ

[11] https://zenodo.org/record/6217744#.Y4CnDYJBwbZ

[12] https://www.nordforsk.org/how-does-research-cooperation-lead-nordic-added-value

[13] https://neic.no/services/

[14] https://dellingr.neic.no/

[15] https://neic.no/puhuri/

[16] https://www.lumi-supercomputer.eu/

regional platform and equipping it with functionalities for automated allocation of HPC resources; in developing the maturity model and service checklist as well as the Nordic interoperability framework and in providing recommendations on cross-border sharing of resources and services with real-life examples to EOSC. Also, the existing collaboration cross-country existing in certain Nordic research communities such as archaeology or biodiversity or environment were the perfect background for exploring sharing of services and resources and also innovative proof of concepts.

Rooted FAIR culture and skills
The EOSC-Nordic FAIR activities could build on the report ´The state of open science in the Nordic countries´[17] released by NeIC in 2018. In addition, the region is active with FAIR-oriented Nordic collaborations and networks (via e.g. NeIC, CESSDA ERIC, ICOS ERIC, etc.) that provided a natural starting point for the FAIR activities.

High level of trust in the region and common values
The Nordic and Baltic setting is an environment with high level of trust and safety which was vital to build services in a collaborative environment, to share feedback, and to promote the adoption of FAIR principles and EOSC tools. This aspect was particularly useful for the work conducted with FAIR and trustworthy digital repositories and for improving alignment and coordination on EOSC in the region. There are also similarities in culture and incentives in repository activities and sharing research data in the Nordic and Baltic region, which have contributed positively to commitment, communications, peer support and general community building.

Impact

This chapter summarises the impact generated by EOSC-Nordic on the region and beyond.

Added value for the Nordic and Baltic countries

Establishment of a regional hub for consuming Nordic and Baltic services and onboarding them in the EOSC marketplace
- The pre-onboarding platform provides a regional hub for consuming Nordic and Baltic services and a tool for Nordic and Baltic providers for publishing services and resources in the EOSC marketplace in an easy way. This effort also created knowledge in the region on how to onboard services in the EOSC Marketplace and raised awareness of the current challenges, first of all the lack of a strong value proposition to motivate providers to onboard services in the Marketplace and the lack of a business model supporting the consumption of Nordic resources at European level.
- Creation of an easy-to-use evaluation model for assessing maturity of the services and their compliances with the current rules of onboarding in the EOSC Marketplace.
- The interoperability guidelines developed in the project helped the consolidation of interoperability principles within the region.

Development of tools used by Nordic research communities
- The Nordic Language Processing Laboratory community now has a reproducible environment within which they can perform their research. It is possible for researchers to share their easyBuild configuration to allow colleagues to reproduce and build upon their work.

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[17] https://zenodo.org/record/2563733#.Y3ycwIJBwbY

- Agreement on the schema for the JSON web token for sensitive data has enabled cross-border access to sensitive data in the Nordics possible.
- The Biodiversity and Climate communities in the Nordics and Baltics have now access to the Galaxy portal for creating reproducible data analysis chains allowing data located in different countries (e.g. data stored in Sweden, Norway and Finland) to be analysed on Cloud platforms in Norway, Sweden and Finland easily;

Increased FAIR skills and uptake in the region
- The project has been able to upskill Nordic and Baltic repositories through the support program and the training material produced can be used in the future by other repositories
- +700 data Stewards trained in the region
- 98 repositories assessed against FAIR, supported repositories increased their FAIR score significantly
- Six repositories from the Nordic and Baltic countries, thanks to the support provided by the project, have submitted or will submit a certification application for the CoreTrustSeal

Increased Open Science and EOSC awareness in the region
- The EOSC-Nordic Knowledge Hub and the website provides a window into the EOSC-Nordic project and its results
- The deliverable D2.8 on Open Science mapping is a reference point for all the stakeholders in the region to understand the status of Open Science in the region. Thanks to the collaboration with the EOSC Association, the information on status of the policies in the different countries is now also available and maintained through the EOSC Mandate Organisations and EOSC national structures on the eosc.eu website[18].
- Deliverable D2.6 is a good source of information for the region to better understand the funding and procurement models behind existing cross-border collaboration models in place in the Nordic countries and the potential challenges that EOSC has in terms of funding and procurement model

Consolidation of the collaboration among the Nordic and Baltic countries
- Strengthen collaboration and improved alignment among Baltic and Nordic countries when it comes to Open Science and EOSC. At the end of the project:
  - all the Nordic and Baltic countries support the ERA policy action number 1
  - all the Nordic and Baltic countries have in place (or will have soon) Mandated Organisations and EOSC national structures and the project has consolidated contacts and collaborations among them in the region.

Added value for EOSC

In addition to the direct benefits brought to the Nordic region, the project has also contributed to advance EOSC at European level. Here is the main impact achieved:

Contribution to the evolution and testing of the EOSC Marketplace
- The pre-onboarding platform provides a reference example on how a regional onboarding process into the EOSC Marketplace could work. The work done by EOSC-Nordic highlighted the current

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[18]   https://eosc.eu/tripartite-collaboration   See   the   individual   country   pages https://eosc.eu/tripartite-collaboration/norway;   https://eosc.eu/tripartite-collaboration/sweden; https://eosc.eu/tripartite-collaboration/finland;   https://eosc.eu/tripartite-collaboration/denmark; https://eosc.eu/tripartite-collaboration/estonia;   https://eosc.eu/tripartite-collaboration/latvia; https://eosc.eu/tripartite-collaboration/lithuania)

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issues of the onboarding process (lack of clarity of the onboarding rules; lack of clear value proposition for service providers to onboard services in the Marketplace; lack of a business model supporting the consumption of the regional resources by other European countries; non-compliance of the EOSC Marketplace with the GDPR rules) but also the advantages of a regional effort in this perspective (capability to reach out to providers in the region in an easier way due to the long lasting collaborations existing in the region; capability to establish more suitable support systems due to the knowledge of the "Nordic culture and way of working"; establishment of a Nordic hub that can allow cross-border sharing of resources and services due to the agreement already in place in the region).

- The EOSC-Nordic maturity model has been adopted by the EOSC Pillar project and it has been presented to EOSC Future and became an input for the service compliance checklist developed by the project.
- The guidelines on the Interoperability framework developed by the project have been shared with EOSC Future as an input for the interoperability framework they are developing.

Contribution to the development of FAIR tools
- The EOSC-Nordic FAIR assessment model was ground-breaking and has received a lot of interest and knowledge has been shared with e.g. FAIR Impact project[19] and the EOSC Association Task Force on FAIR metrics and data quality[20], and initiatives that were developing FAIR assessment tools, especially the FAIRsFAIR project[21] and the F-UJI tool[22]. The project has contributed to the overall development of FAIR assessment tools and FAIR metrics.
- The support model by WP4 for FAIR and Trustworthy Digital Repositories was considered a useful way to implement a targeted change quickly, identify gaps, or produce up-to-date documentation of the repository's processes, policies or practices under expert guidance. It can be used as a basis for future programmes although as FAIR data assessment and repository frameworks develop, support programmes will need to be adjusted and expanded accordingly. It is worth noting that additional work (at EOSC level) is needed to create certification or assessment frameworks for repositories that are not TDRs but e.g. technical service providers for TDRs.

Enhancement of services and tools that can be used by research communities beyond the Nordics
- The NLPL VRE can be used as a model by other language processing communities and in the future, it might become part of the EOSC Exchange.
- The EOSC-Nordic developed plugins for Cloud computing and S3-like storage access are now part of the Galaxy portal and can be used by other communities.
- The enhancements done by the project on B2Find are now available for the entire community.
- The experience implementing the RDA maDMPCS will be valuable for those implementing the RDA maDMPCS in other tools. Also the modifications applied to the easyDMP tool can be deployed in other instances.
- Increased maturity of repositories that participated in the certification support program enables them to demonstrate trustworthiness and to provide better services to researchers.
- The EOSC-Nordic Knowledge Hub concept for competence and knowledge sharing has been presented to other projects and networks. In particular, a dedicated meeting with EOSC Future has been organised to share the experience and lessons learnt acquired in the project and contribute to the development of the EOSC Future Knowledge Hub.

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

[20] https://www.eosc.eu/advisory-groups/fair-metrics-and-data-quality

[21] https://www.fairsfair.eu/

[22] https://www.fairsfair.eu/f-uji-automated-fair-data-assessment-tool

Region upskilled on FAIR, Open Science and EOSC

- The entire EOSC will benefit from the new skills that EOSC-Nordic has created in the region

Contribution to the EOSC Co-programmed partnership

- The regional findings on FAIR incentives could be fruitful in collaboration among European policymakers.
- A reference case for building cross-border data services in Europe has been documented by the project.
- The first EOSC tripartite event in the region was important to bring the Nordic and Baltic countries closer to the European Commission and the EOSC Association in the European panorama. It was also an opportunity to share the Nordic successful use cases with other countries.
- The deliverable D2.8 on Open Science mapping has been shared with the EOSC Steering Board Nordic and Baltic representatives to be used as a basis to complete the first EOSC Steering Board survey on OS & EOSC policy. The results of the survey will be soon published in the EOSC Observatory tool created by EOSC Future[23].
- The deliverable D2.6 documenting the cross-collaboration models in the Nordics has been provided as input for the work of the EOSC Association Task Force on Financial Sustainability.

Exploitation paths for the EOSC-Nordic KERs

In order to maximize the impact of the project, different exploitation paths have been explored for the different KERs. For some of the results no maintenance or future work is required thus they have simply been handed over to other organisations or projects/initiatives. In other cases, extra funding or resources are needed to sustain the result in the future.

The table below summarises the exploitation paths identified for the individual KERs.

KER	Exploitation path
Regional pre-onboarding platform enriched with HPC resources allocation functionality	In order to maintain the pre-onboarding platform after the end of the EOSC Nordic project, the platform has been integrated into the Puhuri gateway (both in terms of AAI and hosting) and ETAIS, the principal EOSC-Nordic partner behind this development, has committed to maintain the platform operational for the next 2 years estimating an overall effort of 0.1 FTEs per month. If the upcoming EOSC procurement call is going to revise completely the concept of the current EOSC Future Marketplace, additional efforts and costs for adjusting the integration will be required.

EOSC-Nordic Service compliance checklist & maturity model	To be used, the models need to be periodically updated. This requires an effort of 0.1 FTEs. The ideal solution would be to have a European service compliance checklist and maturity model centrally maintained and updated by the EOSC operators so that the only cost for the region is distributed to the service providers that will be in charge of assessing their services. The providers in the region have expressed their willingness to absorb that cost if the onboarding in the EOSC Marketplace proves to be valuable for them.
Nordic Service interoperability framework	We estimate an effort of 0.1 FTE required to keep the IF framework up to date with periodic promotion to service providers in the region. These guidelines will be made available for the NeIC members. The actual model developed has been handed over to the EOSC Future project.
Blueprint for mass assessment of FAIRness	The model and the methodology have been described in a blueprint and in project deliverables, and scripts shared in GitHub. No additional effort is needed to keep them available as they are now. It is important to note that the project partners did not see much market for building a service out of the blueprint (it was also out of scope of EOSC-Nordic to offer it). The main motivation was that the F-UJI tool and the interpretations of the FAIR metrics are still in constant change so building and maintaining a service upon them would require constant changes which does not seem to be a sustainable solution at this point in time.
FAIR and Trustworthy Digital Repositories (TDR) certification support model	This effort requires funding of an administrator who can plan and coordinate meetings and a support team that can perform the support activities that are agreed with the community. Estimate 0,5 FTE for administrative coordination and a minimum of 2 FTEs to maintain a similar frequency/level-of-activity as during EOSC-Nordic. At the moment no such funding is available from the partners or from the region. However, some of the partners pioneering this effort in EOSC-Nordic are now involved in two new Horizon Europe projects that are aimed at improving the EOSC awareness and uptake at European level: FAIR Impact and SKILLS4EOSC.
STEP-by-STEP FAIRification webinars	The webinar recordings, presentations and other materials are available via the EOSC-Nordic Knowledge Hub[24] and don't require any additional maintenance. As soon as the EOSC future Knowledge Hub will be available the EOSC-Nordic webinars will be embedded in that channel too.

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[24] https://www.eosc-nordic.eu/kh-usecase/guidance-fairification/

Virtual Research Environments for Nordic Language Processing Laboratory (NLPL)	The VRE now exists as a software package that is maintained by the NLPL community.
JSON Web Token for Sensitive Data	The implementation has been completed and it is available for use in the Nordics.
Galaxy Portal for FAIR Analysis	The EOSC-Nordic developed plugins for Cloud computing and S3-like storage access that are now part of the Galaxy ecosystem.
B2Find metadata indexing for datasets	The enhanced B2Find features developed in EOSC-Nordic are now available for the entire EOSC community.
Enhanced EasyDMP tool	The enhanced easyDMP tool will continue to be supported and maintained in Norway.
EOSC-Nordic Knowledge Hub & website	The EOSC-Nordic Knowledge Hub and the website will run for two years after the project has terminated to allow all resources to remain accessible and usable for this period of time. CSC, the communication partner of the EOSC-Nordic project will be in charge for the maintenance. Once the EOSC Future Knowledge Hub will be available, the relevant content (e.g. the step-by-step FAIRification webinars) will be transferred to make sure it will be maintained after the 2 years standard maintenance.
+700 data stewards trained in the region	The FAIR data stewardship skills built by the project in the region will remain as an asset for the Nordic and Baltic countries to further develop FAIR, Open Science and EOSC in the region. From a training perspective, a broader EOSC training programme is preferred in order to ensure broadest possible impact and cost efficiency.

98 repositories assessed against FAIR	The work conducted by the project with repositories will remain as an asset for the region.
	The continued assessment and possible expansion of the sample of repositories assessed during the project should be carried on in order to continue the incentivisation of FAIR uptake and possible expansion to the EOSC as a whole, as well as to collect information about the level of FAIRness in the Nordic and Baltic region, and to provide feedback to the repositories about their FAIRness.
	This requires funding and an effort to maintain / grow the sample on a Nordic level. There are aspects of the activity that cannot be automated, which either have to be removed or maintained with small efforts (< 0,5 FTE). If a scale-up to the full EOSC is required an additional effort is needed (2-3 FTEs) and to setup of a workflow for scaling up the sample to EU level. Currently the project has not identified a suitable way to continue such activities.
Increased number of trustworthy digital repositories	The work conducted by the project with respect to certification resulted in more mature repositories and will remain as an asset for the region. The repositories are themselves responsible for their certification process and for maintaining their certification and documentation and we hope that the work conducted by EOSC-Nordic will also stimulate other repositories to follow the example.
FAIR incentives: recommendations and FAIR archetypes	The work conducted by the project will remain as an asset for the region.
Prototype of secure data exchange across organisations	No extra funding is required as X-Road-based platforms are funded and developed by Member state funding. The Proof of Concept has been disseminated through EOSC-Nordic and is now available.
Proof of concept of a Nordic Cloud infrastructure	The proof of concept has been completed in the project. The lessons learnt and the results are documented in D5.9.
Policy workshops & EOSC tripartite event	EOSC-Nordic was responsible for the coordination and organisation of these workshops. Thanks to the establishment of Mandated Organisations and EOSC national structures in all the Nordic and Baltic countries and the establishment of the EOSC-Nordic NeiC affiliate project (See next chapter) this joint effort will be continued in the future and the workload needed to organise such regional dialogue will be shared on the different countries.

Open Science policy mapping	The analysis of the Open Science and EOSC policies in the region has been completed in the project and the EOSC tripartite collaboration is in the process of establishing ways to maintain the information updated in the future.
Analysis of cross-border collaboration models in the Nordics	The study has been completed in the project and presented to the EOSC Association Task Force on Financial Sustainability.

Table 2: Exploitation paths for the EOSC-Nordic KERs

Sustaining the coordination of EOSC national initiatives and activities at Nordic level

The end of the EOSC-Nordic project represents the official end of the contractual collaboration among the project partners as no funding is foreseen for regional effort in the upcoming INFRAEOSC 2023-2024 Work programme. This collaboration established by the project has been useful not only to equip the region with new tools and services in a joint action, but also to achieve a common understanding of EOSC among the partners, increase awareness of EOSC in the region and initiate some coordination of the EOSC activities in the region.

Many of the EOSC-Nordic partners have also, over the last three years, taken on official roles in the EOSC ecosystem: some of them have become EOSC Association Mandated Organisations (e.g. DeIC and University of Tartu) or Members (e.g. CSC, Uppsala University, NORDUnet, etc.); many of them are the home of experts that are contributing to the EOSC Association Task Forces[25]; some of them have initiated national initiatives for the country coordination of EOSC (e.g. CSC with the EOSC Finnish Forum[26] or DeIC with the EOSC Denmark Coordination Forum[27]).

The project has been an important instrument to mobilise organisations in the region around EOSC and to make them understand how important it is to exchange information, opinions and maintain a continuous dialogue around the EOSC developments. The dialogue was essential to converge on a single voice for the Nordic region on important topics or EOSC consultation run by the governance and to engage in a more powerful way national and regional policy makers. The first EOSC Tripartite event in the region was an example of the results achieved with the help of the project in terms of EOSC regional alignment and coordination.

In order to sustain these coordination and engagement activities set up in the region after the end of the project, in addition to the already well-established collaboration mechanisms in place among the EOSC national structures and the EOSC Association members and the regional fora (NeIC and NORDUnet), the project partners have decided to continue the dialogue initiated by the project launching an EOSC-Nordic NeIC affiliate project.

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[25] https://eosc.eu/advisory-groups
[26] https://avointiede.fi/en/networks/eosc/eosc-finnish-forum
[27] https://eosc.eu/tripartite-collaboration/denmark

The EOSC-Nordic NeIC affiliate project

NeIC coordinates and funds development projects that usually have a life cycle of 2-3 years. In 2020, NeIC launched the Affiliate Programme[28], to realise the benefits and enhance impacts of NeIC coordinated projects after they have been completed. This extended programme allows the project manager to continue the engagement in the project for up to one year to ensure the transfer of results and sustaining the benefits together with the project partners.

The EOSC-Nordic collaboration will work together with NeIC through the NeIC Affiliate program on the following key areas:
- Enhance sustainability of the EOSC-Nordic results and outcomes within the partner organisations and communities
- Stimulate the FAIR uptake and competences across the Nordic & Baltic region
- Increase the EOSC uptake across disciplines, institutions and country borders in the Nordic & Baltic region
- Strengthen the Nordic & Baltic e-Infrastructure collaboration around Sensitive Data & Infrastructure (i.e. Nordic Forum for Sensitive Data & Infrastructure)

The EOSC-Nordic NeIC affiliate project will be coordinated by Computerome, Denmark. The coordinator will be the EOSC-Nordic Project Manager Lene Krøl Andersen, International Liaison at Computerome, DTU. Lene will work for 1 year on 0.1 FTE effort, during the period 2023-01-02 - 2024-31-01. She will be reporting to the EOSC-Nordic Project Owner within the NeIC Management team. The following list of partners have expressed their interest to continue the collaboration beyond the EOSC-Nordic lifetime and contribute with in-kind resources:

Partner country	Institution
Denmark	Computerome/DTU
Denmark	National Genome Center
Denmark	University of Aarhus
Denmark	Rigshospitalet
Denmark	DeiC
Denmark	Copenhagen University
Denmark	University of Southern Denmark
Estonia	University of Tartu
Finland	CSC-IT Centre for Science
Finland	Tampere University/Finnish Social Science Data Archive
Germany	DKRZ
Latvia	Riga Stradins University
Norway	Sigma2 AS

The EOSC-Nordic NeIC affiliate project will be kicked-off in January 2023.

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[28] https://neic.no/affiliates/

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www.eosc-nordic.eu

EOSC-Nordic project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 857652

Annex A: EOSC-Nordic KERs

New and/or enhanced services and tools

Regional pre-onboarding platform enriched with HPC resources allocation functionality

Short description: Establishment of a pre-onboarding platform to facilitate the integration and onboarding of services provided by Nordic and Baltic service providers into the EOSC Marketplace[29]. Thanks to the collaboration and the strong synergies established with the Puhuri project[30], the EOSC-Nordic pre-onboarding platform has also been enriched with functionalities to onboard HPC resources and other infrastructure services in the EOSC Marketplace in an automated way[31].

Useful Links:

- https://eosc-nordic.atlassian.net/wiki/spaces/EN/pages/473792558/Nordic+gateway+to+EOSC+for+service+providers
- https://eosc-nordic.atlassian.net/wiki/spaces/EN/pages/228655106/How+can+I+offer+my+service+in+EOSC-Nordic+offering+portal

Added value brought by the region: The Nordic e-Infrastructure Collaboration (NeIC) is a regional structure established in 2004 to facilitate the development and operation of high-quality e-infrastructure solutions in areas of joint Nordic interest. One of the efforts undertaken by NeIC was the development of a regional catalogue of services[32]. The expertise matured by the partners of the project that contributed to build the regional catalogue was an important asset to approach the development of the pre-onboarding EOSC regional platform.

In addition, many NeIC funded projects in the past have been addressing the challenges of sharing services cross-border in the Nordic region (e.g. NeIC Dellingr[33] and NeIC Puhuri 1 and 2[34]) with a specific focus on HPC resources (especially with the advent of LUMI[35]) and this is why the development of the pre-onboarding regional platform has also explored automatic allocation of HPC resources.

Target beneficiaries Service/resource providers in the Nordic and Baltic region

Added value for the Nordic and Baltic countries: The pre-onboarding platform provides a regional hub for consuming Nordic and Baltic services and a tool for Nordic and Baltic providers for publishing services and resources in the EOSC marketplace in an easy way. This effort also created knowledge in the region on how to onboard services in the EOSC Marketplace and raised awareness of the current challenges, first of all

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[29] https://marketplace.eosc-portal.eu/

[30] https://puhuri.io/

[31] The platform manages the automatic allocation of those resources by resource allocators

[32] https://neic.no/services/

[33] https://dellingr.neic.no/

[34] https://neic.no/puhuri/

[35] https://www.lumi-supercomputer.eu/

the lack of a strong value proposition to motivate providers to onboard services in the Marketplace and the lack of a business model supporting the consumption of Nordic resources at European level.

Added value for EOSC: The pre-onboarding platform provides a reference example on how a regional onboarding process into the EOSC Marketplace could work. The work done highlighted the current issues of the onboarding process (lack of clarity of the onboarding rules; lack of clear value proposition for service providers to onboard services in the Marketplace; lack of a business model supporting the consumption of the regional resources by other European countries; non-compliance of the EOSC Marketplace with the GDPR rules) but also the advantages of a regional effort in this perspective (capability to reach out to providers in the region in an easier way due to the long lasting collaborations existing in the region; capability to establish more suitable support systems due to the knowledge of the "Nordic culture and way of working"; establishment of a Nordic hub that can allow cross-border sharing of resources and services due to the agreement already in place in the region).

How much it costs to be maintained in the future and exploitation path: In order to maintain the pre-onboarding platform after the end of the EOSC Nordic project, the platform has been integrated into the Puhuri gateway (both in terms of AAI and hosting) and ETAIS, the principal EOSC-Nordic partner behind this development, has committed to maintain the platform operational for the next 2 years estimating an overall effort of 0.2 FTEs. If the upcoming EOSC procurement call is going to revise completely the concept of the current EOSC Future Marketplace, additional efforts and costs for adjusting the integration will be required.

EOSC-Nordic Service compliance checklist & maturity model

Short description: A service compliance checklist to quickly validate if a service is fit for the current EOSC Marketplace (meaning if it complies with the current onboarding rules in the EOSC Marketplace). A service maturity model to easily assess whether a service is good enough for inclusion in the EOSC Marketplace & Catalogue[36]. The secondary purpose of the maturity model is to motivate service providers to enhance the maturity of their services by providing them a model against which they can benchmark.

Useful links:
- https://www.eosc-nordic.eu/kh-material/deliverable-3-1-eosc-service-compliance-checklist-and-maturity-model/
- https://eosc-nordic.eu/eosc-pillar-has-adopted-a-service-maturity-model-developed-by-eosc-nordic-wp3/

Added value brought by the region: Analysis of the current requirements and rules of participation of the EOSC Marketplace and Catalogue performed with "Nordic eyes" leveraging on the experience of the different providers from the Nordic and Baltic region on IT Service Management.

Target beneficiaries: Service providers in the Nordic and Baltic countries to assess their level of compliance with the EOSC Marketplace onboarding rules and to assess the maturity level of their services and benchmark. Funding agencies that could adopt the developed models to introduce evaluation criteria

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[36] https://marketplace.eosc-portal.eu/

for services to be adopted or developed in projects sponsored by the region to improve quality and maturity of services.

Added value for the Nordic and Baltic countries: An easy-to-use evaluation model for assessing maturity of the services and their compliances with the current rules of onboarding in the EOSC Marketplace.

Added value for EOSC: The EOSC-Nordic maturity model has also been adopted by the EOSC Pillar project (https://eosc-nordic.eu/eosc-pillar-has-adopted-a-service-maturity-model-developed-by-eosc-nordic-wp3/) and it has been presented to EOSC Future to improve the service compliance checklist developed by the project.

How much it costs to be maintained in the future and exploitation path: To be used, the models need to be periodically updated. This requires an effort of 0.1 FTEs. The ideal solution would be to have a European service compliance checklist and maturity model centrally maintained and updated by the EOSC operators so that the only cost for the region is distributed to the service providers that will be in charge of assessing their services. The providers in the region have expressed their willingness to absorb that cost if the onboarding in the EOSC Marketplace proves to be valuable for them.

Nordic Service interoperability framework

Short description: Analysis and development of interoperability guidelines for service providers based on specific requirements coming from service providers based in the Nordic and Baltic countries.

Useful links:
- https://eosc-nordic.eu/eosc-nordic-service-interoperability-framework/
- https://www.eosc-nordic.eu/kh-material/d3-3-service-interoperability-framework/

Added value brought by the region: A series of enhanced EOSC interoperability guidelines developed by Nordic service providers with experience in projects dealing with the cross-border sharing of resources.

Target beneficiaries New service developers interested in EOSC. Maintainers of existing services that are aiming to extend the reach through EOSC.

Added value for the Nordic and Baltic countries: Usually in the Nordic countries the developed services are meant to be used by several or all countries at once. As such, common principles of interoperability allow to develop services cheaper and with a better fit to the end users. The guidelines developed in the project helped the consolidation of interoperability principles within the region.

Added value for EOSC: A useful input for the EOSC Interoperability Framework developed by the EOSC Future project.

How much it costs to be maintained in the future and exploitation path: We estimate an effort of 0.1 FTE required to keep the IF framework up to date with periodic promotion to service providers in the

region. These guidelines will be made available for the NeIC members. The actual model developed has been handed over to the EOSC Future project.

Blueprint for mass assessment of FAIRness

Short description: A semi-automated assessment of FAIR uptake of multiple research data repositories. A blueprint that will allow others to follow the EOSC-Nordic approach describing the repository selection criteria, the collection of dataset identifiers, the execution of the assessments, and the analysis of the FAIR score results.

Useful link:

- https://eosc-nordic.eu/fair-is-possible-increasing-fair-maturity-of-the-nordic-and-baltic-research-data-repositories/

Added value brought by the region: The EOSC-Nordic FAIR activities could build on the report ´The state of open science in the Nordic countries´[37] by NeIC in 2018. The project was able to bring together existing expertise from the Nordic and Baltic countries.

Target beneficiaries: Policy makers, funders, or consortiums that wish to assess and follow FAIR uptake of their members, service providers or other stakeholders.

Added value for the Nordic and Baltic countries: Increased awareness and knowledge about FAIR uptake and possibility to identify gaps in FAIRness in general.

Added value for EOSC: The EOSC-Nordic FAIR assessment model was ground-breaking and has received a lot of interest and knowledge has been shared with e.g. FAIR Impact project[38] and the EOSC Association Task Force on FAIR metrics and data quality[39], and initiatives that were developing FAIR assessment tools, especially the FAIRsFAIR project[40] and the F-UJI tool[41]. The project has contributed to the overall development of FAIR assessment tools and FAIR metrics.

How much it costs to be maintained in the future and exploitation path: The model and the methodology have been described in a blueprint and in project deliverables, and scripts shared in GitHub. No additional effort is needed to keep them available as they are now. It is important to note that the project partners did not see much market for building a service out of the blueprint (it was also out of scope of EOSC-Nordic to offer it). The main motivation was that the F-UJI tool and the interpretations of the FAIR metrics are still in constant change so building and maintaining a service upon them would require constant changes which does not seem to be a sustainable solution at this point in time.

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[37] https://zenodo.org/record/2563733#.Y3ycwIJBwbY

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

[39] https://www.eosc.eu/advisory-groups/fair-metrics-and-data-quality

[40] https://www.fairsfair.eu/

[41] https://www.fairsfair.eu/f-uji-automated-fair-data-assessment-tool

FAIR and Trustworthy Digital Repositories (TDR) certification support model

Short description: EOSC-Nordic created a model for providing one-to-one support to individual repositories in their journey to FAIRification and TDR certification using CoreTrustSeal[42]. The model was partly based on CESSDA[43] trust model but included additional elements such as support for FAIRifying metadata. Two paths of support were offered: i) assistance/mentoring on aspects of CoreTrustSeal certification (feedback on self-assessments) and ii) feedback and guidance based on FAIR assessment results (this is an effective way to raise awareness on the importance of FAIRification and often as a result to boost the FAIR score).

Added value brought by the region: Existing Nordic collaborations and networks (via e.g. NeIC and CESSDA ERIC) provided a natural starting point. The Nordic and Baltic setting was an environment with high level of trust and safety which was vital for the flow of feedback, thus allowing the project's support team and the supported repositories to speak and voice concerns freely. The support model proved successful (as reported in D4.5).

Target beneficiaries Research data repositories in the Nordics and Baltics.

Added value for the Nordic and Baltic countries: The project has been able to upskill Nordic and Baltic repositories through the support program. FAIR and certification can be an important contribution to ensuring the reliability and durability of data repositories and hence the potential for sharing data over a long period of time.

Added value for EOSC: FAIR and trustworthy digital repositories are vital components of the EOSC ecosystem. TDRs enable FAIR data and services now and in the long term. FAIRification and TDR certification are new and developing areas, and repositories willing to improve their practices benefit from support that allow them to address the issues cost-effectively. The support model by WP4 was generally considered a useful way to implement a targeted change quickly, identify gaps, or produce up-to-date documentation of the repository's processes, policies or practices under expert guidance. It can be used as a basis for future programmes although as FAIR data assessment and repository frameworks develop, support programmes will need to be adjusted and expanded accordingly. It is worth noting that additional work (at EOSC level) is needed to create certification or assessment frameworks for repositories that are not TDRs but e.g. technical service providers for TDRs.

How much it costs to be maintained in the future and exploitation path: This effort requires funding of an administrator who can plan and coordinate meetings and a support team that can perform the support activities that are agreed with the community. Estimate 0,5 FTE for administrative coordination and a minimum of 2 FTEs to maintain a similar frequency/level-of-activity as during EOSC-Nordic. At the moment no such funding is available from the partners or from the region. However, some of the partners pioneering this effort in EOSC-Nordic are now involved in two new Horizon Europe projects that are aimed at improving the EOSC awareness and uptake at European level: FAIR Impact and SKILLS4EOSC.

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[42] https://www.coretrustseal.org/
[43] https://www.cessda.eu/

STEP-by-STEP FAIRification webinars

Short description: During the three years of the EOSC-Nordic project, we have tracked the FAIR maturity of the Nordic and Baltic research data repositories and supported the repositories in FAIRification. As part of this work, we organised a series of webinars that provide step-by-step guidance to research data repositories on how to make metadata more FAIR.

Added value brought by the region: Existing Nordic collaborations and networks (via e.g. NeIC) provided a natural starting point. The Nordic and Baltic setting was an environment with high level of trust and safety which was vital for the flow of feedback, and the ground-breaking mass FAIR assessments provided a fruitful starting point for planning the webinar contents.

Target beneficiaries Managers and owners of research data repositories.

Added value for the Nordic and Baltic countries: The guidance will enable repositories to enhance their metadata, and to upskill regarding FAIR and FAIR testing. The recording of the webinars can be used by the repositories in the region.

Added value for EOSC: One key message is that calculating FAIR scores or assessing FAIR maturity levels of repositories is not a straightforward task and analysis of the scores needs to be done carefully. However, FAIR assessments are an excellent tool for improving repository practices. Repositories can and should do self-assessments to recognise where they have gaps. It is also worth noting that a digital object cannot really be made FAIR or evaluated for FAIRness in isolation from its context – in our case, the data repository. For example, the persistence of an identifier is determined by the commitment of the organisation that assigns and manages it. The webinars developed by EOSC-Nordic have been promoted in the wider EOSC community (15% of registered participants have so far been from outside the Nordics) and can be used by repositories outside the region.

How much it costs to be maintained in the future and exploitation path: The webinar recordings, presentations and other materials are available via the EOSC-Nordic Knowledge Hub[44] and don't require any additional maintenance. As soon as the EOSC future Knowledge Hub will be available the EOSC-Nordic webinars will be embedded in that channel too.

Virtual Research Environments for Nordic Language Processing Laboratory (NLPL)

Short description: Language processing is a computationally intensive task and usually needs to make use of HPC platforms in order to complete in a reasonable time. This makes cloud resources that usually run containers undesirable. The NLPL[45] community was interested in moving to a portable Virtual Research Environment (VRE) that could be deployed on any HPC platform. EOSC-Nordic tried a few candidates and settled on easyBuild that provides a framework for building and deploying reproducible virtual research environments for language processing.

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[44] https://www.eosc-nordic.eu/kh-usecase/guidance-fairification/
[45] http://wiki.nlpl.eu/index.php/Home

Added value brought by the region: The NLPL researchers in EOSC-Nordic defined the requirements for the VRE based on their long-lasting experience in language processing and the VRE was deployed and tested on the Norwegian and Finnish HPC platforms.

Target beneficiaries: NLPL community and other language processing communities.

Added value for the Nordic and Baltic countries: NLPL now has a reproducible environment within which they can perform their research. It is possible for researchers to share their easyBuild configuration to allow colleagues to reproduce and build upon their work.

Added value for EOSC: The NLPL VRE can be used as a model by other language processing communities and in the future it might become part of the EOSC Exchange.

How much it costs to be maintained in the future and exploitation path: The VRE now exists as a software package that is maintained by the NLPL community.

JSON Web Token for Sensitive Data

Short description: A means of determining the identity of a researcher is necessary when accessing any service. It becomes even more critical for sensitive data resources where audit trails are essential to ensure the data has been accessed in an approved manner and by an approved researcher. The project has proposed an approach for cross-border cooperation via OIDC/JWT token exchange. The aim of this proposal is to make possible the usage of resources provided by one project partner by users of the other project partners. The two main targets are: To recognize the credentials of a user in the infrastructure of one of the project partners by other partners, and to create services aimed at sharing resources that accept credentials from users with different affiliation. This can be achieved in practice by implementing OIDC from the identity providers of each of the Nordic sensitive data providers, and implementing resource access via an exchange of JWT tokens.

Added value brought by the region: Nordic providers are forerunners in dealing with sensitive data and management of sensitive data is one of the top priorities in the Nordic countries. Leveraging on the expertise of the partners involved in the EOSC-Nordic, the project has determined the minimal set of metadata that would be accepted in each Nordic country to access sensitive data cross-border.

Target beneficiaries: The definition of metadata makes it possible for JWTs to be used by Nordic researchers to access cross-border sensitive data resources in the Nordics.

Added value for the Nordic and Baltic countries: The JWT now makes cross-border access to sensitive data in the Nordics possible.

Added value for EOSC: The JWT schema could act as a basis for other countries that wish to collaborate across borders by sharing access to sensitive data resources.

How much it costs to be maintained in the future and exploitation path: The implementation has been completed and it is available for use.

Galaxy Portal for FAIR Analysis

Short description: The Galaxy portal was introduced into the Biodiversity and Climate communities in the Nordics and Baltics as part of the EOSC-Nordic project in order to provide a platform for data analysis. EOSC-Nordic developed plugins to enable interoperation across borders with Cloud and S3-like storage.

Added value brought by the region: EOSC-Nordic developed plugins for Cloud computing and S3-like storage access that are now part of the Galaxy ecosystem (managed on and maintained on the Galaxy github).

Target beneficiaries The Biodiversity and Climate communities in the Nordics were the primary beneficiaries.

Added value for the Nordic and Baltic countries: The Galaxy portal provided a platform for creating reproducible data analysis chains allowing data located in different countries (e.g. data stored in Sweden, Norway and Finland) to be analysed on Cloud platforms in Norway, Sweden and Finland easily.

Added value for EOSC: The Galaxy portal is part of EOSC Marketplace, and has instances in the Nordics. Each organisation maintains the portal, with the plugins being maintained by the communities that use the tools.

How much it costs to be maintained in the future and exploitation path: The EOSC-Nordic developed plugins for Cloud computing and S3-like storage access that are now part of the Galaxy ecosystem.

B2Find metadata indexing for datasets

Short description: The B2Find metadata repository is a service available in the EOSC Marketplace that was chosen as the service to provide a common source for archaeological metadata harvested from Danish and Norwegian archaeological repositories. Modifications of the service were carried out as part of EOSC-Nordic in order to easily harvest and present the metadata such that it is possible for researchers to access the combined metadata in a uniform manner.

Added value brought by the region: The modifications to B2Find make harvesting simpler than before, requiring less effort on the source repository to enable their metadata to be harvested.

Target beneficiaries: B2Find is a generic service and in EOSC-Nordic has benefited archaeology and climate science demonstrating the wide-ranging capabilities.

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Added value for the Nordic and Baltic countries: The B2Find service has demonstrated that within the Archaeological community a common gateway to metadata is a valuable tool. It makes metadata from distributed resources visible in one service.

Added value for EOSC: B2Find is a service that provides researchers with a common gateway to a disparate set of metadata. EOSC-Nordic contributed to improve the functionalities of the service that now are available for the entire community.

How much it costs to be maintained in the future and exploitation path: The enhanced B2Find features developed in EOSC-Nordic are now available for the entire EOSC community.

Enhanced EasyDMP tool

Short description: EasyDMP is a service for creating data management plans (DMP)s. The original easyDMP produced narrative DMP documents which were impossible for a machine to consume. The goal in EOSC-Nordic was to make the DMPs more machine actionable such that they could be consumed by services for allocating resources.

The Research Data Alliance (RDA) machine-actionable Data Management Plan Common Standard (maDMPCS) schema or profile was chosen as the schema for the DMP. EasyDMP was modified to produce and consume RDA maDMP CS plans. This has enabled plans produced by other tools (currently tested with the Data Stewardship Wizard) to be consumed by easyDMP and then used to allocate resources.

Added value brought by the region: EasyDMP is deployed in Norway.

Target beneficiaries: Norwegian researchers are the main target for the Norwegian easyDMP instance. The modifications make it possible to allow easyDMP to interoperate with other tools.

Added value for the Nordic and Baltic countries: The tool will continue to be supported and maintained in Norway.

Added value for EOSC: The experience implementing the RDA maDMPCS will be valuable for those implementing the RDA maDMPCS in other tools. Also the modifications applied to the easyDMP tool can be deployed in other instances.

How much it costs to be maintained in the future and exploitation path: The enhanced easyDMP tool will continue to be supported and maintained in Norway.

EOSC-Nordic Knowledge Hub & website

Short description: The EOSC-Nordic Knowledge Hub and website offer to all the stakeholders an easy way to access and navigate the results produced by the project. They have been designed with a user-centric approach making sure that the users are offered the information and services specifically matching their interests and needs.

Added value brought by the region: The knowledge of the Nordic community and needs allowed to customise the EOSC-Nordic Knowledge Hub and website to respond to the needs of the target users.

Target beneficiaries: Research communities and institutions, service providers and e-infrastructures, and funders and policy makers in the Nordic region.

Added value for the Nordic and Baltic countries: The EOSC-Nordic Knowledge Hub and the website provides a window into the EOSC-Nordic project and its results.

Added value for EOSC: The EOSC-Nordic Knowledge Hub concept for competence and knowledge sharing has been presented to other projects and networks. In particular, a dedicated meeting with EOSC Future has been organised to share the experience and lessons learnt acquired in the project and contribute to the development of the EOSC Future Knowledge Hub.

How much it costs to be maintained in the future and exploitation path: The EOSC-Nordic Knowledge Hub and the website will run for two years after the project has terminated to allow all resources to remain accessible and usable for this period of time. CSC, the communication partner of the EOSC-Nordic project will be in charge for the maintenance. Once the EOSC Future Knowledge Hub will be available, the relevant content (e.g. the step-by-step FAIRification webinars) will be transferred to make sure it will be maintained after the 2 years standard maintenance.

Increased FAIR uptake and skills in the region

+700 data Stewards trained in the region

Short description: NeIC has run, in the context of EOSC-Nordic, a very successful course on FAIR data stewardship in the region (in collaboration with GO-FAIR). In 2019-2020 three courses were held in the Nordics, leading to 161 trained data stewards. This is intended to broaden the competence and common understanding of FAIR among research support staff. A series of train-the-trainer events is also essential to scale the training efforts appreciatively. In EOSC-Nordic WP4, ten events were organised, covering raising awareness of FAIR, implementation of FAIR, and FAIR incentives, and having ~600 participants. The majority of events have had a practical and somewhat technical profile that have intended to support researchers and data managers in implementing FAIR in their repository. In addition, the project team has been upskilled in all things FAIR.

Added value brought by the region: The context in which research data repositories operate must also be recognised. There are similarities in policies, culture and incentives in repository activities and

sharing research data in the Nordic and Baltic region, which we believe has contributed positively to commitment, communications, peer support and general community building.

Target beneficiaries Researchers, data repository managers and data stewards that are willing to open and share their data in a FAIR way.

Added value for the Nordic and Baltic countries: Research data repositories provide the organisational context for FAIR research data and are key actors in the FAIR ecosystem and in supporting open science. It is not sufficient to ensure that these repositories enable FAIR data. EOSC-Nordic contributed to create FAIR data stewardship skills in the region.

Added value for EOSC: FAIR and open data are vital components of the EOSC ecosystem. The entire EOSC will benefit from the new skills that EOSC-Nordic has grown in the region.

How much it costs to be maintained in the future and exploitation path: The FAIR data stewardship skills built by the project in the region will remain as an asset for the Nordic and Baltic countries to further develop FAIR, Open Science and EOSC in the region.

From a training perspective, a broader EOSC training programme is preferred in order to ensure broadest possible impact and cost efficiency.

98 repositories assessed against FAIR

Short description: Semi-automated assessment of FAIR uptake among a sample of 98 repositories and 1000+ datasets (represented by their metadata records) has been performed by WP4.

Added value brought by the region: The EOSC-Nordic FAIR activities could build on the report ´The state of open science in the Nordic countries´[46] by NeIC in 2018. There are similarities in policies, culture and incentives in repository activities and sharing research data in the Nordic and Baltic region, which we believe has contributed positively to commitment, communications, peer support and general community building.

Target beneficiaries Managers and owners of research data repositories.

Added value for the Nordic and Baltic countries: FAIR is a vital component of the EOSC ecosystem. TDRs enable FAIR data and services now and in the long term. FAIRification and TDR certification are new and developing areas, and repositories willing to improve their practices benefit from support that allow them to address the issues cost-effectively. The support model by WP4 was generally considered a useful way to implement a targeted change quickly, identify gaps, or produce up-to-date documentation of the repository's processes, policies or practices under expert guidance. This work helped the repositories of the region in improving their FAIRness.

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[46] https://zenodo.org/record/2563733#.Y3ycwIJBwbY

Added value for EOSC: The work done by EOSC-Nordic can be used as a basis for future programmes although as FAIR data assessment and repository frameworks develop, support programmes will need to be adjusted and expanded accordingly.

How much it costs to be maintained in the future and exploitation path:

The work conducted by the project with repositories will remain as an asset for the region.

The continued assessment and possible expansion of the sample of repositories assessed during the project should be carried on in order to continue the incentivisation of FAIR uptake and possible expansion to the EOSC as a whole, as well as to collect information about the level of FAIRness in the Nordic and Baltic region, and to provide feedback to the repositories about their FAIRness.

This requires funding and an effort to maintain / grow the sample on a Nordic level. There are aspects of the activity that cannot be automated, which either have to be removed or maintained with small efforts (< 0,5 FTE). If a scale-up to the full EOSC is required an additional effort is needed (2-3 FTEs) and to setup of a workflow for scaling up the sample to EU level. Currently the project has not identified a suitable way to continue such activities.

Increased number of trustworthy digital repositories

Short description: In WP4 community support meetings were offered to data repositories that meet certain criteria. Two paths of support were offered; i) assistance/mentoring on aspects of CoreTrustSeal certification (feedback on self-assessments) and ii) feedback and guidance based on FAIR assessment results (this is an effective way to raise awareness on the importance of FAIRification and often as a result to boost the FAIR score).

Added value brought by the region: The EOSC-Nordic FAIR activities could build on the report ´The state of open science in the Nordic countries´[47] by NeIC in 2018. There are similarities in policies, culture and incentives in repository activities and sharing research data in the Nordic and Baltic region, which we believe has contributed positively to commitment, communications, peer support and general community building.

Target beneficiaries Managers and owners of research data repositories

Added value for the Nordic and Baltic countries: The project has been able to upskill repositories. The number of Nordic and Baltic CoreTrustSeal certified repositories was ten when the project started and through the support process, we expect that six more repositories will submit a certification application. Certification can be an important contribution to ensuring the reliability and durability of data repositories and hence the potential for sharing data over a long period of time. By becoming certified, repositories can demonstrate to both their users and their funders that an independent authority has evaluated them and endorsed their trustworthiness.

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[47] https://zenodo.org/record/2563733#.Y3ycwIJBwbY

Added value for EOSC: Trustworthy digital repositories that enable FAIR data in the long term are vital components of the EOSC ecosystem. Data created and used by scientists should be managed, curated, and archived in such a way to preserve the initial investment in collecting them. Researchers must be certain that data held in data repositories remain useful and meaningful into the future. Funding authorities increasingly require continued access to data produced by the projects they fund, and have made this an important element in Data Management Plans. Sustainability of repositories raises a number of challenging issues in different areas: organisational, technical, financial, legal, etc. EOSC-Nordic contributed to the establishment of trustworthy digital repositories in the region.

How much it costs to be maintained in the future and exploitation path: The work conducted by the project with respect to certification will remain as an asset for the region. The repositories are themselves responsible for their certification process and for maintaining their documents and we hope that the work conducted by EOSC-Nordic will also stimulate other repositories to follow the example. Networking of repositories was an essential factor to achieve the current results of the project. Networking is important and requires some funding and coordination, which is addressed in a working paper that EOSC-Nordic contributed to: *Towards a European network of FAIR-enabling Trustworthy Digital Repositories (TDRs) - A Working Paper (v2.0)*. Zenodo. https://doi.org/10.5281/zenodo.7034315

FAIR incentives: recommendations and FAIR archetypes

Short description: Based on interviews of six stakeholder groups in Nordics and Baltics (researchers, data stewards, management personnel at universities, funders, national data services, legal advisors), seven FAIR incentives were recognised and recommendations to stakeholders compiled. We also introduced two FAIR Archetypes with opposite perceptions of FAIR - The FAIR Newbie and the FAIR Master. With these archetypes, different behaviours can be showcased as examples to ultimately be able to leverage a change in how the FAIR principles are perceived in scientific circles.

Added value brought by the region: The EOSC-Nordic FAIR activities could build on the report 'The state of open science in the Nordic countries' by Neic in 2018. There are similarities in policies, culture and incentives in repository activities and sharing research data in the Nordic and Baltic region, which we believe has contributed positively to commitment, communications, peer support and general community building. Allocating resources to support the cultural change towards FAIR data management impacts the whole of research - supporting the community and the researchers. That includes providing adequate resourcing for research-performing organisations responsible for offering training, support, services and tools for researchers. Increased resources for training on applying FAIR in research increases awareness and skills development. Data quality, trust, and research transparency are all expected to benefit from increased support for FAIR research data management. The same applies to providing adequate funding for infrastructure providers, who enable, e.g., researchers to publish FAIR data.

Target beneficiaries: Research performing organisations, service and infrastructure providers, research funding organisations, ministries.

Added value for the Nordic and Baltic countries: It is prevalent that the whole region follows EU-level development and that actions about FAIR compliance form an integral part of national-level decisions and relevant policies. Collaboration and to some measure a joint vision in policymaking between Baltic and Nordic countries is needed to ensure joint cross-border research and a stronger influence on the future developments of EOSC (for example via the EOSC Steering Board).

Added value for EOSC: The regional findings could also be fruitful in collaboration among European policymakers. Incentives are an important driver for cultural change. The necessary changes should be incorporated at all levels, and all stakeholders have a role to play in advancing the uptake of FAIR research practices. A common thread throughout this study has been the realisation that there is a need to raise proper awareness among researchers on FAIR and its values as best practices and through communication with FAIR advocates. Another common denominator throughout the study has been the importance of adequate support services and a rewarding system at organisations for complying with the FAIR Principles. Accelerating the cultural change calls for a stronger emphasis on the "make it required" part coupled with a combination of easy-to-use services and concrete rewards for FAIR compliance. To leverage the change, proper funding is crucial, to begin with. Coupled with the findings made in this study and by creating a sense of urgency among the research communities that things are changing, the situation will evidently change and lead to a research society where FAIR research practices are the norm.

How much it costs to be maintained in the future: The work conducted by the project will remain as an asset for the region.

Proof of concepts

Prototype of secure data exchange across organisations

Short description: EOSC Nordic WP3 deployed and evaluated adoption for R&D purposes of secure data exchange platforms deployed in Estonia and Finland for cross organisational services in different countries. X-road based services in Finland and Estonia support federation and inclusion of members from other countries. On the national level, these exchange services serve as a backbone for e-government.

https://www.eosc-nordic.eu/feasibility-study-of-implementation-of-x-road-for-research-data-is-now-published/

A feasibility assessment was conducted in collaboration with a research group at the University of Tartu, that develops an X-Road-based software project GenMed to process genomic data. Software deployment resulted in a situation where an analytical engine in one country was able to request the genomic data from the registry in another country in a safe and efficient way. Thus, adopting X-Road for real-time applications working with sensitive data has good potential in R&D. Further work compared the service delivery model in X-Road with that of EOSC Marketplace and evaluated its feasibility for transfer of larger data sets.

Added value brought by the region: X-Road is a solution deployed on the national level in Estonia and Finland with a federation of data exchange platforms established in recent years.

Target beneficiaries Developers of services relying on on-line access to sensitive data, mostly from the public sector's registries.

Added value for the Nordic and Baltic countries: Increased adoption of sustainable and highly secure data exchange platforms for R&D purposes.

Added value for EOSC: A reference case for building cross-border data services in Europe.

How much it costs to be maintained in the future and exploitation path: No extra funding is required as X-Road-based platforms are funded and developed by Member state funding. The Proof of Concept has been disseminated through EOSC-Nordic and is now available.

Proof of concept of a Nordic Cloud infrastructure

Short description: Service deployment on distributed Nordic Cloud resources. Deliverable D5.9 aimed at showcasing the service deployment on distributed Nordic Cloud resources. The demonstrator was applied to leverage computing workflows involving artificial intelligence algorithms for language analysis, and federated machine learning for marine biodiversity, as well as climate modelling using machine learning.

The task investigated and showcased innovative platforms for making scientific tools able to discover and consume cloud computing resources, such as IaaS and Kubernetes solutions running either on premises and/or on public clouds.

The solutions investigated were Sigma2's NIRD Toolkit, STACKn and FEDn from Scaleout, cPouta from CSC, as well as UCloud from SDU. The goal was to provide a platform for researchers to deploy and run a variety of tools on user-selected data and cloud computing resources, giving researchers the possibility to focus mainly on research and less on tools and irrelevant tasks.

The cloud solutions were designed to fulfil requirements shaped by various stakeholders. As a consequence, different architectural designs and technical implementations emerged. Although difficult to harmonise code bases, the variety of cloud solutions developed in the Nordics proved to be valuable by addressing different sets of use cases and providing alternatives to research communities. The collaboration and assessment of a common Nordic cloud toolbox revealed possibilities for future collaboration in the form of for example setting up a shared application repository, making applications and frameworks shareable across projects and borders.

Useful link:
- https://zenodo.org/record/7361253#.Y4cj47JBwbZ

Added value brought by the region: The provider solutions were selected based on the user experience and eligibility to host and analyse the associated research data.

Target beneficiaries: Nordic research communities

Added value for the Nordic and Baltic countries:

The work around the marine biodiversity exploration using cross-border resources and federated machine learning, i.e., the FEDn-KSO use case, showcased the capabilities of cross-border cloud computing, exemplifying possibilities for deploying the same software across multiple cloud architectures. It provides a viable technological solution for ecological research communities in the Nordic countries for collaborating on building predictive models across borders while keeping their data samples locally and in place. In the past, such collaboration would require additional ways to facilitate data transfer and model aggregation. Last but not least, emphasised the importance of addressing the policy- and legal limitations and hopefully can be a catalyst in speeding up the processes in the NeIC and for that matter also in broader European partnerships.

Similarly, the use case of NDHL on UCloud demonstrated the importance of collaboration on a Nordic level, where researchers from social sciences and humanities at Nordic universities could collaborate across borders in a secure and interactive virtual research environment, as all data came with restrictions on storage location and access due to copyrighted content.

Added value for EOSC: EOSC-Nordic promoted close collaboration between sites and research communities and pushed the capabilities of existing technologies and cloud infrastructure implementations from which scientists did benefit by getting an easy access to e-science resources. This approach could be interesting for EOSC as a whole.

How much it costs to be maintained in the future and exploitation path: The proof of concept has been completed in the project. The lessons learnt and the results are documented in D5.9.

Increased EOSC alignment and coordination in the region

Policy workshops & EOSC tripartite event

Short description: Policy Workshops have been the cornerstone of the policy work in the EOSC-Nordic project. The workshops have been held once a year and have gathered together every time over eighty policymakers and stakeholders from the Baltics and Nordics to discuss common objectives related to Open Science policies and cross-border collaborations. The policy workshops have been a good opportunity for participants to hear the latest information on Open Science updates in other countries and developments in the EOSC. In addition, the workshops were very valuable gathering points to stimulate the dialogue among the different countries and meet new partners. The workshops were also the opportunity to strengthen the relations with the policy makers. The last policy workshop supported by the project was organised in collaboration with the Nordic and Baltic member states representatives, the European Commission and the EOSC Association and represented the first EOSC tripartite regional event in the Nordic and Baltic Area.

Useful links:

- Policy workshop #1 (February 2020) https://rogue.csc.fi/events/nordic-policy-workshop/
- Policy workshop #2 (March 2021) https://rogue.csc.fi/events/second-eosc-nordic-policy-workshop-nordic-and-baltic-collaboration-as-eosc-enabler/

- Policy workshop #3 (May 2022) https://rogue.csc.fi/events/workshop-eosc-in-the-nordics-from-policy-to-practice/
- EOSC tripartite event in the Nordic and Baltic region (October 2022) https://eosc.eu/events/tripartite-event-nordic-baltic-countries. Post event report https://eosc.eu/sites/default/files/2022-01/NTE_Nordic_Baltic_report2022.pdf

Added value brought by the region: The strong connections of the EOSC-Nordic partners with the policy makers in the region allowed the successful mobilisation of the policy-makers in the region (both at national and regional level). Also, the strong links of the partners with the Mandated Organisations and EOSC national structures in the Nordic and Baltic countries facilitated the collaboration with the EOSC Association and the European Commission at EU level maximising the impact of the policy workshops.

Target beneficiaries: Ministries in charge for EOSC (Research and Education, Infrastructures, Sports and Youth, etc); Research funders; Decision makers at HEIs.

Added value for the Nordic and Baltic countries: Strengthen collaboration and improved alignment among Baltic and Nordic countries when it comes to Open Science and EOSC. All the Nordic and Baltic countries support the ERA policy action number 1. All the Nordic and Baltic countries have in place (or will have soon) Mandated Organisations and EOSC national structures and the project has consolidated contacts and collaborations among them in the region.

Added value for EOSC: The first EOSC tripartite event in the region was important to bring the Nordic and Baltic countries closer to the European Commission and the EOSC Association in the European panorama. It was also an opportunity to share the Nordic successful use cases with other countries.

How much it costs to be maintained in the future and exploitation path: EOSC-Nordic was responsible for the coordination and organisation of these workshops. Thanks to the establishment of Mandated Organisations and EOSC national structures in all the Nordic and Baltic countries this joint effort will be continued in the future and the workload needed to organise such regional dialogue will be shared between the different countries.

Direct contributions to the EOSC Co-Programmed Partnership

Open Science Policy mapping

Short description: The deliverable D2.8 provides an overview of the Open Science and EOSC related policies in all the Nordic and Baltic countries highlighting what are the elements covered by the different national policies and how EOSC is related to them. The deliverable has been structured to collect and provide information on all the policy-related elements needed by the EOSC Steering Board members to complete the first EOSC monitoring survey launched by the EOSC Steering Board in January 2022.

Useful links:
- https://zenodo.org/record/6503709#.Y3zX04JBwbZ

Added value brought by the region: The partner network in the different Nordic and Baltic countries allowed to enrich the extensive desktop analysis on national OS & EOSC policies with information coming from experts and policy makers and to have this information validated. The resulting report is the most authoritative complete study on Open Science policies in the region existing so far.

Target beneficiaries: All stakeholders interested in understanding more about Open Science and EOSC policies in the Nordic and Baltic region; EOSC Steering Board members.

Added value for the Nordic and Baltic countries: The deliverable is a reference point for all the stakeholders in the region to understand the status of Open Science in the region. Thanks to the collaboration with the EOSC Association, the information on status of the policies in the different countries is also available and maintained through the EOSC Mandate Organisations and EOSC national structures on the eosc.eu website[48].

Added value for EOSC: The deliverable has been shared with the EOSC Steering Board Nordic and Baltic representatives to be used as a basis to complete the first EOSC Steerign Board survey on OS & EOSC policy. The results of the survey will be soon published in the EOSC Observatory tool created by EOSC Future[49].

How much it costs to be maintained in the future and exploitation path: The analysis of the Open Science and EOSC policies in the region has been completed in the project and the EOSC tripartite collaboration is in the process of establishing ways to maintain the information updated in the future.

Analysis of cross-border collaboration models in the Nordics

Short description: A key element of open science, FAIR, and the EOSC vision is the notion of cross-border resource access, i.e., the use of cross-border infrastructure and services. For EOSC to be successful, cross-border utilisation, provision, and usage of resources must be sustainably funded, in a way comparable to what is organised nationally in most Member States. This leads to the discussion about cross-border funding models, cross-border cost recovery, or simply collaboration models. Different types of cross-border collaborations exist, organised in different ways, and sometimes provide various types of resources to different user communities they need to serve. In the Nordics, there are several examples of cross-border collaborations: DICE, ELIXIR, LUMI, ESS, ICOS ERIC, NORDUnet.

The EOSC-Nordic deliverable D2.6 gives an overview of the different cross-border collaboration models in place in the Nordic countries for the provisioning of services and resources to support researchers, analysing their funding models and their resource allocation structures from different perspectives: procurers vs users vs providers vs funders. The goal of the document is to provide usable recommendations and input for the future developments of EOSC.

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[48]   https://eosc.eu/tripartite-collaboration   See the individual country pages https://eosc.eu/tripartite-collaboration/norway; https://eosc.eu/tripartite-collaboration/sweden; https://eosc.eu/tripartite-collaboration/finland; https://eosc.eu/tripartite-collaboration/denmark; https://eosc.eu/tripartite-collaboration/estonia; https://eosc.eu/tripartite-collaboration/latvia; https://eosc.eu/tripartite-collaboration/lithuania)
[49] https://eoscobservatory.eosc-portal.eu/home

Useful links:

- https://zenodo.org/record/6217744#.Y3zbh4JBwbZ

Added value brought by the region: The EOSC-Nordic partners and their links to regional cross-border collaborations allowed them to anlayse the funding models and procurement structures of seven regional cross-border collaborations to provide insights on what works and what does not work to EOSC.

Target beneficiaries: Anybody interested in understanding more about cross-border collaboration models in place in the Nordic countries; EOSC Association Task Force on Financial Sustainability.

Added value for the Nordic and Baltic countries: Better understanding of the funding and procurement models behind cross-border collaboration models in place in the Nordic countries and potential challenges for EOSC.

Added value for EOSC: Contribution to the work ongoing in the EOSC Association Task Force on Financial Sustainability.

How much it costs to be maintained in the future and exploitation path: The study has been completed in the project and presented to the EOSC Association Task Force on Financial Sustainability.