EOSC Future

D2.7b

Recommendations for the SRIA

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D2.7b / Recommendations for the SRIA

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Abstract

This report provides strategic recommendations on priorities for EOSC development to inform the forthcoming Horizon Europe work programme for 2025/2027. The deliverable was brought forward by two months to the end of May 2023 to ensure recommendations could be shared with the EOSC Association while it consulted its Members on the draft MAR and consolidated feedback into a final version to share with the European Commission. Inputs were solicited from each Work Package and the key advisory bodies of EOSC Future, namely the Strategy and Oversight Board (SOB) and the Technical Coordination Board (TCB).

Version History

Version	Date	Authors/Contributors	Description
V0.1	03/02/2023	Sarah Jones (GÉANT)	Initial draft for consultation with WP partners
V0.2	13/02/2023	Cathrin Stover (GÉANT), Annabel Grant (GÉANT), John Shepherdson (CESSDA), Jan Meijer (SIKT), Michelle Williams (GÉANT)	Internal review feedback and suggestions from WP leaders
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V0.4	30/05/2023	Cathrin Stöver (GÉANT)	Final version for submission
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V1.0	07/06/2023	Sarah Jones (GÉANT), Ron Dekker (TGB), Mike Chatzopoulos (ATHENA)	Submission to EC

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List of Abbreviations

Acronym	Definition
AAI	Authentication and Authorisation Infrastructure
API	Application Programming Interface
BPA	AARC Blueprint Architecture
CoARA	Coalition for Advancing Research Assessment
CSA	Coordination and Support Action
DMP	Data Management Plan
EOSC-P	EOSC Partnership
ESFRI	European Strategy Forum on Research Infrastructures
FAIR	A set of principles standing for digital objects to be Findable, Accessible, Interoperable and Reusable
IF	Interoperability Framework
MAR	Multi-Annual Roadmap
MS/AC	Member States / Associated Countries
MVE	Minimal Viable EOSC
NFDI	Nationale Forschungsdaten Infrastruktur – an EOSC-like initiative in Germany
PID	Persistent Identifier
R&R	Rewards and Recognition
RI	Research Infrastructure
RoP	Rules of Participation
SOB	Strategy and Oversight Board – a governance body in the EOSC Future Project
SRIA	Strategic Research and Innovation Agenda – a document to define the general framework for future research, development and innovation activities in relation to the EOSC
TCB	Technical Coordination Board – a governance body in the EOSC Future Project
TRL	Technical Readiness Level

1 Executive Summary

This deliverable collates feedback from the project consortium to the Strategic Research and Innovation Agenda (SRIA) for EOSC, identifying which aspects are already addressed by the EOSC Future project and where additional activities are needed.

Where it is known, the deliverable also indicates where other activities in the ever-growing EOSC community are being addressed. The document builds on the earlier version of this deliverable (D2.7a) which made recommendations for the 2023-2024 Multi-Annual Roadmap (MAR). D2.7b has been scheduled to coincide with the EOSC Association consultation to seek inputs for the MAR for 2025-27, in order to help inform the forthcoming work programmes.

Background context on the initial development of the SRIA and the timeline for contributions is provided in the introduction. Section 3 describes the current state of play by examining the existing priorities and how these are addressed in the EOSC Future project. The main chapter of relevance is section 4 which outlines the recommendations coming from the EOSC Future project for proposed updates and inclusion to the SRIA and MAR for 2025-27.

A main recommendation is to keep building EOSC activities on the existing activities already funded in the various EOSC projects, as well as activities being carried out in the ever-growing EOSC community, such as the EOSC Association Working Groups.

There are six specific key areas recommended by EOSC Future which will be explained in detail in section 4.

- **Development of national / regional EOSC nodes**: engaging on a regional/country level with national services as well as research funders and research performing organisations, provides an opportunity to better connect local support infrastructure into EOSC.
- **Supporting practical, scientific use cases**: stronger connections to the Research Infrastructures (RIs), ESFRI Forum, common European data spaces and missions are needed.
- **Interoperability and standards**: while much work has been supported to develop the EOSC Interoperability Framework through EOSC Future and the forthcoming INFRA-2023-01-05 call, the development of community standards and particularly crosswalks between them to support interdisciplinary reuse is still needed.
- **Core allocation of compute and storage resources**: there is no model for individual researchers or small teams who may want to look at the data that is accessible via EOSC to be provided with the necessary storage and compute.
- **Recognition and rewards**: we recommend further investment via EOSC to support the development of metrics / indicators alongside the methods, tools and procedures needed to apply these to evaluate Open Science practices.
- **Ensuring Access to Commercial Services:** support access to commercial services to ensure all European public-sector researchers can benefit from functionality offered by these services, against good conditions.

In addition, section 4 also recommends updating the SRIA considering that much developed within the EOSC context since the SRIA was first published in June 2021. As such EOSC Future recommends to update and add new sections on the Tripartite Collaboration and EOSC Association governance to explain how work is being coordinated and the respective inputs from each party. Likewise, the SRIA should be updated to reflect on the strategy for EOSC, particularly highlighting the recent national developments and their expected added value.

The recommendations were confidentially shared with the EOSC Association in late May 2023 to act as inputs to their draft MAR for 2025-27.

2 Introduction

In 2020, the EOSC Executive Board in collaboration with its Working Groups drafted a Strategic Research and Innovation Agenda (SRIA) for the European Open Science Cloud. The core purpose of the SRIA is to provide input to develop the Work Programmes for EOSC in Horizon Europe.

An extensive consultation was held with the wider community in which hundreds of responses were received and processed. The SRIA was finalised in Spring 2021[1]. It provides background context on Open Science and how EOSC has been developed, as well as overarching strategic objectives, guiding principles and 14 core challenge areas around which further work is recommended. The SRIA concludes with a multi-annual roadmap which prescribes which actions should take place in which phase of implementation and notes the level at which they should be addressed, i.e. by the European Commission, by Member States or by institutions.

Since its formation in July 2020, the EOSC Association has taken over responsibility for maintaining the SRIA and developing Multi-Annual Roadmaps. The Association Board, together with its Task Forces, drafted a MAR for 2023-24 and consulted on it with its member base. This was approved by the Partnership Board in 2022 and a new version of the SRIA was released which incorporates this[2]. The next iteration of the MAR for 2025-27 is currently being worked on by the Association, hence aligning the date of this deliverable with that process: The deliverable was originally scheduled for July 2023 (M28) but is now planned to be finalised and submitted in June 2023 (M27). The EOSC Association, together with the EOSC Focus project, will also update the wider SRIA text in 2023. Recommendations are also made for that process.

This deliverable is intended as input to the EOSC Association and the development of the MAR 2025-27 and revision of the SRIA. As the flagship EOSC project addressing many aspects of the SRIA as noted in chapter 3, it is important that the EOSC Future project consortium reflects on what activities should be prioritised next.

[1] Strategic Research and Innovation Agenda (SRIA) of the European Open Science Cloud (EOSC), v1.0, 15th February 2021, https://www.eosc.eu/sites/default/files/EOSC-SRIA-V1.0_15Feb2021.pdf

[2] Strategic Research and Innovation Agenda (SRIA) of the European Open Science Cloud (EOSC), v1.1, 1st November 2022, https://eosc.eu/sites/default/files/SRIA%201.1%20final.pdf

3 The current state of play

This section outlines the current state of play, explaining what is recommended in the SRIA and where those activities are being addressed in EOSC Future. For this, and for independent readability, we repeat sections 3.1 and 3.2 from D2.7a.

3.1 SRIA November 2022

The EOSC objectives tree notes three core objectives and contextualises these by identifying the problems and barriers they seek to address, as well as the resulting benefits to be gained by meeting them. At a general level, these objectives address the human and policy dimension, the data and content to be exploited and the infrastructure and services needed to enable this. These objectives should be realised by the EOSC Partnership, which is a collaboration between the European Commission, on behalf of the European Union, and the EOSC Association together with its members.

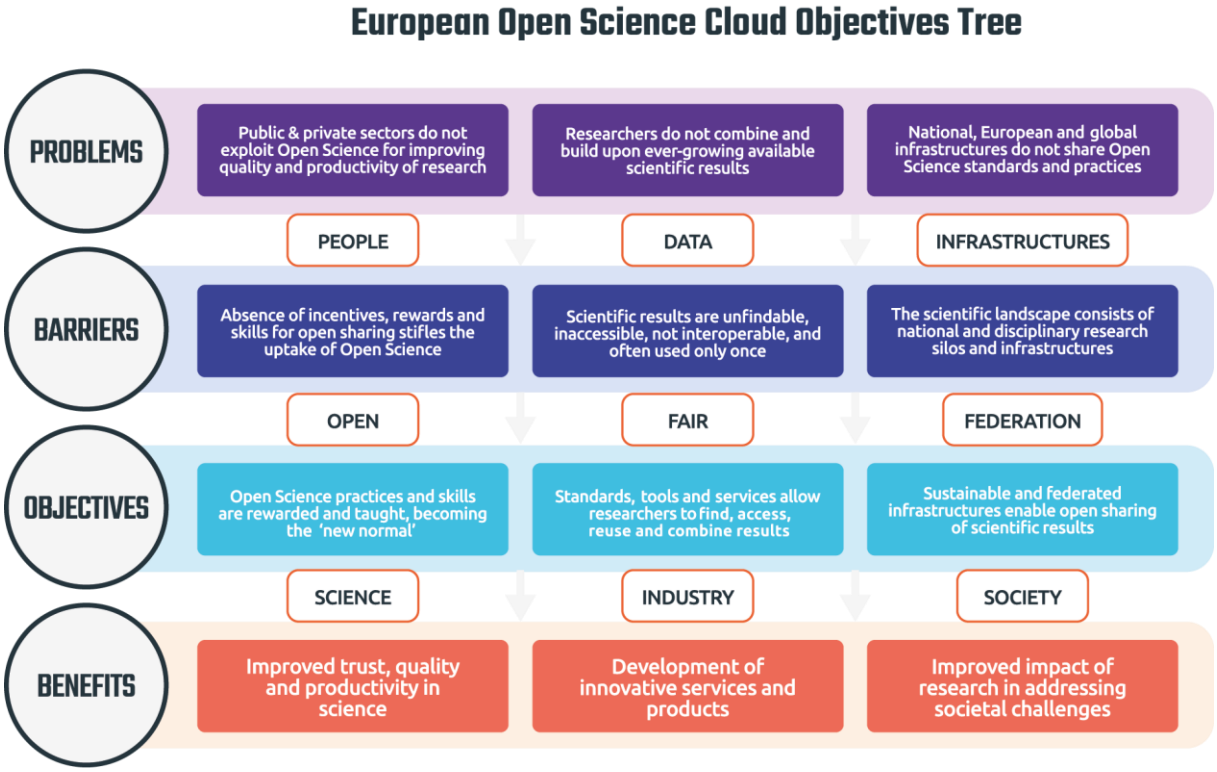

Figure 3.1: The European Open Science Cloud Objectives Tree

3.2 EOSC Future activities mapped to the SRIA action areas

In order to address these overarching objectives, there are 14 action areas noted in the SRIA. Several of these are relevant for and can be mapped against EOSC Future project activities as noted in the table 3.1 below. The recommendations in green align with EOSC Future activities. 11 of the 14 action areas have overlaps with EOSC Future activity and those that are not addressed in this project are being considered in other fora (e.g. FAIR metrics being addressed with FAIR Impact and Business models being addressed in EOSC Focus and the EOSC Association Task Force on financial sustainability). As such, we can see a clear progression towards developing a Minimum Viable EOSC, though work remains in several areas.

Table 3-1: SRIA priorities mapped against EOSC Future activities.

The recommendations in green align with EOSC Future activities

Ref	Topic	Recommendations	EOSC Future activities
5.1	Identifiers	– Establish mature and recognised PID infrastructures for emerging resource types. – Develop a 'meta resolver' that can deal with any type of relevant identifier. – Define specifications for PID records. – Produce type definitions for the most common data formats. – Support the creation and use of a PID graph – Develop tools to certify PID infrastructure.	
5.2	Metadata and ontologies	– Develop governance structures to coordinate the work on metadata and ontologies. – Support registries of metadata schemas and ontologies with clear protocols for harvesting, crosswalks, and metadata management. – Maximise the re-uptake of information in systems that communicate in a semantically interoperable manner. – Develop EOSC guidelines for a minimum metadata description. – Develop services that build on metadata registries.	Recommendations for minimum metadata to support the discovery, metadata exchange, and crosswalks of research products across communities (D3.2).
5.3	FAIR metrics and certification	– Assess and test the proposed EOSC FAIR data metrics in a neutral forum. – Support the definition and implementation of evaluation tools. – Support the definition of FAIR for software. – Support data and service providers to progress in the FAIRness of their holdings. – Align repository certification standards and assessment schemas with FAIR. – Establish core criteria to certify other key elements of the FAIR ecosystem. – Establish registries of certified components of the ecosystem.	No actions relevant within EOSC Future, though being addressed by FAIR Impact, the EOSC Association FAIR Metrics Task Force and other fora
5.4	Authentication and authorisation infrastructure (AAI)	– Establish and implement a common framework for managing user identity & access. – Ensure long-term attribute availability, assurance, freshness, and provenance. – Scale the current proxy (BPA) architecture and supporting infrastructure. – Address user experience challenges. – Provide solutions for identity beyond the research and education community. – Enable identity for the individual scientists. – Develop future trust fabrics and authorisation models in support of dynamic collaborations.	EOSC federated authorisation and authentication, enabling seamless integration of community AAI with EOSC AAI federation (D7.3).
5.5	User environments	– Integration of existing catalogues and portals. – Information about resources should be aggregated to enhance discovery.	Science cases for development of EOSC Architecture (WP6).

		– The distributed architecture model must address legal and organisational frameworks to enable researchers to compose resources. – Strong engagement and consultation is required to ensure interoperability and integration of portals, thematic and regional community services and resources.	Front office requirements analysis, leading to design spec and software release (D5.1, D5.2, D5.3).
5.6	Resource provider environments	– Ensure more efficient onboarding of resources and integration with existing community catalogues and repositories. – Enable the composability of resources and across resource providers. – Ensure the guidelines for resource providers are appropriate to and respectful of the existing interoperability frameworks available at a community level. – Incentivise resource providers to produce and operate resources that are Open Science by design.	EOSC providers services and resource catalogue Workflows developed from the moderation process to onboard external providers (D6.2). Procurement plan for additional services (D8.3). Purchase of private sector solutions to be co-developed with the EOSC DIH and onboarded in the Marketplace
5.7	EOSC Interoperability Framework	– Use open specifications to ensure technical interoperability. – Define a common security and privacy framework. – Govern and maintain repositories of semantic artefacts. – Define clear protocols for the federation / harvesting of these repositories. – Define a list of EOSC-recommended licences. – Implement minimum standardised, human- and machine-readable expressions of right statements and use conditions.	EOSC Architecture and Interoperability Framework, including PIDs, AAI, Metadata and Ontologies, Monitoring, Processing, Compute and Publishing (D3.2) EOSC Future has defined a Security Operational Baseline https://doi.org/10.5281/zenodo.7396724
6.1	Rules of Participation	– Apply the RoP to all digital resources made accessible via EOSC. – Define a minimum set of rights, obligations, and accountability for all those participating. – Evolve the RoP to include aspects on FAIR, Terms and Conditions and Acceptable Use. – Provide a governance structure for the RoP and coordination of EOSC projects.	Onboarding procedures and workflows (D6.1 & D6.2). Inventory of Core Functions and Inclusion Criteria (D2.5).
6.2	Landscape monitoring	– Ensure continuous monitoring of the existing readiness of countries to contribute to EOSC. – Stimulate the definition and implementation of EOSC-related policies and strategies. – Stimulate EOSC-dedicated funding streams and criteria in national programmes. – Stimulate dedicated funding streams for Open Science at institutional level. – Stimulate investment in national infrastructure contributing to EOSC.	EOSC Observatory and mappings to feed into this (D2.2, D2.3, D2.8). Open Science Monitor (included in D5.3).
6.3	Business models	– Perform cost assessments for the EOSC Core services and Minimum Viable EOSC. – Develop financing schemes for EOSC. – Develop monitoring schemes for the in-kind contribution of members. – Develop synergies between national and EC funding streams.	No actions relevant within EOSC Future, though being addressed in EOSC Focus and EOSC Association Financial Sustainability Task Force

			EOSC DIH sustainability workshops, draft cost assessment of business pilots and analysis of potential revenue models
6.4	Skills and training	– Develop the next generation of Open Science and data professionals as well as upskilling existing staff who need to keep pace with current Open Science practices, such as repo managers, research software engineers, service providers and others. – Coordinate and align curricula for students and researchers. – Build a trusted and long-lasting knowledge hub of learning materials and related tools. – Influence national Open Science policy for skills by supporting strategic leaders.	EOSC Knowledge Hub (training catalogue and learning platform) (D9.2). EOSC Training Programmes Results (D9.3). EOSC DIH business-oriented training activities
6.5	Rewards and recognition	– Demonstrate leadership in enacting change towards a culture of trust, openness and risk taking. – Prepare Human Resources to adjust Rewards & Recognition (R&R) structures (including approaches to recruitment and promotion) using next generation and progressive metrics. – Safeguard institutional autonomy. – Identify and remove legal obstacles to empower researchers, organisations, and funders to develop and refine better R&R systems.	No actions relevant within EOSC Future, though being addressed under the Coalition for Advancing Research Assessment (CoARA) and other fora. EOSC DIH as a space for experimentation and innovation between researchers and the private sector
6.6	Communication	– Set up a Strategic Communication Plan. – Inform stakeholders about the developments of EOSC. – Develop and deploy communication channels. – Work on licensing and ownership issues.	Liaison with EOSC Association on communications (D10.1). Support of EOSC Symposia (D10.2). EOSC DIH channels for business-oriented communication
6.7	Widening to public and private sectors and going global	– Widen EOSC stakeholder engagement in a strategic and timely manner, noting that consultation placed this action lowest in relevance for the immediate future.	Alignment with MS/AC & strategic initiatives (D2.4). EuroHPC engagement plan (D2.6). Procurement plan and Business Pilots for additional services (D8.3). EOSC Digital Innovation Hub final results (D8.5) supporting pilot campaigns for private sector engagement and partnerships with other EU initiatives and industry networks. Procurement plan for data spaces (D8.6).

3.3 Summary of the forthcoming work programme

Several of the SRIA action areas will be further advanced by work funded under the forthcoming work programme[3]. The calls are described in the table on the next page to help identify areas which still require further work.

As can be seen, many of the priorities from the 2023-24 Multi-Annual Roadmap have been reflected in the Work Programme, such as infrastructure for software, FAIR metrics, interoperability, trusted environments for sensitive data, long-term preservation, and a network of trusted repositories. Projects will also be supported to further the EOSC Core infrastructure and EOSC Exchange, alongside the procurement activity on these topics.

There are five key areas recommended by EOSC Future. The first three of these build on existing planned work in Horizon Europe and extend it further, while the final two are under-represented and identified as gaps:

- **Development of national / regional EOSC nodes**: this should continue work planned in HORIZON-INFRA-2024-EOSC-01-02 and be based on existing national and regional activities.
- **Supporting practical, scientific use cases**: this should leverage on the ESFRI science clusters (ENVRI-FAIR, EOSC Life, PANOSC, CESSDA and SSHOC) and build on the outcomes of HORIZON-INFRA-2024-EOSC-01-01.
- **Interoperability and standards**: while support for consolidating community standards is covered in HORIZON-INFRA-2024-EOSC-01-03 and HORIZON-INFRA-2024-EOSC-01-04, we believe greater support should be directed towards research communities to develop and maintain their standards and develop alignments and crosswalks between them, where relevant.
- **Core allocation of compute and storage resources**: there is no baseline level of storage and compute offered to EOSC users, and forthcoming calls on EOSC Core and Exchange do not have this in their suggested activities. It has also been identified as a gap during EOSC Future reviews and by the Technical Interoperability Task Force of the EOSC Association. Hence, we recommend it for inclusion in 2025-27 to increase adoption, e.g., by using the experience with the OCRE framework in the project's WP8 calls.
- **Recognition and rewards**: while some projects and initiatives such as CoARA[4] are doing work in this area, it is not covered in the forthcoming work programme, and we see opportunities for greater alignment to embed new Open Science metrics and assessment methods within the EOSC stakeholder communities.

[3] Horizon Europe Work Programme 2023-2024, 3. Research Infrastructures, 6th December 2022, https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/wp-call/2023-2024/wp-3-research-infrastructures_horizon-2023-2024_en.pdf

[4] CoARA - https://coara.eu

Table 3-2: Horizon Calls

Call	Key activities
HORIZON-INFRA-2023-EOSC-01-01	Build on the science cluster approach to ensure the uptake of EOSC by research infrastructures and research communities • Consolidate common EOSC approaches between the RI communities involved in the five science clusters • Support community-based competence centres for continued EOSC-alignment and outreach to new communities • Demonstrate the use of EOSC resources by multiple communities through cross-RI and/or cross-domain projects
HORIZON-INFRA-2023-EOSC-01-02	Development of community-based approaches for ensuring and improving the quality of scientific software and code • Foster alignment of existing initiatives by promoting coherence and developing community guidelines • Promote the use of existing technical specifications, standards and infrastructure • Define software delivering and packing best practices towards software reusability • Ensure integration of infrastructure, tools and services for anything that is code-based • Define a baseline of Source Code quality and provide tools for the automatic testing of conformance • Develop minimum quality certification frameworks for software • Allow for the integration of automatic testing for security vulnerability and license infringements • Ensure optimal and sustainable software archival practices and mainstream software citation • Incentivise open, community-driven and sustainable software development • Develop FAIR metrics frameworks for digital objects such as software, code, computational models, workflows • Develop or align pre-existing training materials for software development skills, digital badges, etc
HORIZON-INFRA-2023-EOSC-01-03	Planning, tracking, and assessing scientific knowledge production • Contribute to the standardisation of DMPs and seek integration in pertinent automated workflows • Ensure the pervasive and comprehensive use of PIDs • Develop use cases of machine-actionable DMPs and automate the evaluation of DMPs • Promote the adoption of interoperable Scientific Knowledge Graphs across countries and disciplines • Extend FAIR metrics guidance, tools, and models to meet the needs of domains and all digital objects • Define a trusted governance to measure successful compliance with metrics/tests • Define minimum levels of FAIRness for a wide spectrum of digital object • Explore how services, processes and activities can be FAIR-inducing, and lead to FAIR-by-design digital objects
HORIZON-INFRA-2023-EOSC-01-04	Next generation services for operational and sustainable EOSC Core Infrastructure • Improve the EOSC Core execution framework by enhanced composability and interoperability • Design and develop components to support seamless integration and composability of applications, tools and services • Provide open API registry, management, development and testing platform and tools for EOSC Core service users

	• Support custom-made front-end portal development environment for various scientific communities and personalization and AI-driven recommendation software for user experience • Facilitate an independent EOSC service incubator and technology development environment to act as a 'testbed' • Ensure financial sustainability and readiness assessment for the next-generation of EOSC Core and horizontal services
HORIZON-INFRA-2023-EOSC-01-05	EOSC Architecture and Interoperability Framework • Provide structure to manage, update, circulate and promote the EOSC Interoperability Framework and guidelines • Coordinate the establishment of IFs and the making of existing IFs available through a library/repository • Support communities in making their IFs available through EOSC IF library • Establish an independent, multi-stakeholder Architecture Board to oversee EOSC MVE deployment and operation • Define processes and guidelines to enable EOSC Core delivery and to ensure openness of EOSC
HORIZON-INFRA-2023-EOSC-01-06	Trusted environments for sensitive data management in EOSC • Explore the possibility of creating specific Public Authorities' Government Zones in EOSC, providing tailored access control and engaging closely with public authorities to establish safe and secure access to their data for FAIR data processing • In addressing the above it is expected that work will cover sensitive data processing workflows, secure data storage, anonymisation, access control management, decentralised transaction records, encryption, data protection in cloud hosted workflows and federated architecture solutions
HORIZON-INFRA-2024-EOSC-01-01	FAIR and open data sharing in support of the mission adaptation to climate change • Use and integrate EOSC resources and extend these to climate adaptation domains that are less familiar with EOSC • Support cross-domain, strategic use cases of direct relevance to the implementation plan of the mission climate adaptation • Provide feedback to the EOSC Partnership on the desired future evolution of the EOSC platform • Foster the creation of user environments that researchers in this field can then use to seamlessly interact with digital information in the framework of the EOSC ecosystem
HORIZON-INFRA-2024-EOSC-01-02	Supporting the EOSC Partnership in further consolidating the coordination and sustainability of the EOSC ecosystem • Enhance EOSC coordination, establishing a more dynamic and responsive interconnection of national nodes • Support the creation of national node structures in countries where those are not yet implemented • Strengthen collaboration and alignment within the portfolio of EU-funded projects, EOSC Association and member activities and other initiatives contributing to the objectives of the EOSC SRIA • Implement clear financial models to support for long term financial sustainability, adopting the most adequate solution to ensure smooth access to transnational resources in EOSC
HORIZON-INFRA-2024-EOSC-01-03	Enabling a network of EOSC federated and trustworthy repositories and enhancing the framework of generic and discipline specific services for data and other research digital objects • Create a European network of trustworthy digital repositories following FAIR-enabling principles with disciplinary and geographical spread • Build a lean governance for the network to moderate, coordinate, align and represent repositories • Enhance the technical federation with standards, APIs and solutions that could enhance the access to resources

	• Increment the framework of services of repositories in the network to support institutions and communities • Promote stable general and discipline-oriented initiatives to support consolidation of metadata schemas and vocabularies, standards in formats and services and to foster interoperability
HORIZON-INFRA-2024-EOSC-01-04	Long-term access and preservation infrastructure development for EOSC, including data quality aspects • Establish a minimum set of practices and a general framework to identify what data is candidate to long term preservation • Support the creation of long-term preservation and access strategies and processes among the different scientific disciplines • Engage domain specific networks that will consolidate practices and standards, such as metadata and ontologies • Enrich EOSC with tools to store and access digital data for long periods, automate and federate curation / preservation tasks • Create an expert curation network that will enhance and facilitate the curation process and the digital preservation actions • Consolidate a network of repositories and archives for long-term preservation to address economy of scale • Address sustainability solutions to ensure long-term preservation services in the EOSC ecosystem. • Coordinate disciplinary networks to develop and promote guidelines to produce high quality data, agree on standards to assess the quality of data and widely promote these among the European research ecosystem • Define, with experts from the disciplinary networks common requirements for data quality that are valid across disciplines
HORIZON-INFRA-2024-EOSC-01-05	Innovative and customizable services for EOSC Exchange • Improve the technology readiness level (TRL) of the EOSC Exchange components • Further develop the ecosystem of research data and related services, covering the whole data lifecycle • Facilitate the collection and analysis of heterogeneous and/or large-scale data sets • Support automatic production of FAIR data at the research instruments and support infrastructures by metadata automation tools and techniques • Add layers to the federated EOSC Data Lake that collects unstructured, semi-structured and structured data sets in order to provide customizable Data Warehouse and Data Mart services used by researchers to prepare for data analytics • Support data streaming and real-time data management and analytics integration • Propose scalable and reliable messaging/even hubs, based on the publish-subscribe principle, for real-time data sources to be integrated into EOSC

4 EOSC Future recommendations for the SRIA and MAR 2025-27

4.1 Recommendations for the MAR 2025-2027

Below is a list of priority areas that the EOSC Future consortium puts forward for consideration in the 2025/27 work programme.

These can be categorised as focusing on aspects that

- support the embedding and uptake of the EOSC platform,
- make it easier for researchers to access services,
- support greater interoperability across disciplines,
- allocate core compute and storage resources,
- provide access to commercial services, and
- ensure appropriate recognition and rewards for culture change.

4.1.1 Development of national / regional EOSC nodes

The procurement call for Managed Services for the European Open Science Cloud platform[5] requests that a contractor or consortium develops the EOSC node at European Level. The premise here is that other nodes at national, regional and institutional level may be federated at a later stage. Successful programmes of work have already been supported by the European Commission to advance regional Open Science activities, specifically via the INFRAEOSC 5b projects. This call comprised EOSC Nordic, EOSC Pillar, EOSC-Synergy, NI4OS-Europe and ExPaNDS.[6] Outputs from the projects include regional catalogues and training resources which have already been integrated into the EOSC Portal and resources catalogue, thereby demonstrating how regional or national nodes can be federated into EOSC.

Engaging on a regional/country level with national services, as well as research funders and research performing organisations, provides an opportunity to better connect local support infrastructure into EOSC. By bringing institutional support infrastructure into closer alignment with EOSC, leverage can be made of institutional support staff such as data stewards to grow capacity for supporting FAIR and Open Science. Models such as the Dutch network of Digital Competence Centres[7] or the German NFDI[8] could be explored to establish closer links between support in research organisations and EOSC. Regional level engagement to support coordination activities will help with practical EOSC onboarding issues, as seen in the INFRAEOSC 5b examples.

The EOSC Association is also fostering the development of national Open Science fora and infrastructures via its Mandated Members and country-based Tripartite Collaboration events. Mandated organisations have a remit to coordinate and represent national interests, and to develop the awareness and engagement in EOSC on a national level. Several of the mandated organisations are also core e-Infrastructures or service providers so could also help play a role in establishing national EOSC nodes. Since the role of Member States and Associated Countries will play an increasingly significant part in developing and sustaining EOSC, national level engagement is a useful vehicle to ensure appropriate political buy-in as well as more pertinent, local based support for research users.

4.1.2 Practical, scientific use cases

In order to embed EOSC and promote meaningful adoption by research communities, stronger connections to the Research Infrastructures, ESFRI Forum, data spaces and missions are needed. The EOSC Association is already forming strategic partnerships, and further Coordination and Support Actions (CSAs) should be funded

[5] Managed Services for the European Open Science Cloud (EOSC) Platform, 25th January 2023, https://etendering.ted.europa.eu/cft/cft-document.html?docId=136318
[6] EOSC Nordic - https://www.eosc-nordic.eu, EOSC-Pillar - https://www.eosc-pillar.eu, EOSC-Synergy - https://www.eosc-synergy.eu, NI4OS-Europe - https://ni4os.eu, and ExPaNDS - https://expands.eu
[7] https://www.lcrdm.nl/dcc
[8] https://www.nfdi.de/?lang=en

to enhance these engagements. The focus in 2025-27 should be on embedding EOSC into the core operations of Research Infrastructures, missions and data spaces, using practical use cases as a way to demonstrate value.

The existing work to federate e-Infrastructures and Research Infrastructures in EOSC Future could be built on further to pursue a domain or sectoral focus addressing global challenges. In order to support practical, scientific use cases and demonstrate the value of EOSC for specific research communities, we recommend a continuation of thematic research calls such as:

- INFRA-2021-EOSC-01-06: FAIR and open data sharing in support of cancer research
- INFRA-2022-EOSC01-03: FAIR and open data sharing in support of healthy oceans, seas, coastal and inland waters
- INFRA-2024-EOSC-01-01: FAIR and open data sharing in support of the mission adaptation to climate change

Focusing on research community needs and directing greater investment to specific science areas will demonstrate how FAIR and open practices help to advance research. European Missions could serve as use cases and proof of concepts to establish best practices to be adopted in the context of integrating heterogeneous datasets for advanced AI aligned with global environmental, social, health and economic challenges, demonstrating the value of EOSC and FAIR data.

4.1.3 Interoperability and standards

While much work has been supported to develop the EOSC Interoperability Framework through EOSC Future and the forthcoming INFRA-2023-01-05 call, the development of community standards and particularly crosswalks between them to support interdisciplinary reuse is still needed.

In order to populate the registry/repository of Interoperability Frameworks, a strong body of community-endorsed, well-maintained standards is required. The absence of quality interoperable metadata continues to be a major obstacle to the discovery and reuse of research outputs, so greater support to enable communities to develop and maintain their standards is needed.

We also recommend the continued development of open interfaces, alignments, crosswalks, and APIs that support the reuse of research data and software in different contexts. Research communities should be at the core of this work and should set priorities for crosswalks between standards, based on specific use cases. Stakeholders such as research funders, infrastructure providers and research performing organisations should also be engaged to promote the adoption of standards and interdisciplinary reuse.

4.1.4 Core allocation of compute and storage resources

EOSC is presented as an environment in which researchers can access data and associated services, but it is unclear how access to such services will be funded and allocated. There is no model for individual researchers or small teams who may want to look at the data that is accessible via EOSC to be provided with the necessary storage and compute. Clear requirements processes exist for researchers to apply for access to compute resources through large research infrastructures, but there are not yet well-defined processes for how others could transparently access IT capacity to visualise and process the data within the context of EOSC.

Access to services is still managed through individual providers and will not permit one RI or national compute facility to finance the IT resources for processing data from others, or by users who are not in their remit to support. If the end users cannot easily access resources within EOSC, the practice of transferring the data to the local PC/laptop will prevail and the benefits of providing an environment where data can not only be found but also accessed, processed and reused will not be achieved.

The Virtual Access Mechanism has been tested to distribute storage and compute services via the INFRAEOSC-07 projects. However, we recommend that a small baseline allocation of storage and compute is provided to all European researchers to facilitate use of the EOSC platform. This gap was also identified in EOSC Future reviews and by the EOSC Association Technical Interoperability Task Force. Access to these resources could be delivered via a provisioning agreement with national, regional, or commercial providers, or via procurement along the lines of the OCRE framework contracts.

4.1.5 Access to commercial services

EOSC should support access to commercial services to ensure all European public-sector researchers can benefit from functionality offered by these services, against good conditions. The MAR currently has no mention of access to commercial services. This activity should support both access to commodity services and allow for EOSC users to act as launching or early customers for new services typically developed by SMEs.

Access to commercial-infrastructure cloud services has been enabled through the framework agreements established by the OCRE-project and has been further developed in the EOSC Future project. The results of these two projects are being sustainably continued by GÉANT which will ensure re-procurement of the OCRE agreements before their expiry end of 2024. If demand for any other types of commercial services is to be identified and services subsequently made available through EOSC, an activity towards this should be specified at European level. The upcoming OCRE-reprocurement should also take the EOSC context into account.

The currently most scalable and deployable method identified is to establish and maintain a portfolio of procurement-compliant agreements with research-relevant commercial services, available to the legal entities employing the public-sector researchers. This implies assessing which service types are in sufficient demand to warrant a joint European procurement through a central purchasing body, executing the procurement for a particular type of service, and ensuring the results of that procurement are made available (and taken up) by the one million public-sector researchers. Through EOSC Future, various mechanisms for making the outcome of a joint procurement exercise available to researchers have been defined and tested with good success. However, mechanisms to assess demand for other commercial services in the wider EOSC community have so far proven elusive.

We suggest a call to widen EOSC's portfolio of commercial services with procurement-compliant agreements with service types other than infrastructure-cloud, to develop and test good mechanisms for continuous demand assessment of commercial services at EOSC-scale and to stimulate the uptake of newly established agreements for new service types. We suggest a point in the MAR that makes explicit the necessity of European-level action to ensure availability of procurement-compliant framework agreements with commercial research-relevant infrastructure-cloud suppliers to all European public-sector research institutions.

4.1.6 Recognition and rewards

In order to promote the culture change needed to make Open Science the new normal, a reform of research assessment criteria is needed. Work is already ongoing in this area via European Commission funded projects and specifically through CoARA which acts as a focal point for coordination of developments. CoARA members, who include funders and research performing organisations, have committed to experiment with new methods for research assessment in order to agree appropriate approaches for the future.

In order to support this work we recommend further investment via EOSC to support the development of metrics / indicators alongside the methods, tools and procedures needed to apply these to evaluate Open Science practices. In order to develop appropriate metrics and indicators, a review of existing best practice should be conducted to identify suitable measures for testing and implementation. Following this, appropriate tools and processes can be developed to enable testing in different contexts, since recognition and rewards is still predominantly focused on outdated measures of science. Support is also needed at national and institutional levels to enable pilot studies and whatever interventions are needed to transform policies and laws to recognise the new criteria.

4.2 Recommendations for the SRIA

Much has developed within the EOSC context since the SRIA was first published in June 2021. As such we recommend to update and add new sections on the Tripartite Collaboration and EOSC Association governance to explain how work is being coordinated and the respective inputs from each party. The future plans for governance post-2027 and new legal structures should also be clearly outlined to highlight how the governance and legal structures are likely to evolve. This should update the "EOSC in the making" section, setting the current governance in the wider context of the European Strategy for Data, Common European Data Spaces and the ERA actions.

Likewise, the "New ways of science" section should be updated and reduced to focus less on historical context and more on the strategy for EOSC, national developments in MS & ACs and expected added value from the collective contributions. The strategic objectives for EOSC are still valid and provide strong continuity, so we recommend retaining the current structure here, and in the action areas as a whole.

Some of the implementation challenges or boundary conditions (action areas) could potentially be merged or rethought. There is overlap in topics like metadata and ontologies and EOSC interoperability framework, and with user environments and resource provider environments. These latter two could potentially be remodelled as the EOSC MVE or core platform to be more in line with the current procurement call.

The content within the Communications section overlaps with internal work of the EOSC Association secretariat and would be better reworked as overall communication and stakeholder engagement for EOSC at large. This could reflect on the key messages about EOSC and how these are shared consistently by the different initiatives, how research communities are being engaged to ensure usage of EOSC, liaison with ESFRI Forum / Research Infrastructures to build an effective data federation, and engagement of the Member States and Associated Countries.

There are also topical areas which have become new priorities in the 2023-2024 MAR which are not well reflected in the existing action areas, in particular data quality, sensitive data, long-term preservation, and infrastructure for research software. These could be addressed collectively under topics such as data services or repositories, addressing the different content types and processes needed to ensure appropriate access and management.

5 Conclusions

The EOSC Future project is establishing the MVE of the EOSC-Core, EOSC-Exchange and Interoperability Framework. The development of EOSC however needs to advance beyond the MVE, hence the identification of several priority areas for the forthcoming Work Programme.

These priorities emphasise areas where additional work is needed, such as on interoperability, and aspects related to embedding and rolling out the platform via collaboration with Member States, RIs and provision of services to users.

There are six specific key areas recommended by EOSC Future:

- **Support the embedding and uptake of the EOSC platform via national / regional EOSC nodes**.
- **Make it easier for researchers to access services, e.g., by supporting practical, scientific use cases.**
- **Support greater interoperability and standards across disciplines.**
- **Allocate core compute and storage resources.**
- **Provide access to commercial services.**
- **Ensure appropriate recognition and rewards for cultural change.**

In addition, EOSC Future recommends updating the SRIA, considering that much developed within the EOSC context since the SRIA was first published in June 2021. As such EOSC Future recommends to update the "EOSC in the making" section and add new sections on the Tripartite Collaboration and EOSC Association governance; to update the "New ways of science" section with more focus on strategy and national developments; to consider merging some boundary conditions to reflect the current situation, to integrate the Communications section with related activities and initiatives; to include new priorities, like data quality, sensitive data, long-term preservation, and infrastructure for research software.

We wish to acknowledge all the consortium members who helped to shape the recommendations put forward for consideration.