

Grant Proposal

DiSSCo Transition Abridged Grant Proposal

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Abstract

The Distributed System of Scientific Collections (DiSSCo) is a pan-European Research Infrastructure (RI) initiative. DiSSCo aims to bring together natural science collections from 175 museums, botanical gardens, universities and research institutes across 23 countries in a distributed infrastructure that makes these collections physically and digitally open and accessible for all forms of research and innovation. DiSSCo RI entered the ESFRI roadmap in 2018 and successfully concluded its Preparatory Phase in early 2023. The RI is now transitioning towards the constitution of its legal entity (an ERIC) and the start of its scaled-up construction (implementation) programme. This publication is an abridged version of the successful grant proposal for the DiSSCo Transition Project which has the goal of ensuring the seamless transition of the DiSSCo RI from its Preparatory Phase to

the Construction Phase (expected to start in 2025). In this transition period, the Project will address five objectives building on the outcomes of the Preparatory Phase project:

- 1) Advance the DiSSCo ERIC process and complete its policy framework, ensuring the smooth early-phase Implementation of DiSSCo;
- 2) Engage & support DiSSCo National Nodes to strengthen national commitments;
- 3) Advance the development of core e-services to avoid the accumulation of technical debt before the start of the Implementation Phase;
- 4) Continue international collaboration on standards & best practices needed for the DiSSCo service provision; and
- 5) Continue supporting DiSSCo RI interim governance bodies and transition them to the DiSSCo ERIC formal governance.

The Project's impact will be measured against the increase in the RI's overall Implementation Readiness Level (IRL). More specifically, we will monitor its impact towards reaching the required level of maturity in four of the five dimensions of the IRL that can benefit from further developments. These include the organisational, financial, technological and data readiness levels.

Keywords

natural science collections, natural history collections, research infrastructure, global natural science, digitisation, data standards, Distributed System of Scientific Collections, DiSSCo, Digital Specimen Architecture, FAIR Data Ecosystem, FAIR digital objects

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Context

This paper is an abridged version of the original proposal which was submitted in March 2023. It contains the overarching scientific case for DiSSCo Transition, alongside a description of our major activities. Differences between this paper and the full “Description of Work” include redactions of financial and personal information alongside our risk analysis; inclusion of additional citations that could not be included in the original proposal due to space limitations; minor edits to improve readability; and the inclusion of higher resolution versions of the figures. The abridged proposal is published here to frame the publication of future outputs from DiSSCo Transition.

1. Excellence

DiSSCo Value Proposition and Current Status

The Distributed System of Scientific Collections (DiSSCo) is a pan-European Research Infrastructure (RI) initiative. DiSSCo aims to bring together natural science collections from **175 museums, botanical gardens and universities across 23 countries** in a distributed infrastructure that makes these collections physically and digitally open and accessible for all forms of research and innovation. DiSSCo **leverages data, expertise and capacity of its distributed facilities, collections and human capital to deliver new cohesive user services** (Fig. 1), predominantly to scientific communities linked to biological and geological diversity (Table 1). DiSSCo adopts novel technologies and approaches to knowledge management which will enable it to achieve its core objective of scaling up knowledge production and broadening the spectrum of users, increasing participation and accessibility of biodiversity and geodiversity knowledge.

Table 1.

Value proposition of DiSSCo RI in relation to **specific needs of its primary user community** (geo- and biodiversity).

Challenge addressed	How DiSSCo responds
Taxonomic expertise across our local collections is declining.	A community curation model that is able to share expert resources across locations, transforming institutionally restricted curation to a collaborative community model.

Challenge addressed	How DiSSCo responds
Digitisation investments are scattered and uncoordinated.	A pan-European digitisation programme that ensures effective scientifically driven prioritisation of content mobilisation across all European assets.
Trust in digital evidence is declining because of quality concerns.	Re-unification of all data classes derived from the study of collection objects and provision of unified access to the digital twins of physical specimens, along with extended provenance information.
Physical, remote and virtual access to collections is disconnected.	An orchestrated multi-modal access programme for European collections.
Collections development is fragmented, and investment decisions are taken based only on institutional or national gaps.	Services that allow a strategic and data-driven understanding of the taxonomic and geographic gaps in biodiversity and geodiversity surveying and related European wide policies that would enable for a pan-European collections development programme.
Data deriving from the study of vouchered specimens is disconnected.	A new concept—the digital extended specimen—is at the core of the data architecture of DiSSCo. The digital extended specimen is an enhanced digital twin of a physical specimen. They act as human-readable and machine-actionable knowledge units that integrate all data from studying the physical object.
The use of collection-derived information in scientific outputs is poorly monitored.	The deployment of a persistent identifier system for digital specimens will facilitate the tracking of individual specimens across scientific publications.
Citizens often feel disconnected from science, which threatens trust in scientific results.	DiSSCo assists in (re-)connecting citizens with science by providing engaging data with cultural and scientific value and provides an infrastructure that promotes citizen scientist participation.

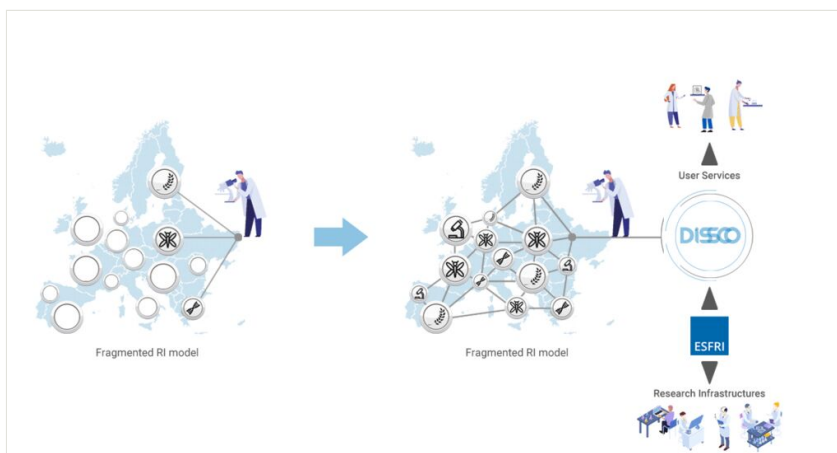


Figure 1. [doi](#)

Conceptual approach to delivering a distributed infrastructure for European natural science collections.

Current status

DiSSCo entered the European Strategy Forum for Research Infrastructures (ESFRI) roadmap in 2018. This achievement signalled the recognition of DiSSCo as a priority infrastructure for the European Research Area and it was the result of the long-standing collaboration between members of the network of European museums (the [Consortium of European Taxonomic Facilities - CETAF](#)). Ultimately, the ambition for DiSSCo is to obtain the status of a European Research Infrastructure Consortium (ERIC), a legal form that facilitates the establishment and operation of the RI. Developing an ERIC, in the context of the ESFRI, typically goes through a series of distinct yet highly interdependent phases (Fig. 2). The most prominent ones are



Figure 2. [doi](#)

Timeline of DiSSCo development until its implementation (Construction) phase through its new legal entity (ERIC). The Project acts as the bridge between DiSSCo Prepare and the start of the Construction (Implementation) Phase of the ERIC.

- the Preparatory Phase,
- the Transition Phase,
- the Construction Phase and
- the Operational Phase.

The Preparatory Phase of DiSSCo was implemented through a complex programme of EU-funded and institutionally funded projects (Table 2). Their completion in Q1 of 2023 marked the end of the Preparatory Phase (2018-2023) and signalled the **entrance to the Transition Phase**.

The Transition Phase is defined as the time between the end of the Preparatory Phase and the start of the Construction Phase. **The latter can only start once the RI legal entity is in place and member-state funding becomes available. The main goal during this**

transitional period is to ensure the formation of the ERIC legal entity as a prerequisite for receiving financial contributions from European governments. For DiSSCo, we expect establishing the legal status of ERIC in Q1 of 2025 (Fig. 2).

Table 2. Projects that directly contributed to the Preparatory Phase of DiSSCo and increased the Implementation Readiness Level of the RI.			
Project	Duration	Scope in relation to DiSSCo	Funding source
DiSSCo Prepare (Koureas et al. 2023)	2019 - 2023	Carried out key tasks across all IRL dimensions.	EU
SYNTHESYS+ (Smith et al. 2019)	2018 - 2023	Develop physical and virtual remote access models and early development of services and standards.	EU
MOBILISE	2018 - 2023	Community engagement and capacity building.	EU/COST Action
DiSSCo CSO project	2018 - ongoing	Programme coordination/support to governance.	Internally funded

1.1 Objectives

The goal of the DiSSCo Transition Project is to ensure the **seamless transition of the DiSSCo RI from the Preparatory Phase to the Construction Phase**. In this Project, we will carry out specific tasks, informed by the **DiSSCo Construction Masterplan (CMP)**, the final deliverable of the DiSSCo Prepare Project (Loo et al. 2023). These tasks are organised into five objectives. These objectives address the need for organisational and technical continuity, community engagement and other challenges identified as critical at the end of the DiSSCo Prepare Project.

Objective 1. Advance DiSSCo ERIC process and complete its policy framework (implemented through [WP1](#))

During the DiSSCo Preparatory Phase and specifically through the work done in the DiSSCo Prepare Project, the DiSSCo community developed the organisational and legal framework in which the DiSSCo RI can grow and operate. This included commissioning a study to: identify the most suitable long-term legal entity (an ERIC), prepare an early draft of the ERIC statutes (Scory et al. 2023) and the Strategic Plan and produce the required financial information (Koureas et al. 2023a).

During the Transition phase, we will continue to **build on the developed corpus of technical documents to complete and consolidate the process for the formal submission to the European Commission of Step 1 and Step 2 application for an ERIC**. We will **support the work of the DiSSCo Funders Forum Advisory Board (FF)**

(formed by ministerial representatives from prospective member states) in their negotiations to reach a consensus and complete the legal and technical documentation required for the ERIC establishment. We will develop the documents required for the early days of the DiSSCo ERIC, including the implementing rules and policies. The above will also enable the transition from the RI's interim governance to the ERIC's new formal governance.

Objective 2. Engage & support DiSSCo National Nodes (implemented through [WP2](#))

During the DiSSCo Preparatory Phase, the participation of institutions and the engagement of National Nodes was done through regular meetings, providing a platform to channel and support their formal commitment towards the RI. This allowed us to capture detailed information on the different needs of the Nodes when developing DiSSCo. These needs included costing, training resources and research priorities. The National Nodes have proven to be an effective channel for aggregating institutional data and tailor narratives for their respective governmental funding agencies.

The second objective will **focus on developing the participation of the National Nodes through two approaches:**

1. **a country-level approach, working with the national representatives of the nodes towards their countries' participation in the DiSSCo ERIC; and**
2. **a community-level approach, developing a comprehensive and consistent commitment towards the operation of the DiSSCo ERIC.**

During DiSSCo Transition, this dual approach will be further used to support the formal commitment of National Nodes to the DiSSCo ERIC, and to establish the path for engaging with future DiSSCo ERIC partners. Comprehensive information about the DiSSCo process will be shared through informative workshops and the identification of mechanisms and tools that will support decision-making at the national level.

Objective 3. Advance development of core e-services (implemented through [WP3](#))

Two work packages*¹ in DiSSCo Prepare laid the foundation for standards implementation, technical architecture and e-services provision. The DiSSCo e-services are expected to be developed in alignment with the provisional DiSSCo Data Management Plan (DMP - Hardisty (2019)), which describes protected characteristics regarding the centrality of the Digital Specimen, FAIRness and Digital Object architecture, as well as requirements for data security. FAIRness of the data means that all the data handled and used within DiSSCo will be Findable, Accessible, Interoperable, and Reusable (FAIR). Software development will follow modern practices like Agile*², DevOps*³ solutions and the resulting code is expected to be open-source and maintained in the [DiSSCo GitHub repository](#).

During the DiSSCo Transition Project, we will **maintain, update, and plan** for future operation and management of selected services that are either

- fundamental for the delivery of the core data architecture of DiSSCo or
- are already at a Technical Readiness Level (TRL) that require continuous development so that they avoid accumulating technical debt before software development activities resume in the Construction Phase.

The development of e-services in the Project will focus on **connecting fundamental end-user services** with core infrastructure components. This creates an integrated data infrastructure, aligned with the DiSSCo DMP and with the standards developed in [WP4](#).

Objective 4. Continue international collaboration on standards & best practices (implemented through [WP4](#))

Data Standards are fundamental tools that, when universally implemented, ensure systems and data interoperability. Especially for biodiversity information, the application of community Standards (such as Darwin Core^{*4}, ABCD^{*5}, IIF^{*6}) has raised the level of interoperability between data providers and data aggregators. DiSSCo data architecture relies on its capacity to process data from multiple sources and redistribute annotated information to other infrastructures and applications. Furthermore, the innovative data architecture planned for DiSSCo required the development of new community Standards, such as MIDS^{*7} and Latimer Core^{*8}. **The DiSSCo Transition Project will continue the work already started within the international community to develop these Standards further and deliver best practices on their implementation in DiSSCo and other linked international infrastructures.**

Objective 5. Continue supporting DiSSCo interim governance bodies (implemented through [WP1](#) and [WP5](#))

During the Preparatory Phase of DiSSCo we established a series of governance bodies. Collectively they ensured the optimum implementation of the DiSSCo Preparatory Phase programme (Table 3) and created opportunities for the engagement and commitment of the DiSSCo National Nodes (through the interim General Assembly) and future funders (through the Funders Forum) and ensured the scientific and technical review of the infrastructure (through the Scientific and Technical Advisory Boards). Their operation is still required and becomes even more important as we transition towards the Construction Phase. **The DiSSCo Transition Project will continue supporting these bodies, providing crucial information to them, and integrating their decisions or advice in the next steps of the DiSSCo development.**

Table 3.

Definitions of the different dimensions of the overall Implementation Readiness Level (IRL) of DiSSCo.

Dimension		Definition
Scientific Readiness	SR	Capacity of the RI to respond/adjust to current and anticipated user needs
Data Readiness	DR	Capacity of the RI data producers and stewards, across the distributed facilities, to serve FAIR and enriched data
Technological Readiness	TR	Capacity of the RI to meet the functional requirements of its user audience through comprehensive and sustainable technological solutions
Financial Readiness	FR	Capacity of the RI to put in place and implement a comprehensive business model
Organisational Readiness	OR	Capacity of the RI to set and implement fit-for-purpose governance and management policies as well as strategic and operational plans

1.2 Coordination and/or Support Measures and Methodology

1.2.1 Overall Coordination Approach

Building on the results of the previous projects

The Project's work plan is based on the recommendations of the DiSSCo Construction Masterplan (CMP). The CMP represents the compilation of all the outcomes of the DiSSCo Prepare Project and the collective effort and inputs of DiSSCo-related projects (Table 2). The CMP is a corpus of knowledge prepared as a design blueprint for the construction and operation of the DiSSCo research infrastructure, designed to support immediate and practical development. It provides over 170 actionable recommendations organised thematically. These recommendations are prioritised and mapped across the development phases of DiSSCo. During the DiSSCo Transition Project, we will use these recommendations and have prioritised those which are the most urgent and relevant to the overall goal of the Project, forming the basis of the Project's Work Packages & Tasks. The work plan of the Project does not address all the prerequisites of the Construction Phase but prioritises areas of work that rely on multi-partner collaboration and international partnerships. The other critical recommendations of the DiSSCo CMP will be complementarily undertaken by the DiSSCo Coordination and Support Office (CSO), i.e. the executive office of DiSSCo RI.

Complementarity to other projects

DiSSCo RI is involved in other EU-funded projects that invest in networking, research or innovation activities. The outputs of these projects are crucial for the success of the infrastructure. As such, we anticipate that we will be able to integrate results from these projects before or during the Construction phase of DiSSCo. Specifically, the following projects and their outputs will be considered:

The Biodiversity Digital Twin (BioDT) Project

The Biodiversity Digital Twin for Advanced Modelling, Simulation and Prediction Capabilities (2022-2025 <https://bioldt.eu> European Commission (2023a)) project aims to develop a prototype that can simulate and predict global biodiversity dynamics by addressing multidisciplinary use cases. One of the main objectives is to build a FAIR Biodiversity Digital Twin that can facilitate the interoperability and link of various scientific models, datasets, workflows, algorithms and software. To achieve this goal, Naturalis Biodiversity Center is leading a work package focused on FAIR and FAIR Digital Objects (FDO) (SGN is also a member of this work package). **DiSSCo's participation in FDO implementation provides crucial input to the BioDT project.** Additionally, integrating cross-research infrastructure data (from [eLTER](#), [LifeWatch](#) and the [Global Biodiversity Information Facility](#) (GBIF)) into the digital twin and High-Performance Computing (HPC) system can also aid the development of DiSSCo's FDO implementation and linkage with automation and enrichment services.

ENVRI FAIR Project

ENVRI FAIR (2019-2023 <https://envri.eu/home-envri-fair> European Commission (2023b)) aims to operationalise FAIR implementation in the environmental sciences and biodiversity community. As part of this effort, Naturalis and CETAF are collaborating on a work package focused on the FAIR implementation timeline and roadmap for different RIs. In addition, we are working with LifeWatch and Catalogue of Life to develop best practices for using and resolving scientific names. Through this collaboration, we address persistent identifiers, metadata, data catalogues and Authorisation and Authentication Infrastructure (AAI) in the cross-RI FAIR implementation framework. The results of this work have already provided valuable input for DiSSCo's FAIR roadmap, and the collaboration is expected to continue beyond the conclusion of ENVRI FAIR.

The Biodiversity Genomics Europe (BGE) Project

The Biodiversity Genomics Europe (2022-2026 <https://biodiversitygenomics.eu> European Commission (2023c)) aims to accelerate the use of genomic science to enhance understanding of biodiversity by bringing together two networks – BIOSCAN Europe (which focuses on DNA barcoding) and the European Reference Genome Atlas (ERGA) (which focuses on genome sequencing). Genomic science in biodiversity is becoming a data-driven endeavour in parallel with the developments in DiSSCo and other stakeholders like INSDC, BOLD, ELIXIR and GBIF. The importance of natural history collections that bring in data from millions of specimens is widely recognised in this initiative and DiSSCo's involvement and usage of the Digital Specimen Architecture will play a crucial role here.

The Biodiversity Community Integrated Knowledge Library (BiCIKL) Project

The BiCIKL project (2021-2024 <https://bicikl-project.eu> European Commission (2023d)) aims to improve how biodiversity data are identified, linked, integrated and re-used across the research lifecycle. By doing so, BiCIKL helps to increase the transparency, trustworthiness and efficiency of the entire research ecosystem. BiCIKL catalyses a culture

change that has already started towards FAIR and interconnected data. It will start and build a new European starting a community of key research infrastructures, establishing open science practices in biodiversity. BiCIKL will provide new methods and workflows for integrated access to harvesting, liberating, linking, accessing, and re-using biodiversity data, including data from the literature. This will improve reuse and help build a global biodiversity knowledge graph.

TETTRIs

TETTRIs (2022-2026 <https://www.tettris.eu> European Commission (2023e)) aims to bring about a significant transformation in the field of taxonomy to address biodiversity changes by enhancing the capacity for taxonomic research and transferring critical scientific knowledge to key societal stakeholders. In advancing the field of taxonomy and beyond, TETTRIs will implement several technical and systems innovations developed by consortium partners and validated in collaboration with target groups such as citizen scientists, through third-party projects.

Approach to the Coordination of the Project

During the 18 months the DiSSCo Transition Project will be strongly focused on consolidating and advancing results from previous work to ensure DiSSCo RI enters its implementation phase with high scientific, data, technical, organisational and financial readiness. The Project will not operate in isolation. As mentioned above, it will be linked to the wider ecosystem of related projects and the wider DiSSCo RI activities (implemented outside of the DiSSCo Transition Project). Our approach to Project coordination includes:

(i) Simple and effective internal project management in proportion to the grant's budget.

The project's management team will comprise the project coordinator, a project manager and a project administrator, who will work together within a Coordination Team. The WP leaders, the management team and the chair of the Technical Team will form a Project Executive Board. The Project Beneficiaries will form the Project Council, which will be the ultimate decision-making body of the Project. Details on the terms of reference and rules of procedure for all the above will be drafted and agreed upon in the Consortium Agreement.

(ii) Alignment between DiSSCo Transition Project governance and DiSSCo RI governance

The work plan of the Project must be aligned to the wider activities of the RI during these 18 months. The DiSSCo CSO will be connected to the Project. The Project Coordinator will be the DiSSCo Coordinator and executive director of the DiSSCo CSO.

(iii) Use of DiSSCo advisory bodies for consultation and assurance

We will make use of the existing and long-standing advisory bodies of DiSSCo RI for guiding the Project beneficiaries as follows:

- The **Technical Advisory Board (TAB)** will advise on technical issues deriving from the activities of the Project and especially issues linked to [WPs 3 & 4](#). Furthermore, they will be reviewing key Project outputs;
- The **Scientific Advisory Board (SAB)** will guide on matters linked to the policy framework and wider engagement and impact of the Project;
- The **DiSSCo Technical Team (TT)** will be connected to [WPs 3 & 4](#) and monitor the overall progress of these technical WPs in relation to the DiSSCo technical development roadmap;
- The **Funders Forum (FF)** has a central role in the future of the RI. It is comprised of representatives of member states' ministries and funding agencies. The currently 11 countries-members of the FF are the potential founding members of DiSSCo ERIC. The Project will not only ensure continuous engagement with the FF through [WP1](#), but also ensure that key outputs are reviewed and agreed upon by the FF.

1.2.2 Open Science/Data Approach and Data Management

One vision outlined in Horizon Europe (European Commission and Directorate-General for Research and Innovation 2021) and other EU-funded programs is to embrace open science as the *modus operandi* for all researchers. The core idea behind DiSSCo's objective and the technical design aligns with this vision. The DiSSCo Construction Master Plan underpins a FAIR-by-design infrastructure with services and policies that foster open science*⁹ and open data*¹⁰.

The project's Data Management Plan (DMP) will include policies on the publication, storage, persistence and accessibility of all data produced or handled by project partners and under the practices of open science. The project's DMP should not be confused with the DiSSCo provisional DMP, which was created in EU funded project [ICEDIG](#) and will be updated and advanced into a machine-actionable DMP in [WP3](#). The DiSSCo provisional DMP underpins active data management planning and stewardship with a focus on achieving maximum accessibility and reusability of data, the longevity of data and data preservation, community curation, linking to third-party information and reproducible science. This is ensured through protected characteristics described in the DiSSCo DMP, such as centrality, accuracy and authenticity of the Digital Specimen, protection of data, preservation of readability, traceability/provenance, and annotation history. These are essential for open science and open data and will also help build long-term trust in DiSSCo.

Deliverable reports from this project will be stored in the DiSSCo Knowledgebase (<https://know.dissco.eu>), designed for persistent storage of FAIR documentation: all documents get a persistent identifier (DOI) and metadata that describes the document and its provenance when stored in this repository. Documents in the repository are publicly accessible and

findable. Software created in the project will be provided with open-source licences in a public repository (GitHub). The e-services developed in the project will be provided as part of the European Open Science Cloud (EOSC) public offering.

The DiSSCo technical infrastructure supports open and collaborative research practices by enabling the sharing of data at the earliest possible stage and making this available for reuse, enrichment and validation by both humans (researchers, citizen scientists) and Artificial Intelligence-driven machines. The FAIR design ensures the inclusion of persistent identifiers and metadata to provide context. Project results will be shared with Creative Commons*¹¹ licences suitable for open data ([CC0 Public Domain](#) and [CC-BY Attribution](#)) through this infrastructure.

By sharing natural science collections data openly, DiSSCo will enable researchers to validate, extend, and build upon existing data leading to a more comprehensive understanding of nature and thus, contribute to further dissemination of the importance of biodiversity knowledge. In DiSSCo, we will also engage stakeholders such as policymakers, conservationists and the public by making data available in accessible formats, such as interactive maps, visualisations and online platforms. This will increase awareness and bring research evidence into policy and practice. In this context, understanding project-specific data management is also critical for ensuring the quality, integrity and accessibility of research data.

By implementing best practices in data management, we ensure that the Project will properly understand the data types and licences and will address access and ethical policies. Even though most project outputs are expected to be made openly accessible to the public, the specific terms of use, licensing, and ownership of the intellectual property may vary depending on agreements between the stakeholders and may need a process for transfer to the DiSSCo ERIC. During the Project, the Project Council (formed by all project beneficiaries) will further establish processes for the potential transfer of intellectual property ownership generated throughout the Project to the legal entity of DiSSCo ERIC. Finally, personal data will be handled under GDPR.

1.2.3 Approach to the Project's Five Objectives

Establishing DiSSCo ERIC (Linked to [Obj. 1 & 5](#))

Establishing the DiSSCo ERIC is the first step for DiSSCo to start operations. It will guarantee financial and organisational capacity to enter the project's construction phase successfully. Moreover, the legal entity will make it possible to establish long-term cooperation and strategic partnerships to create and implement DiSSCo RI programmes. Finally, the ERIC will provide the best platform to define, manage and plan actions to respond to continuous research and changes in national priorities.

The application process for DiSSCo ERIC requires the preparation of several technical documents that, together with national declarations on the international aspects of the ERIC, will form the corpus of information necessary to apply.

During the transition phase, the technical documentation (Statutes, Financial provisions and the Technical & Scientific description) will be completed to support negotiations among the Host and Founding members. Further work is foreseen for submitting the final versions as part of the formal application of Step 2.

The methodology will follow a comprehensive, well-structured process that ensures the participation of key stakeholders, the National Nodes and DiSSCo governing bodies through regular updates and consultations. It will do so by supporting the Funders Forum (FF) members in their role as potential founding members and collaborating closely with [WP2](#) and [WP5](#).

Furthermore, the work will include activities to facilitate discussions in the FF at national level. To do so, [WP1](#) together with DiSSCo CSO, will carry out advocacy actions led by potential founding members to guarantee the necessary critical mass of countries joining DiSSCo ERIC in the first round.

DiSSCo ERIC will need implementing rules and regulations to allow operation and clear agreements between the ERIC and the distributed RI. The preparation of the rules will follow the methodology described above, supported by the experience gained in developing DiSSCo principles and governing requirements during the Preparatory Phase.

Completing the DiSSCo policy framework (Linked to [Obj. 1](#))

It is planned to produce specific policy documents to support the development of the Statutes of the DiSSCo ERIC. The ERIC Regulation (EU) No 1261/2013¹⁴ considers the following policies as part of the 'essential elements' of the Statutes of an ERIC: access policy for users, intellectual property rights policy, employment policy and procurement rules. Scientific evaluation and dissemination usually do not require further supporting policy documents since they are already defined in the ERIC's statutes. These policies and the procurement rules will expand on the principles included in Chapter 1 of the DiSSCo ERIC statutes and provide the principles, procedures, and, where relevant, conditions of use and operation. Another fundamental policy for the future DiSSCo ERIC is the Data Policy, which will also be included in [WP1](#) as it is closely linked to the Access Policy and Intellectual Property Rights Policy. The work will be done in close collaboration with the DiSSCo Technical Team. It will follow the same methodology implemented in [WP1](#), to keep the National Nodes and governing bodies actively involved from drafting to decision.

Continue development of core technical infrastructure (Linked to [Obj. 2](#))

Former DiSSCo-related EU-funded projects (Table 2) provided major contributions to the technical design and functional prototype of the future DiSSCo technical infrastructure based on FAIR principles. The core DiSSCo technical infrastructure must be continuously developed during the DiSSCo's transition Phase. Stopping or slowing down this development would incur significant technical debt, not only because technology is changing fast and new security threats emerge all the time but also because the concept of FAIR Digital Objects (FDOs) that forms the basis of DiSSCo is rapidly evolving through the collaboration with the [German Institute for Standardisation](#) (DIN). Collaborative efforts

involving policy, research and technology experts from science and industry are ongoing through the [FDO Forum](#). DiSSCo is a strategic stakeholder and major driver for the specification process. Furthermore, the core infrastructure needs continued work to remain relevant and aligned with the evolving technological, community and legal environments detailed in the next section (**Consensus building on standards and best practices**).

DiSSCo's value proposition entails several responses that require sustainable technical infrastructure. New services are required to realise the Digital Extended Specimen concept, merge all data classes resulting from the study of collection objects, facilitate community curation to better use limited taxonomic expertise, leverage artificial intelligence, track individual specimens across scientific outputs and to improve access to collections. However, these services can only be operational with a state-of-the-art and FAIR technical infrastructure. To get its place into the future of Research and Development, the infrastructure must also be fully AI-ready by enabling machine-actionable*¹² data. In other words, software agents or machines must handle the data autonomously and properly.

DiSSCo has started implementing this infrastructure through a FAIR-by-design architecture based on FDOs. The concept of FDO is a revolutionary way of organising data with the long-term aim of transforming the Internet into a meaningful and highly integrated data space. FDO provides fundamental contributions to the digital transformation in the "Turning FAIR into Reality" (European Commission, Directorate-General for Research and Innovation 2018), and the "EOSC Interoperability Framework" reports (Directorate-General for Research and Innovation (European Commission) et al. 2021). FDO enables us to bind together all information about any natural item, such as a specimen object, to create a new actionable, meaningful and technology-independent digital object. As stated by the FDO Forum, FDOs provide a conceptual and implementation framework to develop scalable cross-disciplinary capabilities, deal with the increasing data volumes and their inherent complexity, build tools that help to increase trust in data, create mechanisms to operate in the domain of scientific assertions efficiently, and promote data interoperability (The FDO Forum 2023).

Several pilot projects have been conducted to test and develop the concept of FDO, but DiSSCo is the first RI that aims to implement FDOs at the core of its technical infrastructure. DiSSCo's Preparatory phase has already started to implement this infrastructure since it will be fundamental for the further development of DiSSCo's services, such as providing persistent identifiers (PIDs). PIDs are urgently needed to (re)-connect primary data, e.g. specimen records with molecular data and literature, and must continue to be globally developed at the international level of research in collaboration with DiSSCo's partners worldwide (Suppl. material 1). As the development of Digital Extended Specimens (DES) to create an extensible network of biodiversity data records gains global acceptance (Hardisty et al. 2022), we must act quickly before countries or regions develop individual solutions, which could create interoperability issues and likely would increase the costs of implementing global data infrastructures. By continuing the development of the FDO core technical infrastructure during DiSSCo's transition phase, DiSSCo will implement an AI approach that can 'travel' the fast-growing corpus of scientific data to provide

trustworthy answers persistently linked to scientific evidence such as the primary specimen material.

Consensus building on standards and best practices (Linked to [obj. 2 & 4](#))

DiSSCo's Preparatory phase reviewed existing community standards: Gaps have been identified that need to be addressed to develop the open Digital Specimen specification ([openDS](#)) - describing the data model, ontology and Application Programming Interfaces (APIs) for the DiSSCo data infrastructure and services. DiSSCo's partners and the wider international biodiversity and geodiversity community started to address these identified gaps by developing new metadata standards, such as [MIDS](#) and [Latimer Core](#), and adapting existing standards, such as Darwin Core and GGBN to DiSSCo RI needs for persistent references to data and related agents. This is needed to support, e.g. the proposed community curation model and to adapt to changing legal requirements. DiSSCo's partners also led on international consensus-building for adopting these changes in data standards and infrastructures using them. DiSSCo developed best practices and guidelines such as the publication of digitisation guides (DiSSCo Prepare et al. 2023).

Continued work is needed to further develop the core technical infrastructure. Best practices must be maintained and adapted to changing requirements. Also, coordination of pilot integrations and collaboration with international infrastructures, such as the [Catalogue of Life](#) (COL), [GBIF](#), [ENA](#) and [BOLD](#) must be maintained. This coordination will continue to optimise the relevant infrastructures for bi-directional linking after the EU-funded BICIKL project finishes (April 2024), which is currently building the foundations for this cross-infrastructure interoperability. DiSSCo should keep abreast of these developing collaborations during its transition phase.

Besides coordinating these pilot integrations and collaboration with international infrastructures, DiSSCo will also continue to organise and support discussions with organisations through international platforms like International Partners for the Digital Extended Specimen (IPDES), an informal group of relevant stakeholders. It will ensure participation of DiSSCo in further developing the vision regarding a global roadmap for implementing the Digital Extended Specimen concept and a community-driven vision on collections' data mobilisation.

Besides our ongoing international coordination and dissemination activities, further support is needed to facilitate the implementation and widespread adoption of DiSSCo APIs by researchers and infrastructure providers. This will be done during the Project by writing documentation, organising workshops with candidate implementers, and continuing discussions with collection management system (CMS) providers. It will also be important to continuously monitor the evolving needs of researchers during the transition phase of DiSSCo's data infrastructure and services to ensure that the DiSSCo Construction Master Plan remains up to date. This will require further discussion and testing of the scientific usability of the piloted DiSSCo infrastructure with researchers through workshops and consultation in the transition phase.

National Nodes engagement and inclusion (Linked to [obj. 2](#))

As a distributed RI, DiSSCo aims to collate an extensive participation of institutions across Europe that will support the comprehensiveness of the data provided through DiSSCo related to bio- and geo-diversity collections and the wide use of the services built on top of that data. Accuracy, reliability and consistency of the data will entail the endorsement of the DiSSCo principles by a vast range of researchers, the implementation of consistent and interoperable procedures by the facilities involved and an overarching vision of how to run and sustain the RI shared at the European level. For that, the community is instrumental in supporting the RI's constituency, operation and sustainability. During the DiSSCo Preparatory Phase, the existing commitment towards constructing the DiSSCo RI started with the key and most relevant institutions gathered around CETAF that escalated to form National Nodes. Those Nodes include facilities of all sizes and all maturity levels holding collections in each participant country. The formation and consolidation of National Nodes have been crucial during DiSSCo Preparatory Phase and proved to be a very successful mechanism to channel common ambitions. DiSSCo has thus already been fundamental to initiate the development of collaborative processes, workflows, tools and services and to collate data of biodiversity collections at both institutional and national levels. Those National Nodes have been pivotal in constructing the national narrative to address the governmental funding agencies to support DiSSCo, by including digitisation of collections in scientific and strategic roadmaps run nationally, as well as formalising their interest to operate and, thus, promoting the need to fund DiSSCo ERIC.

European scientific facilities across Europe are very diverse in typology, size, funding, governance structures, and even in the development status of their digitisation efforts. Therefore, the National Nodes are also different in size, representation, commitment, and linkage to the funding of national agencies. Such diversity generates complexity that impedes having a unique narrative that may apply to all. For that, special efforts will be dedicated during the Project to supporting those National Nodes already interested in becoming active partners of the DiSSCo ERIC. Support will include engagement, networking, and developing a common message to transmit to their national representatives to consolidate their participation in DiSSCo. During the Projects' lifetime, monthly online meetings and workshops will be held to ensure adequate feedback between the coordination and the community.

Thanks to the DiSSCo-linked projects, a set of instrumental tools have been developed to provide self-assessment mechanisms that help the institutions and the nodes to identify their status quo regarding the digitisation of their collections and, therefore, to address priorities and identify actionable recommendations. Those tools may apply to institutional or national levels and provide the basis to aggregate and organise the resulting information at a European scale. The DiSSCo Transition Project envisages a roadmap for using and exploiting these tools by the entire community around DiSSCo that will facilitate the inclusion and engagement of European collections' holding institutions. Such a roadmap will also help to better structure the deployment, maintenance and enhancement of these tools, namely the Digitisation maturity tool, the Policies compliance tool, and the Specialisation plan. They will eventually be complemented by resources embedded into

the DiSSCo helpdesk as a first entry point to allow an understanding of those tools and how to use them.

Finally, CETAF will act as a channel to ensure inclusion and encourage the participation of as many natural science collection holders as possible who will be actively committed to further developing the DiSSCo RI.

2. Impact

2.1 Project's pathways towards impact

2.1.1 Impact of DiSSCo Transition Project towards the early-phase implementation of DiSSCo

During the DiSSCo Preparatory Phase, we introduced a comprehensive framework for progress assessment using the concept of the Implementation Readiness Level (IRL). IRL is an evaluation framework that includes five dimensions and assesses the overall maturity of an RI towards its ability to embark on its implementation (construction) phase. Specifically, it measures the maturity of the RI regarding

- Scientific readiness,
- Data readiness,
- Financial readiness,
- Organisational readiness, and
- Technical readiness (Table 3).

The DiSSCo Transition Project will directly impact the IRL of the RI, aiming to start the early-phase implementation of the RI at its optimum IRL values (Fig. 3). Specifically, its outputs will focus on the overall business (organisational & financial) and data & technology readiness (i.e. contributing to four out of the five dimensions of the IRL). The Project work plan builds on the outcomes of the Preparatory Phase of DiSSCo. It enables the RI to kick start its implementation phase with the set-up of its legal entity (ERIC) and the financial commitments of member states. At the same time, the Project will ensure that in the early implementation phase, the RI will operate within a clear policy framework and with a strong technical backbone that can support the development of end-user [DiSSCo's services](#).

2.1.2 Impact of DiSSCo Transition Project in relation to the Topic expected outcomes

The Project is expected to deliver impact across all five dimensions of the IRL, as described in Table 4.

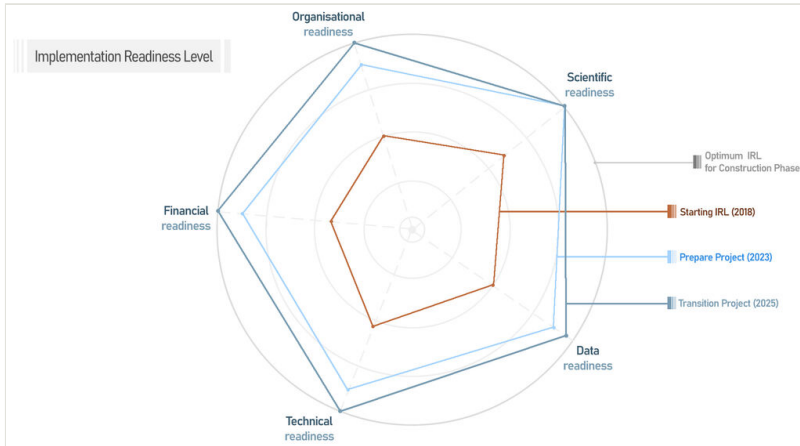


Figure 3. [doi](#)

A schematic representation of the contributions of the DiSSCo Prepare and DiSSCo Transition Projects towards the optimum level of maturity across all required dimensions for the early-phase implementation of the RI.

Table 4.

Project impact in response to the Topic's expected outcomes.

Expected Topic Outcomes(HORIZON-INFRA-2023-DEV-01-02)	Project impact in response to the Topic's expectations
Enhanced ERA excellence and attractiveness through the availability of additional capacities	The Project contributes to new ERA capacities through: <ol style="list-style-type: none"> 1. The contribution to the development of a priority RI (DiSSCo). Sustainable European RIs are crucial parts of an integrated ERA 2. Through the work in WP3, we directly contribute to advancing the maturity of the backbone and end-user e-services. These services are based on the prior assessment of user needs. Their development and introduction to the community (through DiSSCo) provide additional capacities to the ERA
Consistent and well-structured research infrastructures ecosystem in Europe	Through the work in WP1 we are further maturing the already developed business (legal & financial) framework of DiSSCo and continue to engage with DiSSCo potential Funders.
Solid Member States/Associated Country engagement in pan-European research infrastructures, leading to their full implementation	This will result in a much more appealing proposition for attracting national-level investments towards the development of the RI. Through WP2, endorsement and practical implementation by the research community will be addressed. It will contribute to creating a well-structured request for national prioritisation and integration in the pan-European ecosystem of RIs.
Long-term perspective for investments in research infrastructures	Through the work in WP4 we will continue working with other European and international RIs to co-develop best practices and standards that ensure data interoperability and information exchange between the RI data platforms.

Expected Topic Outcomes(HORIZON-INFRA-2023-DEV-01-02)	Project impact in response to the Topic's expectations
Synergies and complementarities between new and existing research infrastructures, including technology infrastructures and infrastructures financed by ERDF	

2.1.3 Wider societal impact of the DiSSCo Transition Project

Target 21 of the outcomes of the Conference of Parties of CBD (COP 15)^{*14} highlighted the importance of data, information and knowledge as part of a wider mechanism for impact delivery towards agreed upon 2030 objectives.

The DiSSCo Transition Project is a necessary part of the development process of DiSSCo RI. It will directly impact the ability of the distributed community of museums to deliver their European RI. For the first time, DiSSCo will make it possible for natural history museums of Europe to virtually display their collections to the widest public, researchers and visitors, including the millions of natural objects stored in the museum's repository that are usually not displayed to the public. The Project will also contribute to the solution space towards a more reliable, interoperable, and service-oriented biodiversity data domain. It will do so by:

1. further developing the core data infrastructure of DiSSCo - A **FAIR-by-design approach** in mobilising and interconnecting data from 175 natural science collection-holding organisations across Europe (see section **Impact through service development below**)
2. enabling international collaboration for developing community consensus and helping towards a beyond-Europe interoperability framework (see section **Impact through international collaboration for Standards and best practices**)

2.1.4 Specific areas of impact delivery

In addition to the responses of the Project to the Topic's expected outcomes above (Table 4) we provide a more detailed view of the Project's wider societal impact through three dimensions:

- the delivery of adding value services,
- the stakeholders engagement and enlargement activities and
- the development of community Standards & best practices.

Impact through service development

Advancement of DiSSCo's core data infrastructure and e-services as planned in [WP3](#) will directly impact knowledge development: it will provide open access to up-to-date and FAIR scientific data about collections and specimens and link these with derived and related biodiversity data. The data infrastructure and services will support the Green Deal and Biodiversity Strategy for 2030 by providing AI-assisted mass digitisation to scale up the

publication of quality digital data. This will provide a further historical reference for climate change research and monitoring the degradation of global ecosystems.

The digital specimens provided by the DiSSCo data infrastructure will support the 'twin transition' vision: there is no Green Deal without digital (Muench et al. 2022). Digital specimens act as digital twins of the physical objects, reducing the carbon footprint of visits to the physical collections. The FAIR and technology-independent design ensures future compatibility with other digital twins from the Destination Earth initiative*¹⁵ through the [Biodiversity Digital Twin project](#). The European Loans and Visits system (ELViS) will help scientists decide if a collection visit is necessary and guide them to the closest location of suitable specimens.

The Unified Curation and Annotation Service (UCAS) improves the connection between citizens and science by enabling the co-creation and enhancement of scientific data about specimens to protect biodiversity. It will ensure optimal use of scarce taxonomic expertise in Europe by providing cross-institutional collaboration on curation and annotation, with the capability of connecting AI services to aid this further.

The Collections Digitisation Dashboard (CDD) can show levels of digitisation across all European collections using the community data standards described in [WP4](#). Advancement of the CDD through integration with DiSSCo's data infrastructure will provide an up-to-date overview of the state of the collections in Europe, impacting decisions on prioritisation of collections digitisation, capacity building and funding.

Impact through stakeholders' engagement & enlargement

Engagement: [WP2](#) will keep the research community engaged with DiSSCo development even if their respective countries have varying levels of commitment to DiSSCo ERIC. By tailoring narratives to the country level, our community will be able to address national priorities and communicate the value of DiSSCo to their governments and at a European level. Global challenges require interoperability, standardisation, common procedures and shared understandings of FAIRness of biodiversity-related information at a large scale that starts with the engagement of researchers and institutions as data providers.

The DiSSCo community's engagement also refers to the RI's inclusive approach to gather all types and categories of natural science collections holders. Smaller institutions cannot be left behind and, on the contrary, may need further support to align with overall European effort, fill in gaps and address specific needs to build an integrative infrastructure for excellent science operating in the ERA.

Finally, a community strongly engaged with DiSSCo's vision will allow the provision of bio and geodiversity data in the format and at the scale needed. This will constitute a reliable and accurate baseline supporting well-informed decision-making in tackling specific critical species and areas and implementing monitoring methods and systems that could halt biodiversity loss.

Enlargement: [WP1](#), in collaboration with DiSSCo CSO, will work towards the enlargement of DiSSCo ERIC members. Discussions at the FF meetings will include significant information and specific narratives, a consistent information package useful for FF members to peer-to-peer advocates. The work will contribute to increasing awareness and support for one of the main priorities for the ERA and strengthen the overall European Research Infrastructures landscape.

The methodology set up by DiSSCo towards the preparation of the ERIC will also create the ideal environment for national funders and institutions to communicate and identify national priorities and common objectives, which will trigger the alignment of positions and coordination and guarantee the maximisation of resources and the fulfilment of common goals.

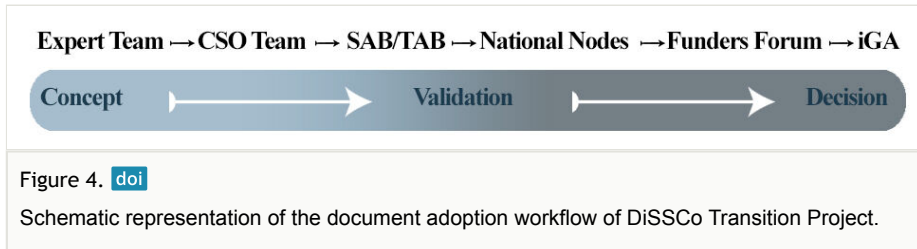
Standards: In 2018, the EU published a report estimating that not having FAIR research data costs the European economy at least €10.2bn annually (Directorate-General for Research and Innovation (European Commission) and PwC EU Services 2018). Therefore, the adoption of FAIR and open standards, open-source development and the FAIR Digital Object framework have the potential to address the inefficiencies arising from using non-FAIR data. In [WP3](#) and [WP4](#), we support DiSSCo's commitment to FAIR and open data, combined with iterative and evolutionary design principles. We see avenues for applying centralised governance while facilitating decentralised data and service interoperability. For instance, with the application of FDO, Agile and DevOps methodologies, external developers, researchers and other RIs and service providers can rapidly develop and test new tools to accelerate data linking and analysis. Adopting FAIR principles will allow for the wider usage of data and will enhance new scientific insights and innovations. The impact of applying and adopting open standards and FAIR principles extends beyond the scientific community: they will also favour greater international collaboration, new partnerships, innovations and discoveries.

Continuing the development of openDS and integrating and supporting emerging standards like Latimer Core and MIDS will ensure DiSSCo is interoperable with other RIs and improve natural science collections' discoverability and citability. These standards will allow RIs to understand the suitability of data for service provision, data enhancement (e.g., through AI-based services like those planned in [WP3](#)), or for research purposes. They also better support data-driven prioritisation of work by quantifying the outcomes and the level of digitisation achieved.

Best practices: [WP4](#) will document best practices to support consistent, reliable, and transparent collection and management of biodiversity data, thus reducing errors and biases in the quality and accuracy of the data. International collaboration and agreement on best practices around data standards will help to promote the sharing and integration of biodiversity data across different regions and stakeholders, including researchers, policymakers and the public. By establishing common standards and best practices, data will be more easily shared for improved understanding of biodiversity patterns and trends, improving, in turn, the information provided to decision-makers, thus having a strong potential to result in better strategies to protect the diversity of life on Earth.

2.1.5 Methodology for reaching consensus

For outcomes that require wider DiSSCo community consensus (e.g. policies, best practices etc.), the Project's approach will be based on a robust consultation process, which was successfully used during the Preparatory Phase of DiSSCo. The consultation process includes three distinct steps as follows (Fig. 4):



1. The Project expert teams produce the first draft of work plan-derived outputs;
2. The drafts are opened up for review and consultation to the DiSSCo Technical or Scientific Advisory Boards and the DiSSCo National Nodes;
3. The draft document (from step (i)) and the results of the consultation are presented and discussed in the interim General Assembly of DiSSCo and the members of the Funders Forum.

2.2 Measures to Maximise Impact - Dissemination, Exploitation and Communication

To ensure maximum impact, DiSSCo Transition will design and implement a Dissemination, Exploitation and Communication strategy throughout the entire lifecycle of the project. Coordinated in [WP5](#), the strategy will focus on achieving four main goals that build on towards the overall objectives of the DiSSCo Transition project:

- Contribute to the cohesiveness of DiSSCo Transition project partners and DiSSCo's wider community during the Transition Phase.
- Support the work with the National Nodes to achieve country-level commitment with the future RI.
- Transfer DiSSCo's knowledge and new developments on its data infrastructure and core services to relevant stakeholders.
- Contribute to the project's effort to foster international collaboration and consolidate its links with other European and global initiatives in the same space.

2.2.1 Stakeholders Engagement Strategy

1. The **DiSSCo Transition project partners** are the 16 institutional beneficiaries of the project. To keep them engaged during the project, internal communication mechanisms and regular meetings at WP and consortium level will be implemented.

2. The **DiSSCo wider community** includes 175 collection-holding institutions across 23 European countries. Beyond being the champions of DiSSCo, collection-holding institutions will be both providers and users of the basis of specimen data that DiSSCo RI will make available through its infrastructure and catalogue of services. Therefore, the developments expected during the Transition Phase will directly involve them. For this reason, DiSSCo Transition will further develop DiSSCo's mechanisms for community-level communication (implemented in [WP2](#)) to provide its wider community with timely information on the ongoing progress during the Transition Phase and proper channels to have their voices heard in important infrastructure and technical matters.
3. **Governments and environmental agencies across Europe**, especially the governments of the currently 13 country members of the DiSSCo Funders Forum, are crucial stakeholders of DiSSCo Transition, as they are to provide long-term support for the future DiSSCo RI. To facilitate the work with the National Nodes in engaging this stakeholder group ([WP1](#) & [WP2](#)), DiSSCo Transition will rely on dedicated workshops and tailor-made content disseminated through the project's website dedicated page (i.e. Knowledge Area) and other mechanisms (presented in the section Dissemination, exploitation and communication strategy below).
4. **Other European RIs in the field of environmental research** (biodiversity, marine and terrestrial Ecosystems, genomics, taxonomy, etc.) will become key users of the future DiSSCo RI. Therefore, the DiSSCo Transition project must actively engage them during the development stage of DiSSCo's data infrastructure and core services. Among other activities, the workshops about implementing DiSSCo's operational services and related standards (planned in [WP4](#)) will be instrumental, as will the promotion of DiSSCo Transition in other third-party events ([WP5](#)). DiSSCo's technical platforms ([DiSSCo Tech](#), [DiSSCo Labs](#) and DiSSCo's page in [GitHub](#) (see [Dissemination, exploitation and communication strategy](#) below), will also be particularly relevant during the transitional period.
5. The **wider scientific community** (health, land use, nutrition, climate change, citizen science etc.) will also become an important stakeholder group. Through its website (i.e. Knowledge Area) and via team attendance at scientific events, DiSSCo Transition will be fundamental to engage with the wider scientific community and communicate with them the need for a new, integrated research infrastructure model like the one that DiSSCo proposes.

2.2.2 Dissemination, Exploitation and communication strategy

The successful conclusion of the Preparatory Phase (2018-2023) has arguably established DiSSCo's name in the European landscape of environmental RIs and paved the way for new organisational and technical development. This makes the DiSSCo Transition Phase the ideal time to disseminate and communicate on DiSSCo's progress. DiSSCo's dissemination and communication will require extending and refining narratives, and methods to both maximise the impact of the team's interactions with the scientific community and society in general and feed the dialogue between DiSSCo and its different stakeholders.

Dissemination

1. The organisation of **Technical Workshops and Conferences** will act as a major channel for sharing the results of the Project, engaging future users of DiSSCo on the development of its infrastructure and services, and strengthening the links between DiSSCo and the scientific and policy making communities. DiSSCo Transition plans to organise four workshops during the lifecycle of the project. The two workshops organised within [WP2](#) (MS2.1-2.2) ensure that DiSSCo's National Nodes will get a sound knowledge of the progress of the RI while also allowing DiSSCo to gather feedback on the needs and requirements detected at the national level and also from the perspective of other potential users of the RI. The two workshops of [WP4](#) (MS4.2 and MS4.3) will aim at sharing DiSSCo's technical designs and prototypes with its community. They will also be crucial tools to foster international collaboration around data standards and best practices and to strengthen DiSSCo's links with other European projects and instruments, such as ESFRI. Dissemination in DiSSCo Transition will also involve further post-workshop activities, including records of the workshops made available to the wider audience (e.g. via social media, institutions' websites and a dedicated YouTube channel), technical publications in diamond open-access, peer-reviewed journals such as the [European Journal of Taxonomy](#) (EJT), CETAF communication platforms, DiSSCo technical platforms and partners' blogs and bulletins, and reports adapted to the largest audience and fed into the Project website's. Dissemination activities surrounding DiSSCo Transition Project workshops will be a shared responsibility of all the partners, who will provide support and use their resources to provide visibility of these events among their networks.
2. **Attendance at third-party technical events** (e.g. Biodiversity Information Standards (TDWG), BiCIKL, BioDT, IUCN, FDO, Society for the Preservation of Natural History Collections (SPNHC), Research Data Alliance (RDA), SciDataCon) will give DiSSCo Transition the possibility to showcase its technical propositions and make the case for strengthening interoperability among different RIs and initiatives at large, also at the global level.
3. **DiSSCo's technical platforms and Knowledgebase.** DiSSCo Transition Project will allow for further development and strengthening of DiSSCo's technical platforms: [DiSSCoTech](#), [DiSSCo Labs](#) and [DiSSCo's page in GitHub](#). These platforms will document and describe the ongoing technical status of DiSSCo's digital architecture and services. Furthermore, they will constitute essential complements to the workshops planned in WPs 2&4, and the perfect forum to engage the Project's technical stakeholders (e.g. DiSSCo's wider community and other RIs), in an ongoing dialogue about the technical development and harmonisation of the future RI. DiSSCo Transition will thus reinforce the technical platforms with new articles, training materials, infographics and videos specifically dedicated to communication on the Transition Phase: video presenting the services that will be provided by DiSSCo and Q&A pieces to address DiSSCo stakeholders' evolving needs. Simultaneously, DiSSCo's Knowledge Base (<https://know.dissco>.

[eu](#)) will continue growing to act as the main comprehensive repository for all organisational and technical information about DiSSCo RI.

4. The implementation of **DiSSCo Transition's Knowledge Area** within the Project's website is the fourth pillar of the dissemination strategy of DiSSCo Transition. Its main goal is to disseminate tailored-made content that distinctly states the scientific, technical and socio-economic benefits of the future RI to the largest audiences, including policy-related audiences and the wider scientific community. The contents of the Knowledge Area will be co-created by DiSSCo Transition's communication team in collaboration with the other WPs and will include accessible summaries, factsheets, as well as specific resources (e.g. DiSSCo Transition's new corporate video and printed materials), to support activities and meetings with government officials and other institutional actors.

Exploitation

Exploitation strategy will be part of the plan for Dissemination, Exploitation and Communication strategy developed by [WP5](#). DiSSCo Transition's exploitation strategy will include:

1. Exploitation of technical reports, plans, methodologies and other outputs will be made available via **scientific journals and platforms** (e.g. Open Research Europe platform, [Research Ideas and Outcomes](#) (RIO), Horizon Results platform). Publications of reports or software development affiliated with DOIs for each output of DiSSCo will ease their findability and sharing via other services and platforms (e.g. [DataCite](#), [OpenAIRE](#)), providing multiple avenues for exploitation. Additionally, by adhering to open standards and FAIR principles, DiSSCo's output will provide easier access and interoperability to the widest spectrum of stakeholders.
2. A key element of DiSSCo Transition strategy for exploitation are the measures planned in WP5 throughout the whole time span of the Project, which will culminate in the final in-person **Wrap-up Event** (D5.2) that will mark the end of the Project and provide an excellent opportunity to present its outputs and organise specific sessions to explore the opportunities of exploitation.

Communication

1. An updated DiSSCo website will play a primordial role in the Project's communications. It will host a new, specific **site for the DiSSCo Transition project**. Featuring its visual branding and specific sections, it will act as the main access point for all information about the Project, including dissemination tools, such as the Knowledge Area and DiSSCo's technical platforms. As a complement to the website, DiSSCo Transition will also create and operate its profile on **social media** (Twitter, YouTube and LinkedIn) as an effective channel for calling the stakeholders' attention to the project's initiatives and supporting the organisation of and attendance at technical events.
2. DiSSCo has two different community-level engagement mechanisms that will continue playing a vital role in fostering cohesiveness and alignment among

DiSSCo partners. **DiSSCo's newsletter** and [DiSSCo's Binnacle](#) will closely follow the organisational and technical matters of the DiSSCo Transition project.

3. The Transition Phase will require that DiSSCo, now a more mature endeavour, refine its narrative. For this purpose, DiSSCo Transition will create a **New Corporate Video** as the most effective vehicle to communicate the value proposition and impact of the future RI in a way accessible to all stakeholders. The video will have a prominent position in all dissemination activities, both in person and online, and will give way to other shorter **Video Pieces**, such as Q&A pieces and video demonstrators of DiSSCo's data infrastructure and services to support communication and dissemination activities in more specific areas of interest for stakeholders. A fully renovated set of **Printed Materials** (roll-ups, posters, brochures and flyers) will also complement the videos in dissemination and communication actions.

2.2.3 Intellectual Property Management Strategy

In full alignment with Horizon Europe's recommendations and following the principles of DiSSCo's Construction Master Plan underpinning a FAIR-by-design infrastructure, policies and services, DiSSCo Transition will embrace open science as its *modus operandi*. In DiSSCo's view, this open and collaborative approach entails sharing data at the earliest possible stage, making this available for reuse, enrichment and validation while ensuring the implementation of persistent identifiers and metadata to give context and provenance information.

Data products (technical reports, plans, methodologies, etc.) will be stored in the DiSSCo Knowledge Base to be publicly accessible and findable. Similarly, software developments will be published in a public repository (GitHub) with open-source licences, while e-services will be provided as part of the EOSC public offering. All outputs will have their own persistent identifier (DOI) and metadata, ensuring an appropriate content description and provenance description. DiSSCo Transition's Consortium Agreement, to be signed by all the project's partners, will specify the terms for Intellectual Property Rights (IPR) management.

2.3 Summary

Specific Needs

1. **Secure successful transition** from the Preparatory Phase **to the Implementation Phase** for DiSSCo
2. Define a clear **regulation and policy framework for the early-implementation phase** of the DiSSCo ERIC
3. **Avoid accumulation of technical debt** in e-services that already have been developed at high TRLs
4. Continue international collaboration on required **data standards and best practices** that promote cross-RI interoperability

5. Sustain continuous **engagement** of and **support** to DiSSCo **National Nodes**

Dissemination, Exploitation & Communication Measures

1. **Dissemination:** **a.** Technical Workshops/Conferences and post-workshop dissemination activities. **b.** Attendance at third-party technical events. **c.** DiSSCo's technical platforms and Knowledge Base. **d.** Knowledge Area within the project's site
2. **Exploitation:** **a.** Data products available via scientific journals and platforms. DOIs of software developments registered. **b.** final in-person Wrap-up Event (D5.1)
3. **Communication:** **a.** Specific site and social media for the DiSSCo Transition. **b.** DiSSCo's newsletter and Binnacle. **c.** Corporate video, shorter training video-pills and printed materials

Expected Results

1. Formal submission for **Step 1 & 2 of the DiSSCo legal entity** - ERIC
2. Development of DiSSCo ERIC detailed **policy framework and internal regulations**
3. **Preventing technical debt** in already developed service prototypes
4. **Continue standards development** as required by DiSSCo
5. **Support National Nodes** in engaging with their governments

Target Groups

1. **DiSSCo Transition project partners** (16 beneficiaries)
2. **DiSSCo wider community** (170+ institutions across 23 countries)
3. **Governments and environmental agencies** across Europe (especially the members of the DiSSCo Funders Forum)
4. **Other European RIs** in environmental research (biodiversity, Ecosystems, genomics, taxonomy, etc.)
5. **Wider scientific community** (health, land use, nutrition, climate change, societal infrastructure, etc.)

Outcomes

1. **Enlargement** of countries supporting DiSSCo ERIC
2. **Better understanding among national funders** of DiSSCo's contribution to national priorities
3. **Stronger support from the community** (at institutional and national levels) to creating pan-European infrastructures for data access across borders
4. **Improved engagement of (potential) users** with the technical data infrastructure and end-user services
5. **Improved understanding of (potential) users** about the advantages the technical data infrastructure will bring for them and for science

6. **Improved interoperability with other biodiversity data infrastructures** and their respective users

Impacts

1. Increase of the **DiSSCo Implementation Readiness Level** to the required optimum for the early-phase implementation
2. Provide more capacity for **collections-derived data access, interpretation and analysis**
3. Contribute to the **COP15 Target 21** of mobilisation of fit-for-purpose biodiversity information
4. Contribute to the **consolidation of the European landscape of environmental RIs**

3. Quality and Efficiency of the Implementation

3.1 Work Plan and Resources

3.1.1 Overall Project Structure

The structure of the project is given in Fig. 5

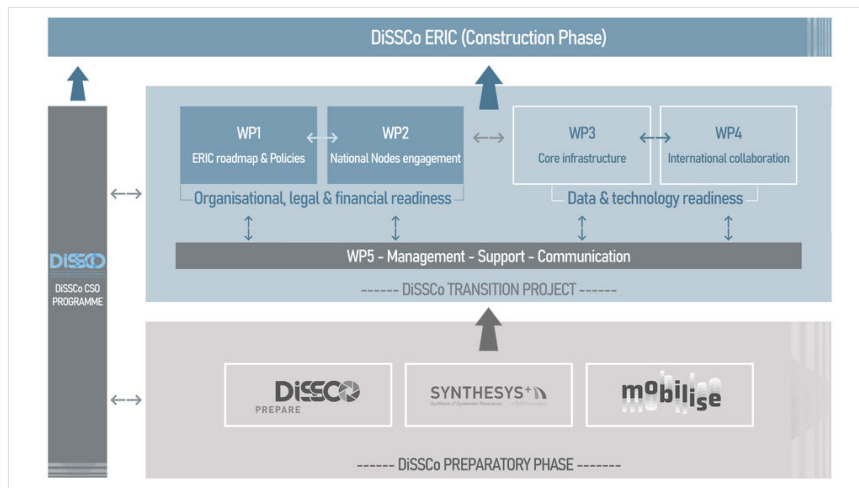


Figure 5. [doi](#)

Overall structure of work packages in the DiSSCo Transition Project.

3.1.2 Timeline of Project Detailing Tasks and Deliverables

DiSSCo Transition Project has a lifetime of 18 months, a life span that is considered sufficient to critically address the combination of limited resources available with the need

to bridge between the Preparatory and the Construction phases of DiSSCo. Work is concentrated in 1.5 years to ensure efficiency in resource use while allowing the implementation of expected actions in a focused program. The previous DiSSCo programme provided the basis to ensure continuation of activities in a both seamless and targeted manner, with the right partners fully committed, the synergies and interlinkages between WPs already tested, and a set of objectives clearly defined.

3.1.3 List of Work Packages and Detailed Description of the Project’s Work Plan

The work packages are summarised in Table 5.

Table 5. List of workpackages.					
Work Package	Work Package Title	Lead Participant Short Name	Person-months	Start Month	End Month
WP1	ERIC Roadmap & Policy Framework	Naturalis	35	M01	M18
WP2	National Nodes Engagement & Inclusion	CETAF	34	M01	M18
WP3	Data Infrastructure & Core Services	SGN	62	M01	M18
WP4	International Collaboration on (data) Standards	NHM	18	M01	M18
WP5	Management, Communication & Outreach	Naturalis	12	M01	M18

Work Package 1: ERIC Roadmap & Policy Framework

Objectives:

1. Pave the way towards the ERIC application process.
2. Develop a complete portfolio of bylaws and further regulations of DiSSCo ERIC governing bodies.
3. Develop a complete framework of main policies for the operation of the DiSSCo ERIC.

Description of work

Work package 1 (WP1) builds on the work done during DiSSCo’s Preparatory Phase, specifically on the recommendations on organisation and finance from the DiSSCo Construction Master Plan. The goal is to guarantee the successful constitution of the legal entity and to ensure a critical number of member countries supporting the DiSSCo ERIC to

allow operations. Furthermore, the work aims to provide organisational and financial structures to support daily governance.

WP1 benefits from the experience of the participant partners already involved during the Preparatory Phase. The methodology will follow the principles of transparency and inclusiveness with a well-structured process from drafting to decision and the participation of the main DiSSCo stakeholders. WP1 will collaborate with [WP2](#) and [WP3](#) to guarantee a successful implementation and the overall increase of the IRL.

Task 1.1: ERIC Roadmap implementation (M1-M18) - Naturalis, RBINS, X-Officio, MNHN, BGMeise, CETAF.

This task focuses on the ERIC application process: supporting the preparation of technical documentation, supporting the Funders Forum (FF) and potential founding members, and preparing narratives that highlight the added value of the Research Infrastructure (RI).

The work will be done in close collaboration with the FF, the advisory body in which national funding agencies are represented, to ensure complete alignment between DiSSCo developments and national priorities. Furthermore, to support the enlargement of founding members, the team will work in the preparation of a Socio-Economic impact assessment that will showcase the added value of the RI and will support advocacy activities.

- Finalisation of the corpus of technical documentation necessary for the ERIC application process (Step 1 and preparation for Step 2).
- Support the FF advisory body as the main actor in implementing the ERIC roadmap.
- Enlargement of FF membership and Founding Members of the ERIC. The work aims to facilitate and support discussions among potential founding members.

Task 1.2: ERIC Implementing Rules and Terms of Reference for the DiSSCo ERIC bodies (M1-M18) - X-Officio, RBINS, Naturalis, MNHN, BGMeise.

This task will focus on the preparation of the documents which are required for the proper functioning of the DiSSCo ERIC, other than the Statutes (the Statutes are covered in Task 1.1). As provided for by the ERIC Regulations, the Statutes are complemented by a set of Implementing Rules complying with the Statutes as well as a set of policies and principles which will be referred to in the body of the Statutes (covered mainly in Task 1.3 and partially under this Task).

- **Preparation of a comprehensive set of rules of procedures and terms of references for DiSSCo ERIC governing bodies** (M1-M10):
 - Rules of Procedure for the DiSSCo ERIC General Assembly as the ultimate decision-making body.
 - Rules of Procedure of the Nodes Advisory Committee, as the main body representing Nodes and institutions part of the distributed RI.
 - Preparation of the Terms of Reference for the Executive Board, as the body supporting the Director General in daily operations.

- Preparation of Terms of Reference for the Scientific, Ethical and Technical Advisory Committee.
- **Preparation of the financial framework for the DiSSCo ERIC and consideration of future economic impact (M3-M15):** The work will produce a list of financial management principles and administrative framework for member contributions and potential service costs. The team will consider ways of assessing the socio-economic impacts during operation as well as a reflection on the implementation of a monitoring system. Furthermore, the team will build on results from the Preparatory Phase to define how DiSSCo Centres of Excellence may function and may be financially managed.
- **Preparation of the Procurement Framework (M3-M15):** To set out the basic principles and relationship between DiSSCo ERIC and its suppliers and users, setting up for a clear and standardised procedure for purchasing goods and services, including Research and Development.

Task 1.3: Policy Framework (M1-M18) - RBINS, X-Officio, MNHN.

This task focuses on the preparation of the policy documents which will be referred to in the Statutes of DiSSCo ERIC, in particular, on the preparation of Access and Data policies in close collaboration with [WP3](#) and Employment and principles for Intellectual Property Rights (IPR) policies.

- **Preparation of Data policy framework (M1-M13):** It will provide guidance to the users to ensure that research involving material made accessible through DiSSCo ERIC shall recognise the rights of data owners and the privacy of individuals. The Data policy will establish the rights and obligations of the users by setting the terms and conditions for governing access and guaranteeing that suitable security arrangements are in place regarding the storage and handling of data. It will also ensure that the data providers, right holders, authors and DiSSCo ERIC are acknowledged in an appropriate manner.
- **Preparation of Access policy framework (M5-M17):** The work builds upon the DiSSCo Policy Metadata Schema, which described possible institutional policy alignment allowing the seamless flow of FAIR data, the creation of a detailed common research agenda for the DiSSCo consortium, and for the infrastructure to provide distributed services at a consistent level of optimal quality. It will support the establishment of sustainable mechanisms and tools to streamline the communication of the policy alignment needs and their purpose to DiSSCo partners, as well as to provide support and guidance for institutions for assessing their current policy status and progress towards alignment.
- **Employment policy (incl. Code of ethics) (M6-M17):** It will set out the basic principles and relationship between DiSSCo ERIC and its employees. It will ensure that uniform standards and consistent employment and staff relations practices are applied. It will also include a basic recruitment procedure for new employees and a code of ethics for the staff of DiSSCo ERIC. The employment policy will complement any aspects not covered by national labour law but is relevant for the

DiSSCo ERIC. It will mainly focus on ethical aspects in the new working environment created by establishing the DiSSCo ERIC entity.

- **Principles for Intellectual Property Rights (IPR) policy (M6-M17):** DiSSCo ERIC will digitally unify all European natural science collections under common access, curation, policies and practices that ensure FAIR data. The principles for the DiSSCo IPR policy will frame this common access and ensure that the data and scientific collections can be shared and reused through DiSSCo ERIC without breach of copyrights or IPR. The principles for the IPR policy will also propose governing principles for the treatment of all intellectual property produced in connection with the activity of DiSSCo ERIC and/or in the production of deliverables by DiSSCo ERIC partners.

Work Package 2: National Nodes Engagement & Inclusion

Objectives:

1. Maintain a cohesive and comprehensive community in support of DiSSCo RI.
2. Identify a roadmap to ensure sustainability of supporting tools for self-assessment and prioritisation.
3. Define resources to facilitate the use of the research infrastructure.

Description of work

The tasks under WP2 are intended to achieve consolidation of certain dimensions (information, engagement and exploitation) related to the community, which will ensure the necessary increase of the IRL in the organisational dimension. Collaboration with CETAF will multiply the impact.

Task 2.1: Consolidate channels of participation of NNs in the development of DiSSCo (M1-16) - CETAF, Naturalis, SGN, RBINS, NHM, NHM UoC, NHM ULisboa, IBER-BAS, PSB-SAS, UTartu, BGMeise, NHMD, UniFi, MNHN, FUB-BGBM.

It is crucial to keep the community updated on the DiSSCo process. Similarly, to continue building the RI with a bottom-up perspective, it is essential to receive feedback whenever needed to support the development of the core services and critical dimensions included in the project. For this purpose, monthly recurring meetings will be organised with all the participating National Nodes. Three (3) workshops are envisaged (to be held in collaboration with corresponding related WPs) in order to 1) keep the nodes informed on the progress of the core activities included in the transition process to achieve shared understanding, 2) facilitate sustainability of the engagement through stable connection with CETAF, and 3) receive feedback on the further development of the RI to meet the needs and requirements detected at a national/institutional perspective.

The main aspects to debate will be the following to understand, facilitate and ensure endorsement of DiSSCo outcomes across the community:

- The technical architecture, in collaboration with [WP3](#) (see Milestone 3.1)

- The legal status-quo, in collaboration with [WP1](#) (see Milestone 1.3)
- The implementation of standards, in collaboration of [WP4](#) (see Milestone 4.2)

These workshops are meant for fostering engagement of the beneficiaries towards the DiSSCo ERIC but also to facilitate an inclusive approach on critical aspects of the core development of the DiSSCo RI. Two of them (the first and second) will be held virtually, whilst the third will run on a hybrid format, under the organisation of NHM. The latter will be organised jointly with WP4 and the objectives of both WPs will be merged in a single event. The outcomes of that joint workshop will serve both WPs, 2 and 4, by collating information from experts, on a technical basis, and from institutions and NNs, in terms of implementation. The discussions during these events will provide fundamental information with a bottom-up approach that will serve, among others, to consolidate the framework of standards applicable, to contribute to the inclusive development of the DiSSCo community and to tackle critical aspects of core architecture such as identification of bottlenecks, sustainability or implementation requirements. Outcomes from Workshops will support the identification of best practices and recommendations to enhance the participatory schema for DiSSCo RI.

Task 2.2: Identify means to sustainably collect, aggregate and analyse information from National Nodes (M1-M18) - RBINS, CETAF, NHM, Naturalis, MNHN.

The contribution of the beneficiaries with data is essential to rely on well-grounded tools that could support the participation of researchers, institutions and nodes in the DiSSCo Research Infrastructure. To that end, it is important to enlarge the ground base of the data collected during previous DiSSCo-linked projects to be able to

- provide meaningful tools to the community, and
- organise the collective information into dashboards and priority areas that could drive well-informed decisions in the future.

This Task will be dedicated to identifying sustainable pathways to gather contributions from the community and, therefore, enhance means to examine priorities, promote the creation of centres of excellence and set the basis for strategic partnerships, around the basic tools that were initiated during the DiSSCo Preparatory Phase, specifically:

- The Specialization Plan (linked to the CETAF Registry of Collections).
- The digital maturity self-assessment tool.
- The policy compliance tool.

For that, relevant data shall be collated to support and secure the usability of those mechanisms with the addition of more content and an examination of analytical data pipelines, and procedures.

Task 2.3: Provide entry-point resources for the DiSSCo Helpdesk (M4-16) - CETAF, ULisboa, UoC.

To ensure inclusion and effective participation, the community needs to be capable of exploiting DiSSCo RI and, for that, it needs to be tooled-up and provided with tailored training resources to foster the participation of instrumental groups. This Task aims to create a manual/set of guidelines that will be integrated into the first layer of the DiSSCo Helpdesk, to facilitate understanding, access and exploitation of DiSSCo RI from the users' perspective. Such resource for community capacity building will be based on the lessons learned from the related project [BiCIKL-Biodiversity Community Integrated Knowledge Library](#) and drawing from the recommendations contained in the Construction Master Plan resulting from DiSSCo Prepare project. Interconnection of the envisaged DiSSCo Helpdesk with the DiSSCo Knowledge Base as well as with other European Environmental Research Infrastructures and the European Open Science Cloud-EOSC will also be addressed in this Task. Integration of AI into the Helpdesk mechanism will be explored. The Helpdesk will constitute a vital component for attracting external users and stakeholders and increasing their satisfaction with DiSSCo, ultimately strengthening DiSSCo sustainability.

Work Package 3: Data Infrastructure & Core Services

Objectives:

1. Advance DiSSCo's data infrastructure to a minimum viable product in preparation for operation under the ERIC and adapt to evolving data standards (T3.1)
2. Integrate key e-services with the DiSSCo data infrastructure and improve technical readiness (T3.2)
3. Update the DiSSCo Data Management Plan in preparation for operation under the ERIC and advance the DMP in support of machine-actionability (T3.3)

Description of work

This work package aims to advance DiSSCo's data infrastructure based on its Digital Specimen architecture (DSarch) and core end-user services (e-services) that will rely on this infrastructure for reading, writing, processing and annotating data. These services are the European Loans and Visits System (ELViS), the Unified Curation and Annotation System (UCAS), the Collections Digitisation Dashboard (CDD), and the Specimen Data Refinery services (SDR). The work package also aims to prepare for operation under the ERIC by advancing the provisional DiSSCo Data Management Plan, including supporting documentation in preparation for the distributed operation and continued development of the data infrastructure and end-user services. These activities will strengthen DiSSCo's IRL with reference to technological readiness.

Task 3.1: Further develop the piloted Digital Specimen Architecture (DSarch) into a minimum valuable product (M1-M18) - Naturalis, SGN. This task will plan and develop piloted components of DSarch into a minimum valuable product (MVP) of Technical Readiness Level (TRL) 6: Technology demonstrated in a relevant environment with a representative set of real data, with enough features to attract early-adopter users of the RI. DSarch has been developed by the DiSSCo development team (funded by DiSSCo members) based on the results from the DiSSCo-linked projects such as the first version of

the openDS (open Digital Specimen) specification with a conceptual data model and API specifications, the data modelling framework, drafts of the developed MIDS and Latimer Core standards and the provisional DiSSCo DMP.

The architecture design and development of the PID infrastructure, one of the DSarch components, is carried out under the EU-funded BiCIKL project and currently TRL 4-5 (proof of concept tested with Handle infrastructure). Other components of DSarch are the Digital Specimen Repository, Data Processing and Publishing services, Indexing services and API, and AAI. These are already demonstrable in a controlled environment prior to this project (TRL 4-5). During further development, DSarch will be aligned with evolving standards and specifications (e.g. openDS +FAIR Digital Objects/FDO) in connection with ongoing tasks in [WP4](#). DSarch will also be extended to support future event-based data updates: events in institutional data management systems or end-user services that trigger updates in the DiSSCo data infrastructure and vice versa.

The DiSSCo infrastructure is summarised in Fig. 6.

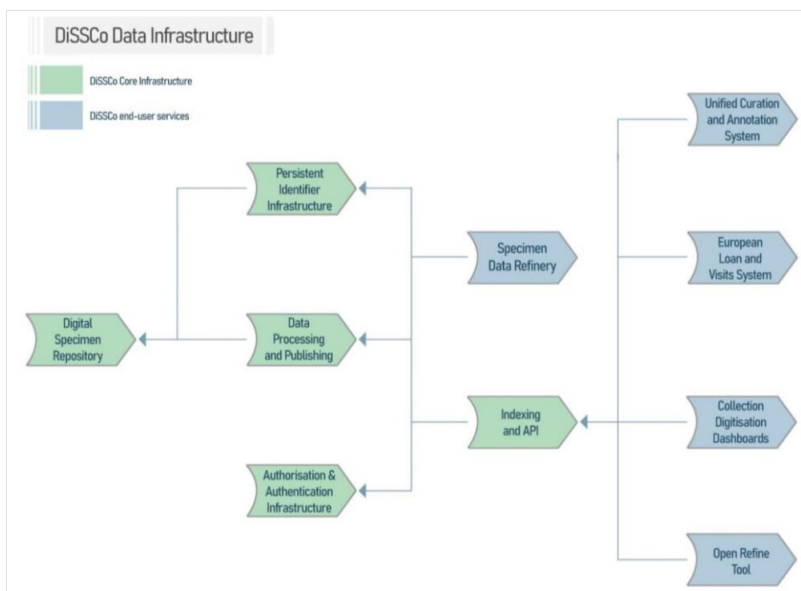


Figure 6. [doi](#)

Overview of the DiSSCo Data Infrastructure with core infrastructure (DSarch) and end-user service components.

Task 3.2: Advancement of end-user Services through integration with core infrastructure and continued e-services development (M1-M17) - SGN, MNHN, NHM, CETAF, RBINS, Naturalis.

This task will focus on integration of SDR, CDD, ELViS and UCAS end-user services with the API and AAI components of the core infrastructure, and Machine Learning-assisted services for data enrichment (such as SDR) with the Data Processing and Publishing

component. The task will also expand the functionality of ELViS with a service for individual visits. By implementing the FAIR Digital Object Architecture, the e-services involved will be conceptually and technically merged to form a highly integrated service ecosystem, and access will be provided through a common AAI. This AAI infrastructure is EOSC compliant and provides federated authentication and authorisation among participating organisations to provide cross-institutional services. The work includes the migration of ELViS users and the change of the party responsible for providing the system, which will be carried out in line with GDPR. Special attention will be given to developing the end-user services to provide and connect with open and standardised APIs for future expansion and interaction with other RIs (following the API guidelines developed in the BiCIKL project). This will enable DiSSCo to connect with data infrastructures from environmental RIs such as [eLTER](#) and [LifeWatch ERIC](#) as well as with services from international data aggregators like GBIF.

Task 3.3: Update and advance the DiSSCo DMP for machine actionability and create supporting documentation (M1-16) - UTartu, Naturalis, SGN.

This task will update and continue the work towards a DiSSCo DMP for the ERIC as initiated in the ICEDIG project (Hardisty 2019 -provisional DMP) and the work carried out in DiSSCo Prepare to develop principles and policies with respect to FAIR data policies. The task will build on developments towards machine-actionable DMPs as carried out in the [Research Data Alliance](#) (RDA). A fully machine-actionable DMP will enable flexible integration of all relevant information in the data life cycle and the creation of reports containing structured data (with metadata, identifiers and provenance).

The DMP will be supported with service management documentation for preparing the transition and further development of the DiSSCo data infrastructure and e-services ecosystem for operation under the ERIC. This documentation will focus on service enrolment with the AAI services (describing access rights management and user profiles), usage of PID services (with a small case study for applying PIDs to specimen objects), documentation for future collaboration in teams on distributed code development, and on documentation for connecting small datasets (i.e. with tools like [OpenRefine](#)).

Work Package 4: International Collaboration on (data) Standards

Objectives:

1. Report on the state of standards interoperability and gap analysis for the next stage of DiSSCo RI development and support continued development and adoption of new community standards (T4.1).
2. Write and evaluate documentation for DiSSCo's operational services and related standards, and report the use of pilot DiSSCo infrastructure and the adoption of contemporary practices following workshops and community consultation (T4.2).

Description of work

The biodiversity data community has made good progress in developing new information standards during the SYNTHESYS+, ICEDIG and DiSSCo Prepare projects (Hardisty et al. 2020, Hobern et al. 2022). These standards, like the openDS specification describing the Digital Specimen data model, APIs and ontology, are key to advancing our future ambitions and ensuring interoperability between the DiSSCo RI and other infrastructures.

WP4 will continue to support and enable this work, ensuring that the different standards reach the level of maturity required for DiSSCo and that the communities remain engaged. We will support the testing and documentation of existing tools that aim to implement standards and bridge gaps between those who create data and the needs of those that use the data (e.g., Marcer et al. 2020). This will include engaging with our user community and running workshops to increase adoption and address barriers to standards adoption and use. We will support the work of [WP3](#) by documenting and describing best practices for using data created from DiSSCo services.

Task 4.1 Standards interoperability (M1-18) - NHM, Naturalis, SGN, UTartu, BGMeise.

Task 4.1 will facilitate the continued development of contemporary community standards (e.g., Minimum Information about a Digital Specimen (MIDS), and Latimer Core) to ensure alignment with openDS, and support the testing of current and emerging tools that increase standards interoperability. This task will coordinate pilot integrations and collaboration with international infrastructures, e.g., [Catalogue of Life](#) (CoL), [GBIF](#) including [ChecklistBank](#), and the [Barcode of Life Data System](#) (BOLD), and continue discussions with standards development groups like [Biodiversity Information Standards \(TDWG\)](#). It will advance the development of the openDS specification, extend the data model, and continue to harmonise with existing and emerging standards.

Task 4.2 Standards adoption and use (M1-18) - NHM, Naturalis, CETAF, SGN, UTartu.

Task 4.2 will organise and support discussions with international organisations through e.g. IPDES (International Partners for the Digital Extended Specimen – informal group) for DES using Persistent Identifiers (PIDs). This task will promote the implementation of prototype DiSSCo APIs and community standards by writing documentation, providing examples, organising workshops with implementers, and continuing discussions with Collections Management System providers on effective standards adoption.

Task 4.2 will coordinate discussion with users and key stakeholders on scientific use cases and FAIR practices through workshops and community consultation, including National Nodes (T2.1) and DiSSCo's Scientific Advisory Board. This will be done with the planning and iterative implementation of the Minimum Viable Product in Task 3.1. Finally, it will continue the development of a community vision on how to integrate geo-collections data within the DiSSCo core data infrastructure in collaboration with the CETAF Earth Science group.

Work Package 5: Management, Communication and Outreach

Objectives:

1. Ensure the smooth implementation of the Project work plan.
2. Support DiSSCo advisory bodies in their operation and their links to the Project.
3. Implement communication plan and monitor Project-wide dissemination & exploitation of results.

Description of work

WP5 includes Tasks that focus on the coordination, support and communication actions of the Project. It is organised into three Tasks as follows:

Task 5.1 Day-to-Day Management (M1-M18) - Naturalis.

This task focuses on the day-to-day management of the project. Specifically:

- Set-up and operation of the project online management platform;
- Support for the operation (administration and logistics) of the project's governance and management bodies);
- Internal communication with partners on contractual responsibilities and evaluation of progress against upcoming milestones and Deliverables;
- Communication with the European Commission;
- Financial administration of the project;
- Data management.

This Task will be under the responsibility of a Project manager and Project administrator. Together with the Project Coordinator will form the Project coordination Team. The Project will use, already established in DiSSCo, Project management and communication tools. This will lower the access threshold of these tools for the beneficiaries, who are already familiar with their use. Furthermore, we will benefit from the already established administrative structure of DiSSCo RI to reduce costs linked to the management of the Project.

A kick-off meeting is planned for Month 1. A final event of the Project will run at the end of the project and if feasible, be coupled with the official start of the DiSSCo ERIC. The event will showcase the results of the Project and hand over its outputs to the DiSSCo ERIC management. A Data Management Plan for the Project will be delivered by Month 3.

Task 5.2 Support to governance bodies of DiSSCo RI (M1-M18) - Naturalis, CETAF.

The main objective of this task is to support the operation and communication of the Project's key governance and management structures and the DiSSCo RI as well. Specifically, this task will focus on:

- Supporting of the project governing bodies (Project Council and Executive Board);

- Evaluating of the quality and fitness for the project outputs (Milestones and Deliverables), using internal and external (as needed) review panels;
- Risk monitoring and initiation of risk mitigation actions;
- Liaising with DiSSCo RI governing bodies (interim General Assembly, Scientific & Technical Advisory Boards) and the Technical Team (TT), as needed for the review of project outcomes.

The responsibility of this task lies mainly with the Executive Board of the project. A sound governance of the project will be guaranteed in the provisions of the Consortium Agreement.

Task 5.3 Coordination of dissemination, exploitation and communication activities
(M1-M18) - Naturalis, CETAF, NHM, SGN.

This Task will focus on the coordination of the communication, exploitation and dissemination activities of the Project, as described in [section 2.2](#) of the Proposal. A Dissemination and Exploitation plan including communication activities will be delivered early in the Project's life. Participation in third-party events will also be coordinated through Task 5.3.

Deliverables, Milestones, and Staff Effort

The project's Deliverables, Milestones and Staff Effort are summarised in Table 6, Table 7, and Table 8.

Table 6. List of DiSSCo Transition Deliverables.						
Deliverable (number)	Deliverable name	Work package number	Short name of lead participant	Type	Dissemination level	Delivery date (month)
D1.1	Corpus of documentation for ERIC application (Task 1.1)	WP1	Naturalis	Report (R)	Confidential (CO)	M18
D1.2	Corpus of implementation rules and further regulation for DiSSCo ERIC (Task 1.2)	WP1	X-Officio	Report (R)	Confidential (CO)	M18
D1.3	Corpus of main policies for DiSSCo ERIC (Task 1.3)	WP1	RBINS	Report (R)	Confidential (CO)	M18
D2.1	Participatory schema for DiSSCo NNS (Task 2.1)	WP2	CETAF	Report (R)	Public (PU)	M16
D2.2	Integration and adoption roadmap of assessment tools (Task 2.2)	WP2	RBINS	Report (R)	Public (PU)	M18

Deliverable (number)	Deliverable name	Work package number	Short name of lead participant	Type	Dissemination level	Delivery date (month)
D2.3	Model of training resources for users in connection with the DiSSCo Helpdesk (Task 2.3)	WP2	CETAF	Report (R)	Public (PU)	M16
D3.1	Minimum Viable Product of CoreInfrastructure with a selected set of relevant data (TRL 6) (Task 3.1)	WP3	Naturalis	Other	Public (PU)	M18
D3.2	ELViS running in an operationalenvironment managed by MNHN, its users migrated and connected to the AAI core infrastructure component and connected with a new service forsupporting individual visits (Task 3.2)	WP3	MNHN	Other	Public (PU)	M17
D3.3	DiSSCo DMP ready for use in the ERICwith supporting documentation anddemonstrator for a machine-actionableDMP enabling provenance trackingbased on open standards (PRO V-O)(Task 3.3)	WP3	UTartu	Other	Public (PU)	M16
D4.1	Report on state of standards interoperability and gap analysis for next stage of DiSSCo RI development. (M18) (Task 4.1)	WP4	NHM	Report (R)	Public (PU)	M18
D4.2	Report on standards adoption including workshops, current state of geo-collections data mobilisation and documentation for DiSSCo services(Task 4.2)	WP4	NHM	Report (R)	Public (PU)	M18
D5.1	Data Management Plan (Task 5.1)	WP5	Naturalis	Report (R)	Public (PU)	M3
D5.2	Project Wrap-up Event (Task 5.3)	WP5	Naturalis	DEC	Public (PU)	M18

Table 7.

List of DiSSCo Transition milestones.

Milestone number	Milestone name	Related work package	Due date (month)	Means of verification
MS1.1	Socio-Economic impact assessment (Task 1.1)	WP1	M18	Document
MS1.2	Rules of Procedure for the DiSSCo ERIC General Assembly (Task 1.2)	WP1	M10	Document
MS1.3	Rules of Procedure for the Nodes Advisory Committee (Task 1.2)	WP1	M10	Document
MS1.4	Terms of reference for the DiSSCo Executive Board & the Scientific, Ethical and Technical Advisory Body (Task 1.2)	WP1	M10	Document
MS1.5	Principles for financial rules & Procurement framework for DiSSCo (Task 1.2)	WP1	M15	Document
MS1.6	Data policy (Task 1.3)	WP1	M13	Document
MS1.7	Access policy (Task 1.3)	WP1	M17	Document
MS1.8	Employment policy (Task 1.3)	WP1	M17	Document
MS1.9	IPR Policy framework (Task 1.3)	WP1	M17	Document
MS2.1	(Virtual) Workshop on technical core architecture (Task 2.1 in connection to T3.1)	WP2	M8	Workshop
MS2.2	(Virtual) Workshop on legal status-quo (Task 2.1 in connection to T1.2)	WP2	M10	Workshop
MS2.3	Survey for tools data collection (Task 2.2)	WP2	M6	Document
MS2.4	Translation of lessons learned from BICIKL into the DiSSCo context (Task 2.3)	WP2	M7	Document
MS3.1	Definition of a TRL 6 Minimum Viable Product of core infrastructure (Task 3.1)	WP3	M6	Document
MS3.2	Plan for integration of the Collection Digitisation Dashboard with the core infrastructure and connection with Latimer Core compatible data sources for collection descriptions (Task 3.2)	WP3	M4	Document
MS3.3	Pilot integration of Machine Learning-assisted services for dataenrichment (such as SDR) with DSarch to create a coherent framework enabling seamless integration of machine-annotated data with the Digital Specimens (Task 3.2)	WP3	M12	Demonstrator

Milestone number	Milestone name	Related work package	Due date (month)	Means of verification
MS3.4	Documentation for the enrolment of DiSSCo services into DiSSCo's federated AAI infrastructure services and specify authorization schemas for resources in the infrastructure (Task3.3)	WP3	M14	Document
MS4.1	Interim report on state of standards interoperability (Task 4.1)	WP4	M9	Document
MS4.2	First user and technical stakeholder workshops (Virtual + In-person) on standards in support of the development in WP3 (Task 4.2)	WP4	M12	Workshop
MS4.3	Second user and technical stakeholder workshops (Virtual + In- person) to discuss the progress with standards interoperability in the development in WP3 (Task 4.2)	WP4	M15	Workshop
MS5.1	Project kick-off meeting (Task 5.1)	WP5	M1	Meeting
MS5.2	Plan for Dissemination, Exploitation including Communication activities (Task 5.3)	WP5	M6	Document

Table 8.

Summary of staff effort.

Participant Number / Short Name	WP1	WP2	WP3	WP4	WP5	Total Person-Months per Participant
1. Naturalis	5.0	1.0	15.0	2.0	9.0	32.0
2. CETAF	2.0	9.0	1.0	1.0	2.0	15.0
3. SGN		1.0	14.0	2.0	0.5	17.5
4. NHM		2.0	9.0	7.5	0.5	19.0
5. UoC		2.0				2.0
6. ULisboa		2.0				2.0
7. IBER-BAS		2.0				2.0
8. PSB-SAS		2.0				2.0
9. UTartu		1.0	6.0	3.5		10.5
10. BGMeise	4.0	1.0		2.0		7.0
11. X-Officio	12.0					12.0
12. RBINS	8.0	3.0	1.0			12.0
13. NHMD		2.0				2.0
14. UniFi		2.0				2.0

Participant Number / Short Name	WP1	WP2	WP3	WP4	WP5	Total Person-Months per Participant
15. MNHN	4.0	2.0	16.0			22.0
16. Freie Universität Berlin		2.0				2.0
Total Person Months	35.0	34.0	62.0	18.0	12.0	161.0

3.2 Capacity of Participants and Consortium as a Whole

The DiSSCo Transition Project consortium directly stems from the DiSSCo wider partnership. The Consortium involves 16 Partners with three profiles (i) DiSSCo partners that bring in required technical expertise for the implementation of the work plan, (ii) external to DiSSCo expert partners and (iii) DiSSCo institutions that represent national nodes.

To ensure the continuity of work from the Preparatory Phase to the Transition Phase, many of the members of the consortium of the DiSSCo Prepare Project are also leading parts of the work in the DiSSCo Transition Project. This ensures the productive advancement of the work and good collaboration between all the Project's partners, as they have been working together already since 2018. Similarly, the long-standing collaboration among partners facilitates the concentration of work in the short time frame of 18 months without risking the thoroughness and the quality and timely delivery of expected outcomes. Given the complexity of the work, especially in legal documentation ([WP1](#)) the consortium also brings in an external legal expert partner (X-Officio). This partner has specific legal expertise in European RIs and has already provided legal services to DiSSCo over the last four years.

The partnership includes the following institutions with specific responsibilities in the work plan of the Project:

Naturalis Biodiversity Center (Naturalis) has been leading the development of DiSSCo, hosts the DiSSCo Coordination and Support Office and takes up the role of the Coordinator of the Project, to ensure alignment between the DiSSCo RI leadership and the Project coordination. Furthermore, Naturalis has been championing the technical development of the core data services of DiSSCo and co-developing its underlying data architecture. With a strong profile in research infrastructures and a 70-strong Sector for Digital, Naturalis is committed to the success of DiSSCo and has put in significant in-kind investments for its development.

Consortium of European Taxonomic Facilities (CETAF), representing the European community of taxonomic facilities, is a core partner in the process of establishing the DiSSCo RI, has taken a prominent role in all the DiSSCo-related projects and leads the Coordination and Support Office alongside Naturalis. Due to its unique role as a network, CETAF has been instrumental in fostering communication and collaboration among DiSSCo stakeholders and in paving the way for support services towards the future RI across several projects (ICEDIG, SYNTHESYS+, DiSSCo Prepare).

The Natural History Museum, London (NHM) has led the SYNTHESYS series of projects since 2004, establishing the concept and delivery of both Physical and Virtual Access in Natural Science Collections. In recent DiSSCo-linked projects (ICEDIG, SYNTHESYS+, DiSSCo Prepare), NHM has led on key technical components of the future DiSSCo RI like the Specimen Data Refinery and measuring the financial benefits of digitisation. NHM has been coordinating the development of the DiSSCo-UK node and brings experienced managerial and technical specialists from its Digital, Data and Informatics group.

Senckenberg Gesellschaft für Naturforschung (SGN) was responsible for the work package “technical architecture & service provision” in DiSSCo Prepare and is actively involved in the development of the DiSSCo-linked specifications openDS and MIDS. SGN represents DiSSCo (together with Naturalis) in the context of the FAIR Digital Objects Forum, which develops the concepts essential for the implementation of the Digital Specimen as an FDO. Furthermore, SGN is actively advancing Germany’s participation in the transformation process to the ERIC in close cooperation with its national partners (DiSSCo-D).

Further to the Partners above (WP leaders) the Consortium includes partners with specific expertise (technical or organisational) across the Tasks. Specifically, Muséum national d’Histoire naturelle (MNHN) brings in expertise in the development of ELViS system ([WP3](#)), as well as expertise in the financial and organisational development of DiSSCo. Similarly, Institut Royal Des Sciences Naturelles De Belgique (RBINS) has previously led the development of the organisational framework of DiSSCo and will continue within DiSSCo Transition Project. Tartu Ülikool (UTartu) and Agentschap Plantentuin Meise (BGMeise) bring in long-standing expertise in standardisation and technical developments, as well as expertise in procurement frameworks. The Partners of [WP2](#) (Task 2.1) also lead the national activities regarding the engagement of the national funders to DiSSCo across all countries that are members of the DiSSCo FF.

Glossary

- CDD - Collections Digitisation Dashboard which summarises the levels of digitisation across all European collections.
- DiSSCo CSO - DiSSCo Coordination and Support Office, the executive office of DiSSCo RI.
- DSarch - Digital Specimen architecture.
- ELViS - European Loans and Visits system.
- FF - Funders Forum.
- SAB - Scientific Advisory Board.
- SDR - Specimen Data Refinery.
- TAB - Technical Advisory Board.
- TRL - Technical Readiness Level.
- TT - Technical Team.

- UCAS - Unified Curation and Annotation Service.

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Funding program

[HORIZON.1.3 - Research infrastructures](#)

[HORIZON.1.3.1 - Consolidating and Developing the Landscape of European Research Infrastructures](#)

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Conflicts of interest

The authors have declared that no competing interests exist.

References

- Access to Biological Collections Data Task Group (2005) Access to Biological Collection Data (ABCD). Biodiversity Information Standards (TDWG). <http://www.tdwg.org/standards/115>. Accessed on: 2023-10-31.
- Amazon Web Services (2023) What is DevOps? <https://aws.amazon.com/devops/what-is-devops/>. Accessed on: 2023-10-31.
- Atlassian (2023) The Agile Coach: Atlassian's no-nonsense guide to agile development. <https://www.atlassian.com/agile>. Accessed on: 2023-10-31.
- Directorate-General for Research and Innovation (European Commission), PwC EU Services (2018) Cost-benefit analysis for FAIR research data – Cost of not having FAIR research data. Publications Office <https://doi.org/10.2777/02999>
- Directorate-General for Research and Innovation (European Commission), EOSC Executive Board, Corcho O, Eriksson M, Kurowski K, Ojsteršek M, Choirat C (2021) EOSC interoperability framework: Report from the EOSC Executive Board Working Groups FAIR and Architecture. Publications Office <https://doi.org/10.2777/620649>
- DiSSCo Prepare, MOBILISE, DiSSCo UK (2023) DiSSCo Digitisation Guides: Guidance and workflows for the digitisation of natural science collections. <https://dissco.github.io/>. Accessed on: 2023-11-06.
- EOSC-hub (2023) Open Science. <https://www.eosc-hub.eu/open-science-info>. Accessed on: 2023-10-31.
- European Commission (2023a) Biodiversity Digital Twin for Advanced Modelling, Simulation and Prediction Capabilities. <https://doi.org/10.3030/101057437>. Accessed on: 2023-10-31.
- European Commission (2023b) ENVironmental Research Infrastructures building Fair services Accessible for society, Innovation and Research. <https://doi.org/10.3030/824068>. Accessed on: 2023-10-31.
- European Commission (2023c) Biodiversity Genomics Europe. <https://doi.org/10.3030/101059492>. Accessed on: 2023-10-31.
- European Commission (2023d) Biodiversity Community Integrated Knowledge Library. <https://doi.org/10.3030/101007492>. Accessed on: 2023-10-31.
- European Commission (2023e) Transforming European Taxonomy through Training, Research, and Innovations. <https://doi.org/10.3030/101081903>. Accessed on: 2023-10-31.
- European Commission and Directorate-General for Research and Innovation (2021) Horizon Europe, open science – Early knowledge and data sharing, and open collaboration. Publications Office of the European Union <https://doi.org/10.2777/18252>
- European Commission, Directorate-General for Research and Innovation (2018) Turning FAIR into reality – Final report and action plan from the European Commission expert group on FAIR data. Publications Office [ISBN 978-92-79-96547-0] <https://doi.org/10.2777/54599>
- Hardisty A (2019) Provisional Data Management Plan for DiSSCo infrastructure. Deliverable D6.6. Zenodo <https://doi.org/10.5281/zenodo.3532936>
- Hardisty A, Saarenmaa H, Casino A, Dillen M, Gödderz K, Groom Q, Hardy H, Koureas D, Nieva de la Hidalga A, Paul D, Runnel V, Vermeersch X, van Walsum M, Willemse L (2020) Conceptual design blueprint for the DiSSCo digitization infrastructure -

DELIVERABLE D8.1. Research Ideas and Outcomes 6 <https://doi.org/10.3897/rio.6.e54280>

- Hardisty AR, Ellwood ER, Nelson G, Zimkus B, Buschbom J, Addink W, Rabeler RK, Bates J, Bentley A, Fortes JAB, Hansen S, Macklin JA, Mast AR, Miller JT, Monfils AK, Paul DL, Wallis E, Webster M (2022) Digital Extended Specimens: Enabling an Extensible Network of Biodiversity Data Records as Integrated Digital Objects on the Internet. *BioScience* 72 (10): 978-987. <https://doi.org/10.1093/biosci/biac060>
- Hobern D, Livermore L, Vincent S, Robertson T, Miller J, Groom Q, Grosjean M (2022) Towards a Roadmap for Advancing the Catalogue of the World's Natural History Collections. *Research Ideas and Outcomes* 8 <https://doi.org/10.3897/rio.8.e98593>
- International Image Interoperability Framework (2023) <https://iiif.io/>. Accessed on: 2023-10-31.
- Koureas D, Raes N, Alonso E, Casino A, Addink W (2023a) DiSSCo Strategy & operational planning. Zenodo <https://doi.org/10.34960/8171-gs91>
- Koureas D, Livermore L, Alonso E, Addink W, Alves MJ, Casino A, Curral L, Enghoff H, Guiraud M, Hardy H, Hoffmann J, Landel S, Paleco C, Petersen M, Scory S, Smith V, Weiland C, Wesche K, Woodburn M (2023b) DiSSCo Prepare Project: Increasing the Implementation Readiness Levels of the European Research Infrastructure. *Research Ideas and Outcomes* 9 <https://doi.org/10.3897/rio.9.e113906>
- Loo T, Benvenuti M, Cecchi L, Innocenti G, Biaggini M, Bellucci L, Moggi Cecchi V, Di Vincenzo F, Rossi de Gasperis S (2023) DiSSCo Prepare Deliverable D9.6 Compilation of Construction Masterplan. DiSSCo Prepare <https://doi.org/10.34960/cy1m-b238>
- Marcer A, Haston E, Groom Q, Ariño A, Chapman A, Bakken T, Braun P, Dillen M, Ernst M, Escobar A, Fichtmüller D, Livermore L, Nicolson N, Paragamian K, Paul D, Pettersson L, Phillips S, Plummer J, Rainer H, Rey I, Robertson T, Röpert D, Santos J, Uribe F, Waller J, Wiczorek J (2020) Quality issues in georeferencing: From physical collections to digital data repositories for ecological research. *Diversity and Distributions* 27 (3): 564-567. <https://doi.org/10.1111/ddi.13208>
- Muench S, Stoermer E, Jensen K, Asikainen T, Salvi M, Scapolo F (2022) Towards a green and digital future. Publications Office of the European Union, Luxembourg. [ISBN 978-92-76-52451-9] <https://doi.org/10.2760/977331>
- Open Data Handbook (2023) What is Open Data? <https://opendatahandbook.org/guide/en/what-is-open-data/>. Accessed on: 2023-10-31.
- Scory S, Paleco C, Alonzo-Vizcaino E, Koureas D, Graber-Soudry O, Casino A, Dusoulier F, Worley K (2023) D7.2 Draft Statutes and future milestones for the creation of DiSSCo ERIC. Zenodo <https://doi.org/10.34960/ft1c-qz88>
- Smith V, Gorman K, Addink W, Arvanitidis C, Casino A, Dixey K, Dröge G, Groom Q, Haston E, Hobern D, Knapp S, Koureas D, Livermore L, Seberg O (2019) SYNTHESYS+ Abridged Grant Proposal. *Research Ideas and Outcomes* 5 <https://doi.org/10.3897/rio.5.e46404>
- The FDO Forum (2023) FAIR Digital Objects Forum. <https://fairdo.org/>. Accessed on: 2023-11-06.
- Wiczorek J, Bloom D, Guralnick R, Blum S, Döring M, Giovanni R, Robertson T, Vieglais D (2012) Darwin Core: An Evolving Community-Developed Biodiversity Data Standard. *PLoS ONE* 7 (1). <https://doi.org/10.1371/journal.pone.0029715>
- Wiczorek J (2023) tdwg/dwc: 2023-07-10. Zenodo <https://doi.org/10.5281/zenodo.592792>

- Woodburn M, Buschbom J, Droege G, Grant S, Groom Q, Jones J, Trekels M, Vincent S, Webbink K (2022) Latimer Core: A new data standard for collection descriptions. Biodiversity Information Science and Standards 6 <https://doi.org/10.3897/biss.6.91159>

Supplementary material

Suppl. material 1: Letter of Intent for Collaboration: Development of a Global Partnership on Persistent Identification of Digital Extended Specimens & other Natural Science Collections Data Entities [doi](#)

Authors: Alliance for Biodiversity Knowledge

Data type: PDF

Brief description: PDF of Letter of Intent for Collaboration, currently live as of 2023-11-06 on <https://www.cognitofrms.com/DiSSCo1/LetterOfIntentForCollaboration>

[Download file](#) (520.75 kb)

Endnotes

- *1 DiSSCo Prepare DPP Work Package 5 - Common Resources and Standards (MS5.1–5.7 and D5.1) and Work Package 6 - Technical Architecture & Services provision (D6.1–D6.4).
- *2 "A project management approach that involves breaking the project into phases and emphasizes continuous collaboration and improvement. Teams follow a cycle of planning, executing, and evaluating." - Atlassian 2023
- *3 "Under a DevOps model, development and operations teams are no longer "siloeed." Sometimes, these two teams are merged into a single team where the engineers work across the entire application lifecycle, from development and test to deployment to operations, and develop a range of skills not limited to a single function." - Amazon Web Services (2023)
- *4 "Darwin Core is a standard maintained by the [Darwin Core Maintenance Interest Group](#) [...] Darwin Core is primarily based on taxa, their occurrence in nature as documented by observations, specimens, samples, and related information." Wiczorek et al. (2012) and Wiczorek (2023)
- *5 "The Access to Biological Collections Data (ABCD) Schema is an evolving comprehensive standard for the access to and exchange of data about specimens and observations (a.k.a. primary biodiversity data)." - Access to Biological Collections Data Task Group (2005)
- *6 "IIIF is a set of open standards for delivering high-quality, attributed digital objects online at scale. It's also an international community developing and implementing the IIIF APIs. IIIF is backed by a consortium of leading cultural institutions." - International Image Interoperability Framework (2023)

- *7 Minimum Information about a Digital Specimen - current draft of specification on [GitHub](#).
- *8 "The Latimer Core (LtC) schema, named after [Marjorie Courtenay-Latimer](#), is a standard designed to support the representation and discovery of natural science collections by structuring data about the groups of objects that those collections and their subcomponents encompass." - Woodburn et al. (2022)
- *9 "Open Science represents a new approach to the scientific process based on cooperative work and new ways of diffusing knowledge by using digital technologies and new collaborative tools. The idea captures a systemic change to the way science and research have been carried out for the last fifty years: shifting from the standard practices of publishing research results in scientific publications towards sharing and using all available knowledge at an earlier stage in the research process" - EOSC-hub (2023)
- *10 "Open data is data that can be freely used, re-used and redistributed by anyone - subject only, at most, to the requirement to attribute and share alike." - Open Data Handbook (2023)
- *11 "Creative Commons (CC) is an international nonprofit organization dedicated to helping build and sustain a thriving commons of shared knowledge and culture." - <https://creativecommons.org/>
- *12 FDO Machine Actionability Definition V2.2, <https://drive.google.com/file/d/1Bbzb2f8yuR01E0uGldctE9JXF8DuTw8g/view>
- *13 Council Regulation (EU) No 1261/2013 of 2 December 2013 amending Regulation (EC) No 723/2009 concerning the Community legal framework for a European Research Infrastructures Consortium (ERIC) - Permanent URL: <https://eur-lex.europa.eu/eli/reg/2013/1261/oj>
- *14 COP15 [Target 21](#) "Ensure that the best available data, information and knowledge, are accessible to decision makers, practitioners and the public to guide effective and equitable governance, integrated and participatory management of biodiversity, and to strengthen communication, awareness-raising, education, monitoring, research and knowledge management and, also in this context, traditional knowledge, innovations, practices and technologies of indigenous peoples and local communities should only be accessed with their free, prior and informed consent, in accordance with national legislation."
- *15 The Destination Earth (DestinE) is a flagship initiative of the European Commission to develop a highly accurate digital model of the Earth on a global scale. - <https://digital-strategy.ec.europa.eu/en/policies/destination-earth>