



Humanities and cultural Heritage Italian Open Science Cloud

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#### ABSTRACT

This deliverable reports a series of information to help the decision-making structure to channel its strategies in order to guarantee the maintenance of the project's knowledge, outputs and services for at least 10 years after the end of the Next Generation EU funding period.

The ultimate goal is to elaborate timely actions to stimulate scientific excellence and unlock the full potential of the H2IOSC solutions by promoting methodological innovation in research and elaborate coherent and shared strategies to facilitate the financial sustainability of the H2IOSC cluster, including in finding national and international funding occasions to provide additional resources for the project's sustainability.

It has been built as a "Business plan" which includes, moreover, many factors, as: the role of the RIs, national, international and domain contexts, the stage of the H2IOSC's lifecycle phase. The Business plan has to be revisited regularly, taking into account that it will still have to be updated once the H2IOSC cluster is fully operational.

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## LIST OF ACRONYMS

<b>CLARIN</b>	Common Language Resources and Technology Infrastructure
<b>CNR</b>	Consiglio Nazionale delle Ricerche (National Research Council)
<b>DARIAH</b>	Digital Research Infrastructure for the Arts and Humanities
<b>DiPText-KC</b>	Digital and Public Textual Scholarship Knowledge Centre
<b>DSU</b>	Dipartimento di Scienze umane e sociali, patrimonio culturale
<b>EAB</b>	External Advisory Board
<b>EOSC</b>	European Open Science Cloud
<b>ERCC</b>	Eurac Research CLARIN Centre
<b>E-RIHS</b>	European Research Infrastructure for Heritage Science
<b>ERIC</b>	European Research Infrastructure Consortium
<b>ESFRI</b>	European Strategy Forum on Research Infrastructures
<b>EU</b>	European Union
<b>FAIR</b>	Findable Accessible Interoperable Reusable
<b>FTE</b>	Full Time Equivalent
<b>GLAM</b>	Galleries Libraries Archives Museums
<b>H2IOSC</b>	Humanities and cultural Heritage Italian Open Science Cloud
<b>HS</b>	Heritage Science
<b>ICT</b>	Information and Communication Technologies
<b>JRU</b>	Joint Research Unit
<b>LOD</b>	Linked Open Data
<b>NLP</b>	Natural Language Processing
<b>OPERAS</b>	Open scholarly communication in the European research area for social sciences and humanities
<b>OS</b>	Open Science
<b>NRRP</b>	National Recovery and Resilience Plan
<b>PMB</b>	Project Management Board
<b>PNIR</b>	Piano Nazionale Infrastrutture di Ricerca (National Research Infrastructure Program)
<b>RI</b>	Research Infrastructure



<b>SME</b>	Small or medium-sized enterprise
<b>SSH</b>	Social Sciences and Humanities
<b>SSHOC</b>	Social Sciences and Humanities Open Cloud
<b>SW</b>	Software
<b>SWOT</b>	Strengths Weaknesses Opportunities Threats
<b>TEI</b>	Text Encoding Initiative
<b>WP</b>	Work Package



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## 1. H2IOSC OBJECTIVES AND STRATEGY

### 1.1 The Vision

H2IOSC (Humanities and cultural Heritage Italian Open Science Cloud) builds on a long-term strategy developed by the Department of Humanities and Social Sciences, Cultural Heritage of the National Research Council (CNR) to create a cluster of distributed technological infrastructures in the humanities and cultural heritage sectors across Italy. Its goal is to provide researchers, businesses, and citizens with a federated and open multidisciplinary environment. This environment enables access to advanced tools for conducting innovative and computationally intensive research on complex digital data and objects.

The H2IOSC acronym is a clear reference to the establishment of an Italian platform for open science, following the model of the European Open Science Cloud (EOSC). It aims to strengthen and enhance the national nodes of European Research Infrastructures settled in Italy, in line with the recommendations of the European Council's Pact for Research and Innovation in Europe. By reducing fragmentation through shared practices, standards, and processes, and by collaborating with other high-tech innovation domains, H2IOSC seeks to import experiences and solutions, fostering the creation of a competitive digital research ecosystem in Italy. Through the enhancement and federation of Italian nodes of the four high-priority research infrastructures (*E-RIHS - European Research Infrastructure for HeritageScience*, leading the cluster; *CLARIN - Common Language Resources and Technology Infrastructure*; *DARIAH - Digital Research Infrastructure for the Arts and Humanities* and *OPERAS - Open scholarly communication in the European research area for social sciences and humanities*), H2IOSC develops a network of high-performance computing nodes connected at high speeds to the Italian research network. These nodes aim to provide shared services for the creation, management, retrieval, and reuse of open and interoperable digital resources, including data, tools, services and digital objects provided by participating infrastructures or produced by researchers.

H2IOSC has also the objective to establish customizable digital laboratories dedicated to cutting-edge research in various disciplines across the SSH, including textual sciences (philology, linguistics, etc.), art history, archaeology, and cultural heritage sciences. These laboratories leverage technologies such as virtual and augmented reality, artificial intelligence, and big data analysis.

Promoting the adoption of open science paradigms, H2IOSC aims to become a national and international reference model for the development of open and interoperable digital research ecosystems. Through extensive collaborations with universities, libraries, archives, museums, and other research actors, H2IOSC involves the scientific community directly in its activities, ensuring that their needs are represented.

H2IOSC has an innovative potential which lies in the multidisciplinary collaboration between high-tech sectors such as computer science, data science, and artificial intelligence, and traditionally considered "long-tail" disciplines like the humanities. This synergy is made possible by the research infrastructures involved, which create a distributed network of high-power and high-efficiency computing nodes using state-of-the-art technologies to facilitate the digital transformation in these domains.

In the long run, H2IOSC's ultimate challenge is to facilitate the development of innovative sustainability models for RIs in the Social Sciences and Humanities ESFRI landscape, including

collaborations with the cultural and creative industries sector across different regions of Italy, to generate positive economic and social impact. Furthermore, H2IOSC is implementing a strategy to enhance the potential of new generations of researchers by improving their skills and expertise through doctoral scholarships with high scientific and technical competence. By leveraging advanced technologies and interdisciplinary approaches, H2IOSC aims to foster research excellence, societal impact, and economic growth in Italy and beyond, as well as to promote internationalization by enhancing the services of the cluster's national nodes, also within the context of the ERICs to which they refer, in order to contribute to their positioning within the EOSC.

## 1.2 The Context

The following paragraphs provide information relating to the Research Infrastructures participating in the H2IOSC federation, E-RIHS, CLARIN, DARIAH and OPERAS, about the role they have at an international and national level and the domains in which they operate.

### 1.2.1 E-RIHS

**E-RIHS** is the European Research Infrastructure for Heritage Science, created to support the research community on heritage interpretation, preservation, documentation, innovation and management.

Led by the National Research Council (CNR), E-RIHS community has developed a new paradigm in heritage science, thanks to over twenty years of experience in EU-funded projects.

E-RIHS applies an innovative and interdisciplinary approach to answer the specific needs of cultural and natural heritage assets and improve their understanding and preservation.

In 2016, E-RIHS entered the ESFRI Roadmap and it became a legal entity as ERIC - European Research Infrastructure Consortium in 2025.

E-RIHS is a distributed research infrastructure with a formal structure and two operational levels: a Central Hub (or Headquarters) hosted in Florence, Italy at the Manifattura Tabacchi, and National Nodes.

Currently, the National Nodes are active in Cyprus, France, Hungary, Italy, Malta, The Netherlands, Poland, Romania, Spain, Slovenia and the United Kingdom.

E-RIHS has 120 facilities and laboratories distributed throughout Europe, accessible and organised in four integrated platforms:

- ARCHLAB, with its local physical and digital archives of samples, reference materials, restoration reports;
- FIXLAB, including large-scale laboratories, synchrotrons, particle accelerators, neutron laboratories for the study of mobile works of art or samples;
- MOLAB, consisting of mobile instruments that are moved to museums, archaeological sites for the study of immovable objects through non-invasive in situ multi-diagnostic techniques;
- DIGILAB, with online access to digital data generated by ARCHLAB, FIXLAB and MOLAB integrated with digital tools for the creation of new knowledge.

The mission of E-RIHS is to deliver integrated access to expertise, data and technologies for protecting heritage.

The vision of E-RIHS is to ensure that heritage remains meaningful, relevant, and accessible in a diverse and changing world for the benefit of present and future citizens. E-RIHS uncovers the cultural and historical layers embedded in heritage, seeks optimal ways to preserve it by understanding material changes, and harnesses its potential as a source of socio-economic and environmental sustainability.

E-RIHS has the aim to serve the Heritage Science community of both scholars and practitioners by:

- providing access to world-class laboratories, data and collections coupled with high-specialised expertise to address complex research questions;
- delivering interdisciplinary and intersectoral training;
- promoting open science and FAIR principles in cultural heritage;
- enhancing service value as a result of user-provider co-creation process;
- stimulating open innovation in heritage practices and interventions;
- integrating world-leading EU facilities into a unique organisation with a significant cohesive role in the global HS community;
- increasing the impact of HS for the benefit of society.

Based on these principles and Open Science, E-RIHS is working to achieve its mission through the following key points to producing a decisive impact on heritage science research:

- Catalysing new cross-disciplinary research by mobilising expertise and researchers in the humanities and natural sciences;
- Integrating world-class facilities across Europe to connect the global community of heritage science;
- Building state-of-the-art tools and services for research communities and the heritage industry;
- Driving scientific excellence and innovation through visionary research projects;
- Leading the way to develop digital platforms for the improved understanding, visualisation and use of heritage;
- Developing skills and capabilities to build strong science and to foster collaboration.

**E-RIHS.it**, at national level, supported by the MUR, strengthens the Italian position in Europe in the field of Heritage Science and improves its capabilities in the technological and scientific fields related to Cultural Heritage, integrating cutting-edge facilities and offering access to a wide range of high-level scientific tools, as well as methodologies and data, to promote knowledge and innovation in the conservation of Cultural Heritage. E-RIHS.it connects researchers from different organisations and contributes to their mobility, fostering the dissemination and exploitation of national research and technological development.

Currently, the node consists of:

- CNR - National Research Council of Italy;
- INFN – Italian National Institute for Nuclear Physics;
- ENEA - Italian National Agency for New Technologies, Energy and Sustainable Economic Development.

National Institutions involved in the integrated platforms (ARCHLAB, FIXLAB and MOLAB):

- CNR ISPC - Istituto di Scienze del Patrimonio Culturale - E-RIHS Italian node coordinator. Local branches: Naples, Florence, Milan, Rome, Catania, Potenza, Lecce.
- CNR SCITEC - Istituto di Scienze e Tecnologie Chimiche "Giulio Natta". Local branch: Perugia.
- CNR INO - Istituto Nazionale di Ottica. Local branch: Florence.
- CNR ISTI - Istituto di Scienza e Tecnologie dell'Informazione. Local branch: Pisa.
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The E-RIHS Italian node is under enlargement, involving universities already engaged in European projects.

### 1.2.2 CLARIN

**CLARIN** is a distributed digital infrastructure providing access to multimodal digital language data (text, audio, video) and advanced tools, supporting research in the humanities, social sciences and other fields.

Since the tools and data from different centres are interoperable, they can be combined, and tools from various sources can be chained to perform operations at different levels of complexity, regardless of their location. Members can access all tools and resources with a single sign-on. Many of the resources are also open access for other interested communities of use, both within and outside the academia.

CLARIN was founded in 2012 as a European Research Infrastructure Consortium (ERIC). In 2016, it received the status of a Landmark on the ESFRI roadmap.

CLARIN has today 27 members (Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Germany, Greece, Hungary, Iceland, Italy, Latvia, Lithuania, The Netherlands, Norway, Poland, Portugal, Slovenia, Slovak Republic, South Africa, Spain, Sweden, Switzerland, United Kingdom) and > 80 centres.

CLARIN's mission is to create and maintain an infrastructure to support the sharing, use and sustainability of language data and tools for research in the humanities and social sciences.

CLARIN's vision is for all digital language resources and tools from all over Europe and beyond to be accessible through a single sign-on online environment for the support of researchers in the humanities and social sciences.

CLARIN's Technical Pillars are:

- Federated Identity: Letting users log in to protected data and services with their own institutional login and password;
- Persistent Identifiers: Enabling sustainable citations of electronic resources;
- Repositories: Digital archives where language resources can be stored, accessed and shared;
- Component Metadata and concept definitions: To ensure semantic interoperability when describing language resources;
- Content Search: Offering a search engine for a wide range of language resources;
- Web service chaining: giving users the possibility to freely combine language processing services.

The Knowledge Infrastructure is a set of facilities aimed at securing a continuous transfer of knowledge between all players involved in the construction, operation and use of the infrastructure. Each of them needs knowledge and expertise to do their jobs, and they continue to generate new knowledge and expertise.

**CLARIN-IT** is the Italian node of CLARIN. On the 1st of October 2015, Italy became the 16th Full Member of CLARIN ERIC. The Italian Representative at the CLARIN General Assembly is the Italian Ministry of University and Research. CNR is the lead institution of CLARIN-IT and the Institute of Computational Linguistics "A. Zampolli" (CNR ILC) coordinates and hosts ILC4CLARIN, the Italian node of the CLARIN infrastructure. CLARIN-IT gathers experts who operate in the field of computational linguistics, language resources and language technologies. It has strong contacts with various research communities, such as digital humanities, computational philology, oral history, thus including Libraries and Archives and Foundations.

CLARIN-IT is being formed and includes several of the major universities and research institutes of the country:

- Dipartimento di Filologia e Critica delle Letterature Antiche e Moderne – Università di Siena;
- Associazione EURAC Research (Bolzano);
- Fondazione Bruno Kessler (Trento);
- Soprintendenza Archivistica e Bibliografica della Toscana (Firenze);
- Dipartimento di Ingegneria Elettrica e delle Tecnologie dell'Informazione – Centro Interdipartimentale di Ricerca "URBAN/ECO" – Università degli Studi di Napoli Federico II;
- Università Cattolica del Sacro Cuore (Milano);
- Università di Parma;
- Università degli Studi di Padova;
- Centro Linguistico di Ateneo - Università degli Studi di Ferrara;
- Dipartimento di Studi Letterari, Linguistici e Comparati – Università degli Studi di Napoli "L'Orientale";
- Fondazione RUT (Roma and Ercolano);
- Università di Bologna "Alma Mater Studiorum".

CLARIN-IT main research topics are:

- Resources for regional languages and multilingual corpora (Learner corpus of German, Italian and Czech);
- Resources for the Italian Language (Creation new resources by enriching existing ones, Lexical datasets with Linked Open Data, Specialized corpora for computer-mediated communication, NLP and analysis tools, offered as web services and integrated into Weblicht);
- Digital Classics (Resources for ancient Greek and Latin - LOD version of the TEI-dict Perseus Liddell-Scott Jones. Dictionary, Latin of the Middle Ages, Digital editions of ancient fragmentary texts);
- Speech Archives (Grafo, Caterina Bueno Archive).

The CLARIN-IT technical infrastructure comprises three centres:



- Pisa ILC4CLARIN data centre which hosts data for the Italian language as well as for the classical languages and Arabic. In the evolving open science paradigm context, many Italian universities recognize the importance of depositing their data in institutional open repositories. ILC4CLARIN is among the only 3 with certification awarded by an external body (Trust Seal). This certification underscores its commitment to maintaining high standards in data management and accessibility, aligning with the principles of open science.
- Eurac Research CLARIN Centre (ERCC), a CLARIN metadata providing centre (CLARIN Centre of Type C).
- The Digital and Public Textual Scholarship Knowledge Centre (DiPText-KC), established under the aegis of CLARIN-IT, is focused on digital philology. DiPText-KC offers expertise on methods, data, instruments and technologies relevant in the field of Philological and Literary Studies, History, Art History and Cultural Heritage.

### 1.2.3 DARIAH

In August 2014, the European Commission established **DARIAH** as an ERIC with 15 Founding Members (Austria, Belgium, Croatia, Cyprus, Denmark, France, Germany, Greece, Ireland, Italy, Luxembourg, Malta, The Netherlands, Slovenia and Serbia). Currently, DARIAH has 23 Members (Austria, Belgium, Bosnia-Herzegovina, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, France, Germany, Greece, Ireland, Italy, Luxembourg, Malta, Poland, Portugal, The Netherlands, Serbia, Slovenia, Spain, Sweden and Switzerland) and 17 coordinating partners in 10 non-Member countries (Egypt, Finland, Hungary, Latvia, Norway, Romania, Slovakia, Turkey, the United Kingdom, and the United States of America).

DARIAH is a network of people, expertise, information, knowledge, content, methods, tools and technologies from its member countries, that develops, maintains and operates a pan-European distributed infrastructure supporting digitally enabled research practices and promoting their use in the SSH domain. DARIAH brings together national state-of-the-art digital arts and humanities activities and scales their results to a European level, preserving, providing access to and disseminating research that stems from these collaborations and ensuring that best practices, methodological and technical standards are followed.

DARIAH also aims at enhancing and supporting the digital transition across the arts and humanities.

DARIAH's mission is to empower research communities with digital tools and methods to create, connect and share knowledge about culture and society. DARIAH's vision is that the Arts and Humanities are anchored at the centre of a technologically evolving knowledge society thus DARIAH works towards developing an infrastructure that supports researchers working in the diverse community of practice known as the arts and humanities to build, analyse and interpret digital or hybrid resources. As such, DARIAH supports and enhances the sustainable development of digitally enabled research and teaching through its network of people, knowledge, content, methods and tools. DARIAH's main focus is to ensure that humanities researchers are able to:

- assess the impact of technology on their work in an informed manner;
- access the data, tools, services, knowledge and networks they need seamlessly and in contextually rich virtual and human environments;
- produce excellent, digitally enabled scholarship that is reusable, visible and sustainable.

The challenges emerging from the intersection of these long-standing research fields and methods with technology and technological advancement lie at the heart of DARIAH's strategy, based upon four pillars that derive from its mission and vision. These pillars represent the organisational priorities and the services provided to the community, as outlined in the DARIAH Strategic Plan 2019 – 2026:

- Build a Marketplace to facilitate fluid exchange of tools, services, data and knowledge;
- Build access to education and training;
- Build Working Groups, Hubs and other forms of Transnational and Transdisciplinary organisation;
- Build bridges between research policy and communities of practice.

At national level, **DARIAH-IT** is supported by a diverse and cohesive partnership: the Italian Ministry of Universities and Research, the Italian Ministry of Culture and the CNR, which acts as national coordinator.

DARIAH-IT aims to enhance and disseminate Italian humanistic research and expertise, strengthen its presence and role on the international scene, and seize funding opportunities at national, European and international levels. The organization's autonomy, which is both strong and wellstructured, supports these goals.

The Italian network started as a strong network of researchers and over time transitioned into a fully-fledged research infrastructure, involved in the management of a complex service-oriented infrastructure. DARIAH IT is based at the Istituto Opera del Vocabolario Italiano (OVI-CNR), in the Villa Medicea di Castello in Florence.

DARIAH-IT is composed of:

- 30 Partners (and counting): CNR Research Institutes, Universities, Public / private research and memory organizations, SMEs in the Cultural and Creative industry;
- a national network of eight data centres, strategically distributed across the country and equipped with state-of-the-art computing infrastructure, high-performance storage systems, and advanced digital service frameworks, supported by a set of smaller nodes providing continuity, redundancy, and fault-tolerance, thereby ensuring high availability and resilience of critical digital services;
- an advanced digital ecosystem with services and platforms for the SSH domain, including the MetaFAIR Ecosystem for semantic and FAIR-compliant data management, the Digital Philology Hub for critical digital editions, and the AEON Platform for the secure orchestration of scientific workflows. The DARIAH-IT infrastructure also supports interoperability and data federation within the H2IOSC cluster, ensuring alignment with EOSC standards and enabling resilient, high-availability digital research environments.

From a technical standpoint, DARIAH-IT aims to provide its reference communities with tools and services that support the transition to Open Science and Data-Driven research.

The DARIAH-IT Data Centres have been developed as part of a large-scale, long-term national project, funded by the Italian Ministry of University and Research. This initiative marks the beginning of a complex infrastructure layer for DARIAH-IT, creating an optimal environment for the entire Italian SSH community to a federated digital ecosystem of datasets, tools, and services.

These data centres aim to provide both basic infrastructure services - such as data storage, hosting, virtual machines, and virtual desktop environments with dedicated tools and



software support - and advanced scientific services developed within the DARIAH network or integrated from external sources. While some data centres are specialised in particular activities (e.g.: Natural Language Processing, 3D simulation or big data analytics), researchers can access all these capabilities through a single-entry point, ensuring a unified and federated service layer. The distributed architecture of multiple data centres also provides redundancy and resilience, ensuring service continuity in the event of potential failures.

#### 1.2.4 OPERAS

Open scholarly communication in the European research area for social sciences and humanities, **OPERAS**, is a distributed research infrastructure supporting open scholarly communication in the Social Sciences and Humanities (SSH) in the European Research Area, enabling and promoting Open Science in line with the European Open Science Cloud (EOSC). Selected as a key research infrastructure in Europe in the ESFRI Roadmap 2021, it is headquartered in Brussels.

OPERAS is currently transitioning from the status of an international non-profit association under Belgian law to that of an ERIC - European Research Infrastructure Consortium, to become fully operational as an ERIC in 2028.

The OPERAS national nodes play a key-role as two-way hubs:

- they bring local communities together to help identify their needs and act as catalysts to connect people and projects;
- they bring back what is new and what is happening in the wider European context.

Today OPERAS has 25 Countries: Australia, Austria, Belgium, Brazil, Canada, Croatia, Cyprus, Denmark, Finland, France, Georgia, Germany, Greece, Italy, Luxembourg, Netherlands, Norway, Poland, Portugal, Serbia, Slovenia, Spain, Sweden, Switzerland, United Kingdom.

In the context of Open Science, OPERAS' vision is to achieve an open scholarly communication system that benefits researchers, academics, students in general, across Europe and worldwide, without barriers. The mission of OPERAS is to enable the SSH research community to find, access, create, edit, disseminate and validate research results across Europe in a simple and efficient way and to coordinate and federate resources to best meet their needs.

The European scholarly communication systems in the SSH face major challenges, such as a patchy and fragmented landscape, the diversity of publication languages, the persistence of heterogeneous cultural backgrounds and specific forms of scholarly communication (e.g. monographs, critical editions, edited bibliographies). OPERAS contributes to the structuring of the European research infrastructure ecosystem by:

- pooling resources and providing services to enable all SSH stakeholders to streamline their activities and maximise societal impact, in an interdisciplinary, mission-driven approach;
- fostering the co-creation and adoption of open scholarly communication services that meet research needs in terms of discovery, content creation, quality assurance, dissemination, outreach, exploitation, and evaluation of results.

OPERAS Special Interest Groups are dedicated to key topics, such as Common Standards and FAIR Principles, Tools and Platforms, Multilingualism, Advocacy, Open Access Business Models. These groups work collaboratively, share information, and prepare projects. Their work is the foundation on which the Research Infrastructure will build its strategy and prepare its next



projects. OPERAS has implemented many projects and services at the European level within its main study and research strands, addressing the specific needs of the SSH research community with tools for discovery, publishing, evaluation metrics, collaboration, etc. OPERAS services pool, aggregate, or federate existing resources from across Europe to provide European researchers with a single point of access to the full range of available resources. They are aimed at providing transnational access to scholarly communication resources and services to researchers across the ERA, and at integrating them into the EOSC marketplace.

**OPERAS-IT** is the Italian node of OPERAS. It was legally established in August 2023 as a Joint Research Unit (JRU), coordinated by the National Research Council (CNR) through the ILIESI - Istituto per il Lessico Intellettuale Europeo e la Storia delle Idee.

The JRU currently counts of:

- Consiglio Nazionale delle Ricerche (Roma);
- Università degli Studi di Torino;
- Università degli Studi di Bologna;
- Università degli Studi di Macerata;
- Università degli Studi di Messina;
- Università degli Studi di Milano;
- Università degli Studi di Roma Tor Vergata;
- Firenze University Press;
- Lexis Compagnia editoriale srl (Torino);
- Net7 srl (Pisa).

OPERAS-IT encourages broad participation of the national scientific community and helps to maximise the results of investment in research in the Humanities and Social Sciences in Italy. Moreover, it promotes the transfer of technology and knowledge, and contributes to carry out activities in the multidisciplinary field of open scientific communication in the SSH.

OPERAS-IT provides a voice and offers services to the national SSH community, which is often underrepresented in the scientific arena.

It enables the Italian SSH community to address common issues and share methods, tools and best practices, and to disseminate knowledge of what is being developed in the wider European context.

It is committed to the active support and promotion of Open Science within the Italian SSH community, providing theoretical and practical training on the various topics related to Open Science and FAIR principles.

The next goals of OPERAS-IT are:

- use the expertise, actions and results of the H2IOSC project to provide studies, analyses and advanced tools as needed by the Italian SSH community;
- collaborate with OPERAS PLUS Innovation Lab to provide innovative tools (e.g. on critical editions);
- collaborate with DIAMAS and CRAFTOA projects on the institutional capacity building for Open Access publishing.

### 1.3 H2IOSC LIFE CYCLE PHASE

H2IOSC is a pioneering project funded by the Italian Ministry of University and Research as part of the National Recovery and Resilience Plan (NRRP). With a budget of over 41 million euros, H2IOSC foresees the collaboration among the Italian national nodes of the aforementioned European Research Infrastructures - E-RIHS, CLARIN, DARIAH and OPERAS - with the aim to accelerate innovation and to promote the digital transformation of the humanities and cultural heritage sectors.

The project aims to support the implementation of a coherent strategy for RIs development and integration in Italy, optimizing the use of the most relevant assets, upgrading, and implementing the facilities. All the four national nodes of the above RIs are led by CNR and are strategic and considered of “High Priority” within the national policies and roadmap (PNIR). H2IOSC aims at creating the Italian Cloud Network for research in humanities, linguistics and heritage science, a federated and inclusive cluster of RIs in the ESFRI domain of Social Sciences and Humanities (SSH) to allow researchers from various disciplines in the Humanities, Language technologies and the Cultural Heritage sectors to collaborate in data and computing intensive research.

H2IOSC services has the scope to address the needs of a vast range of disciplines in the SSH spectrum and possibly beyond. The project elaborates priorities for the resources onboarding process in the integrated environment. Each participating RI works towards reaching the maturity threshold set by the project as entry point, as a prerequisite for the actual alignment and integration of the selected assets within the federation. To promote accessibility and realize the FAIR approach, a one-stop, easy-entry place is expected to be created, where users can find tools, datasets, services, and pilot projects supporting specific needs of domain and cross-domain research scenarios. H2IOSC project promotes a data centric approach, where resources are available in an integrated environment accessible through a set of Virtual and Remote access methods. It also promotes training and engagement activities to build FAIR and Open Science skills, boost the visibility of RIs at national and international level, create new profiles (e.g.: data stewards, data curators, etc.) supporting digital processes in research and in the Cultural and Creative Industries.

The CNR is the single beneficiary Institution of the project, with a research team composed of 12 Institutes and 18 Operating Units, namely:

- Istituto Opera del Vocabolario Italiano (OVI), with its Pisa and Florence branches;
- Istituto di Scienze del Patrimonio Culturale (ISPC), with its Lecce, Catania, Naples, Florence, Rome and Milan branches, as Lead Institute of the project;
- Istituto per il lessico intellettuale europeo e storia delle idee (ILIESI);
- Istituto di linguistica computazionale "Antonio Zampolli" (ILC);
- Istituto Nazionale di Ottica (INO);
- Istituto di Storia del Pensiero Filosofico (ISPF);
- Istituto di Scienze e Tecnologie Chimiche "Giulio Natta" (SCITEC);
- Istituto per le applicazioni del calcolo "Mauro Picone" (IAC);
- Istituto di scienza e tecnologie dell'informazione "Alessandro Faedo" (ISTI);
- Istituto di Calcolo e Reti ad Alte Prestazioni (ICAR);
- Istituto di Nanotecnologia (NANOTEC);
- Istituto di Matematica Applicata e Tecnologie Informatiche "Enrico Magenes" (IMATI).

In line with the call eligibility criteria and the three horizontal priorities (youth, gender equality and territorial cohesion) of the NRRP, the total budget of the project was approved as shown in the table below.

COSTS (€) ENTIRE PROJECT			
	Costs included in the request for funding		
	To be located within the eight southern Regions	To be located outside the eight southern Regions	Total requested grant
a. Fixed term personnel specifically hired for the project	3.070.780,00 €	5.260.720,00 €	8.331.500,00 €
b. Scientific instrumentation and technological equipment, software licenses and patent	13.773.000,00 €	10.829.000,00 €	24.602.000,00 €
c. Open Access, Trans-National Access, FAIR principles implementation	799.000,00 €	2.272.344,00 €	3.071.344,00 €
d. Civil infrastructures and related systems	795.500,00 €	530.000,00 €	1.325.500,00 €
e. Indirect costs, including running costs	1.331.839,60 €	1.395.993,48 €	2.727.833,08 €
f. Training activities	588.000,00 €	1.050.700,00 €	1.638.700,00 €
<b>Total</b>	<b>20.358.119,60 €</b>	<b>21.338.757,48 €</b>	<b>41.696.877,08 €</b>

Table 1- H2IOSC budget

The 8 WPs that build the structure of the project are: WP1. Project and Financial Management, Quality Assurance; WP2. Landscaping & building communities; WP3. Digital Resources Standardization, Consolidation & Alignment; WP4. RIs Nodes and Resources Interoperability; WP5. Marketplace; WP6. Resources Accessibility: Servification, Virtualization, Remotization; WP7. Community pilots: innovative cross-domain services and environments; WP8. Training, Capacity Building, Engagement. Their interaction is shown in the Figure below:

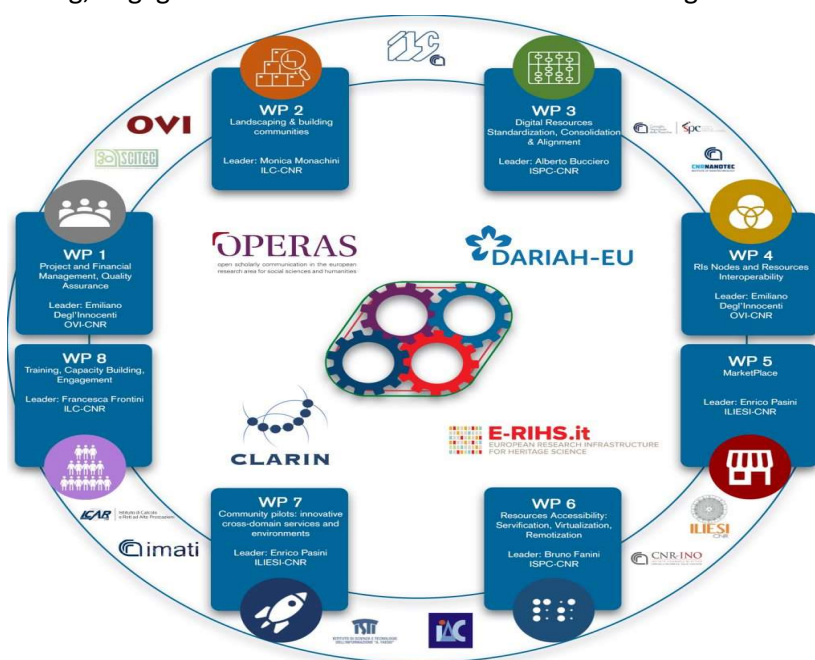


Figure 1- WPs inter-relation

More specifically:

- WP1 aims at ensuring that the work programme objectives, milestones and deliverables are met in a timely manner and within budget constraints; it enables an interface with Italian Ministry as well as addresses external relationships between the project and other external stakeholders, puts in place the project agreements, ensures conformance compliance with the ministerial and NRRP's rules and reporting requirement.
- WP2, the general objective of this work package is the outlining of a detailed survey of the panorama in the language technologies, humanities and heritage science in Italy, taking into account existing projects, resources, tools, communities, best practises, and standards in use that need to be onboarded in the national marketplace and in the national nodes of the four Research Infrastructures.
- WP3 is devoted to the consolidation and overall alignment of both RIs and priority resources. On the basis of the outcomes of WP2 this workgroup works towards: 1) filling the gaps found within each infrastructure, to reach the maturity threshold set by the project as entry point and, 2) aligning the participating infrastructures to reduce the lack of interoperability, encompassing different layers, including but not limited to: technological, ICT, and scientific issues.
- WP4 aims at developing interoperability between the various multidisciplinary resources possible both at a physical level, creating a special National Cloud infrastructure, and at a semantic level translating the state of knowledge with respect to the resources offered by each RI into a common semantic interdisciplinary and interoperable representation.
- WP5, the objective of this WP is to create and develop the framework for the H2IOSC MarketPlace, as an online tool to increase visibility and valorisation of the data sources, services, and resources provided by the RIs and the research community at large, and hosted in the H2IOSC National Cloud under full compliance with the FAIR principles. The MarketPlace structure has been identified in the European research space as an essential step in supporting the transition from the ordinary research landscape to cloud-based infrastructures. The H2IOSC MarketPlace aims to, first of all, offer a universal entry point for various user types and different usage models of the national research communities involved in finding and employing services and resources. It also, by its very availability, advertise tools and methodologies, introduces collaboration instruments, and fosters innovation. It allows participants to share and make findable research datasets and tools as well as training materials, through dedicated hubs, contextualised catalogues, instruments for presentation, visualisation, and aggregation.
- WP6 is devoted to activities related to servification, virtualization and remotization of existing tools and services available from involved RIs based on the outcomes of landscaping tasks carried out in WP2, standardization (WP3), interoperability (WP4) and National Cloud marketplace (WP5). Regarding servification and virtualization, each RI already provides valuable tools addressing various research domains. However these resources are often not easily accessible to the vast community of researchers through a common layer or are not yet fully servified. In line with the common service layer defined in the previous WPs, the involved RIs are undertaking refactoring and re-engineering activities on their existing tools and services. This process aims to ensure standardisation, interoperability, and integration within the federated environment, thereby enabling uniform and unified access for researchers scientific communities across disciplines. The



WP indeed deals with the diverse nature of the tools and their maturity level, with each RI focused on servification or virtualization efforts.

- **WP7** provides an essential layer in the architecture of the H2IOSC and a common base for its operational use by researchers from different domains. Its objective is to define and implement a series of innovation oriented services and proof-of-concept sets of resources for direct use by researchers in the form of Pilot applications hosted on the H2IOSC platform. The developments provided by WP5 and WP6 and their innovation potential is validated in the WP7 Pilots.
- **WP8**, the objective of this WP is to empower user communities with interdisciplinary as well as domain specific FAIR and Open Science skills and competences as well as training them on what disciplinary infrastructures can offer them at national and international level. This enables them to better use the services of the RIs national nodes, of the ERICs and of the national marketplace, as well as become capable of correctly managing the lifecycle of their data.

The following figure schematically illustrates the interaction between the different Work Packages of the project, providing a chronological overview of the implementation of activities and the progress toward the related objectives.

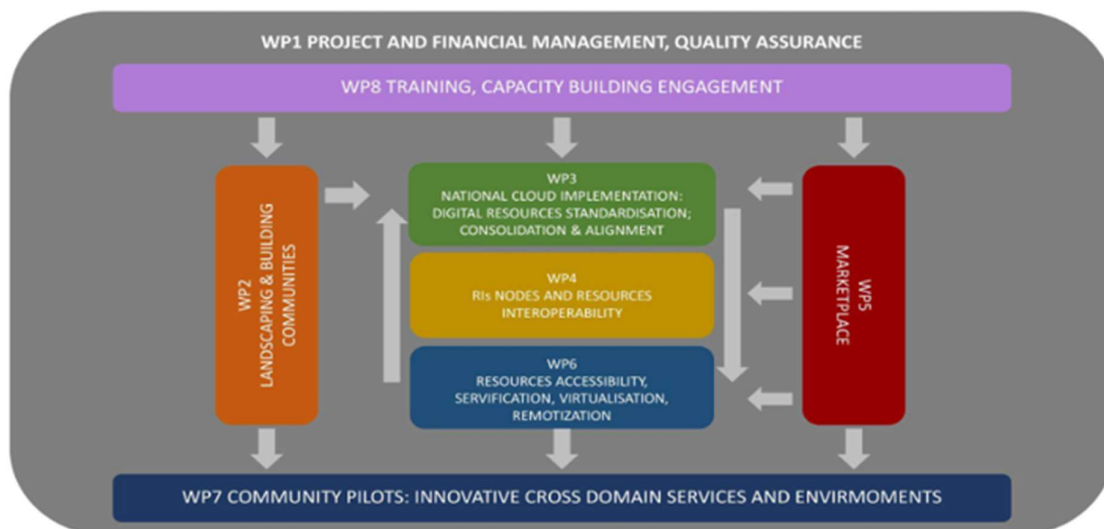


Figure 2- H2IOSC - WPs Interrelation

The project, as can be seen from the chart below, started on November 1<sup>st</sup>, 2022 and its expiry, in consideration of the extensions granted by the Italian Ministry for University and Research, is scheduled for April 30<sup>th</sup>, 2026.

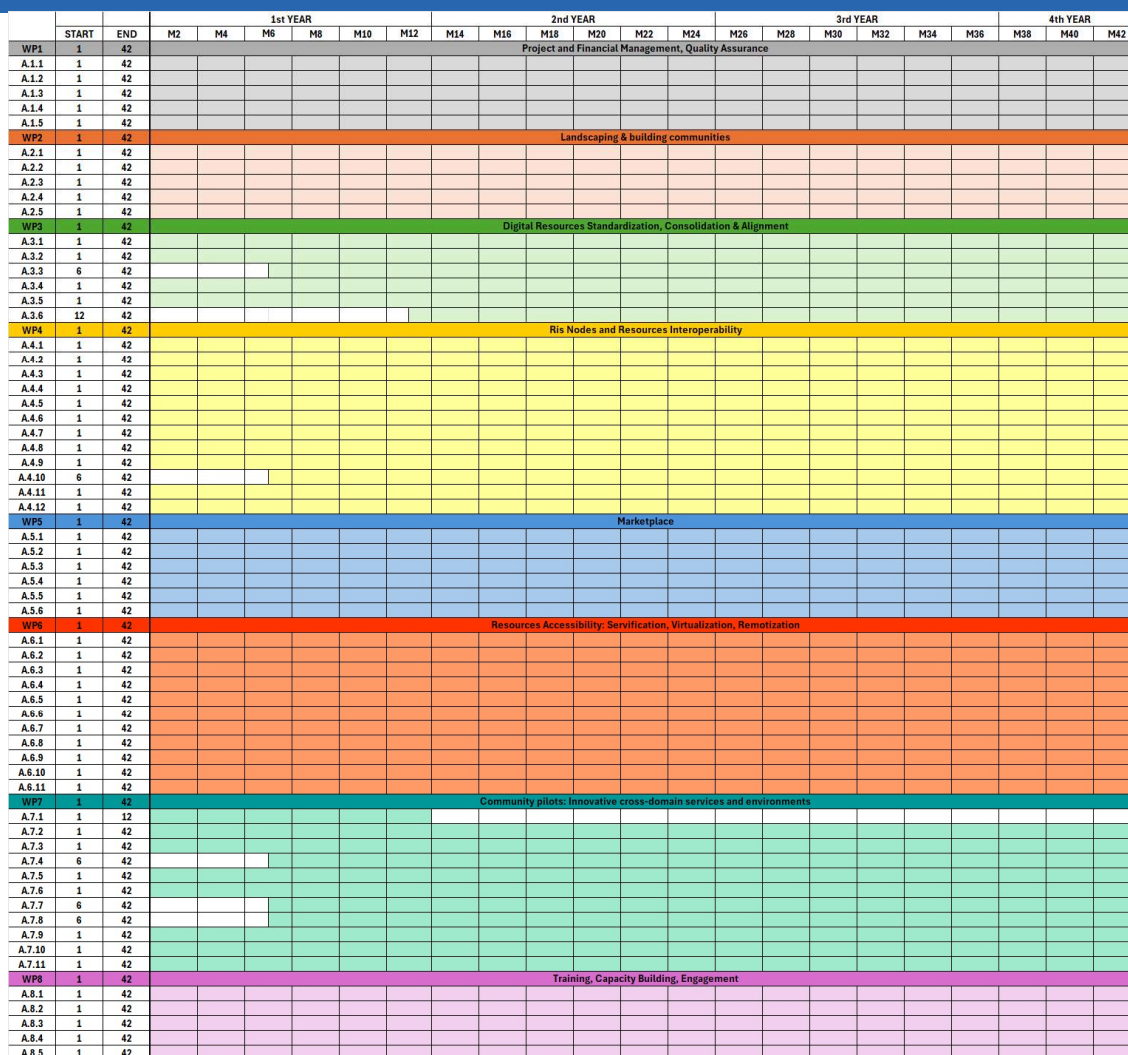


Figure 3- H2IOSC Gantt chart

Once the activities envisaged by the various project work packages have been completed, within the communicated deadlines, a phase of operation and functioning of the H2IOSC federation will open in which the “souls” represented by the participating RIs will continue to collaborate in order to achieve the strategic objectives identified and shared over a medium and long term period.

#### 1.4 OUTLINE OF H2IOSC’S BUSINESS MODEL

The construction of a business model for the H2IOSC federation presents an intrinsic level of complexity, as it cannot be conceived as the model of a single project or research infrastructure. Instead, it must serve as a collaborative framework encompassing four distinct initiatives, each established as an independent European Research Infrastructure with corresponding national nodes in Italy. These research infrastructures, in addition to operating in different domains and with methods that are not always homogeneous, have a different history and a specific identity which translates, as described in the previous paragraphs, into their autonomous strategic vision and mission.

Taking into account the above, the business model construction exercise is developed in consideration of the strategy shared by the national nodes of the four RIs, aiming to establish a single operational federation. This federation functions in full compliance with the operational boundaries of each participating national node, while leveraging a set of strategic elements - described later in this document - designed to guarantee a competitive advantage in the management, sharing and reduction of costs, and to promote collaboration and federation of funding resources.

To ensure the long-term sustainability of H2IOSC through its future lifecycle - and, as requested by the Italian Government, to preserve the project's knowledge, outputs and services for at least 10 years after the end of the funding period - the federation must balance its incoming resources with the costs of the services provided. At the same time, it must continuously support maintenance activities and make strategic investments to strengthen the cutting-edge equipment acquired with NRRP funds or otherwise made available by the participating CNR institutes to achieve common objectives.

The document describes the actions undertaken to stimulate scientific excellence and unlock the full potential of H2IOSC solutions, by: promoting methodological innovation in research; developing coherent and shared strategies to facilitate the financial sustainability of the H2IOSC cluster; finding national and international funding occasions to provide additional resources.

The sustainability of the H2IOSC business model is based on the fundamental assumption that the value generated by the federation, at a minimum, matches the level of public investment made to support it.

This, above all, in terms of dissemination/cooperation/sharing of the activities carried out and competencies acquired in the humanities and cultural heritage sectors, taking into account that H2IOSC adopts open science paradigms.

The Open Science paradigms affect, indeed, the whole research cycle and all its stakeholders. It implies sharing knowledge and tools:

- “as early as possible” in the research process;
  - “as openly as possible”;
  - “as FAIR as possible”;
- not only within individual disciplines but also across disciplinary boundaries and in direct engagement with society at large.

Therefore, the evaluation of H2IOSC will need to consider the fundamental ambition of the Social Sciences and Humanities ESFRI landscape, which goes well beyond the mere commercial value of its activity: the delivery of non-financially evaluated public goods, including research, training and capacity building will remain a paramount responsibility of H2IOSC.

Indeed, in principle, H2IOSC services will be free at the point of use for research and training purposes. Instead, fees for the supply of added-value services will be defined.

In addition, the business model described here may also need to be revised in its strategy and framework in the event of aggregation to other project initiatives or other external subjects, decided by the CNR.



### 1.4.1 SWOT ANALYSIS

Considering the peculiarity of H2IOSC as a cluster of different infrastructures, for the purposes referred to in this document, we wanted to carry out a SWOT analysis first at the level of the single national node of the respective RI and then of the cluster, to then identify the elements of sustainability of this latter.

As known, SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis is a framework used to develop strategic planning. SWOT analysis assesses internal and external factors, as well as current and future potential. A SWOT analysis is indeed designed to facilitate a realistic, fact-based, data-driven look at the strengths and weaknesses, in this specific case, of a medium-long term project collaboration.

The results of the aforementioned analyses are reported schematically below.

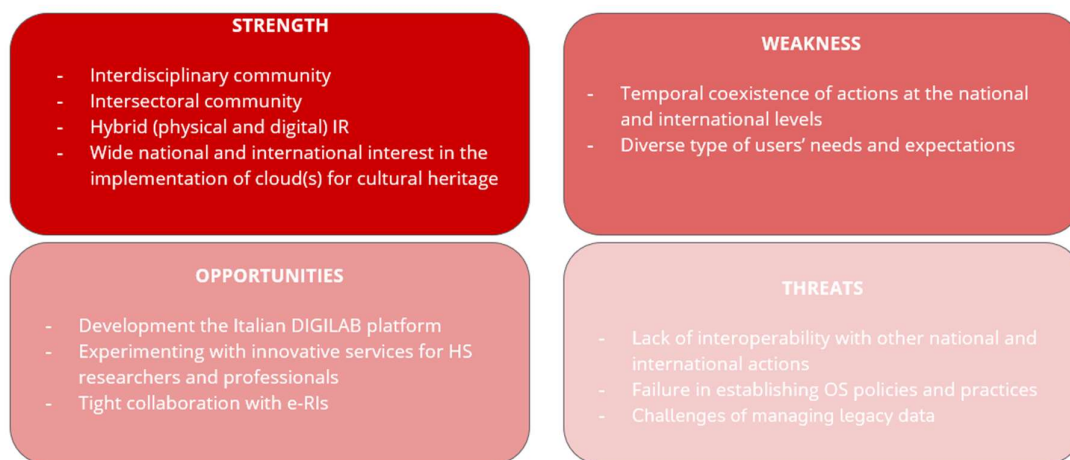


Figure 4- E-RIHS.it SWOT Analysis

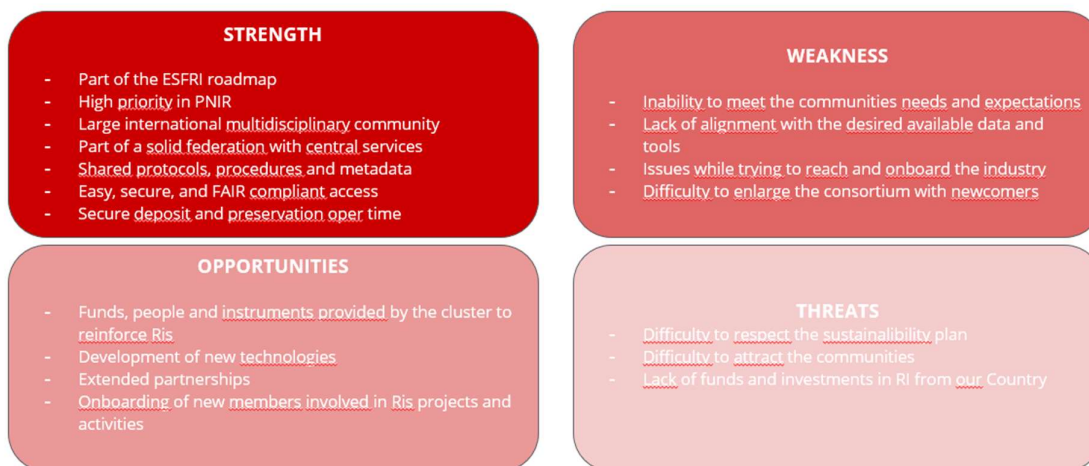


Figure 5- CLARIN-IT SWOT Analysis

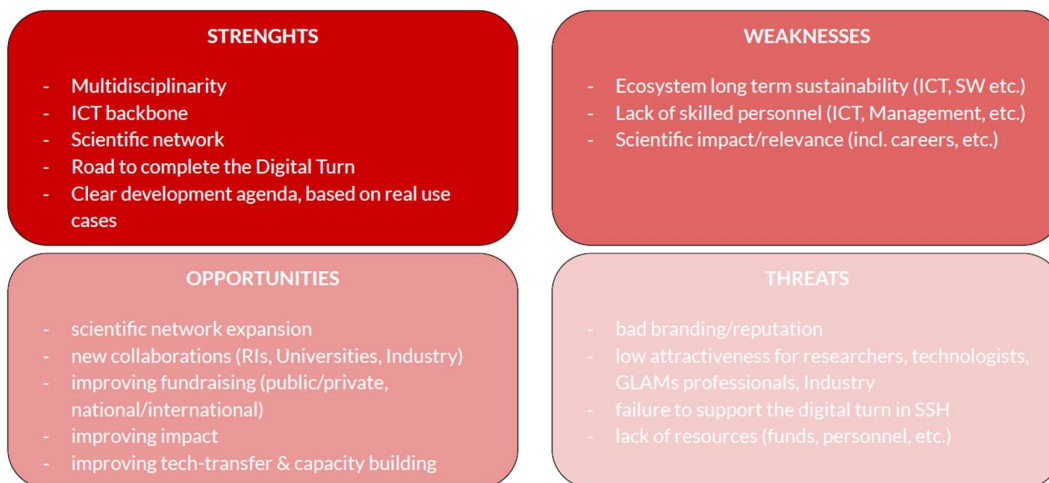


Figure 6- DARIAH-IT SWOT Analysis

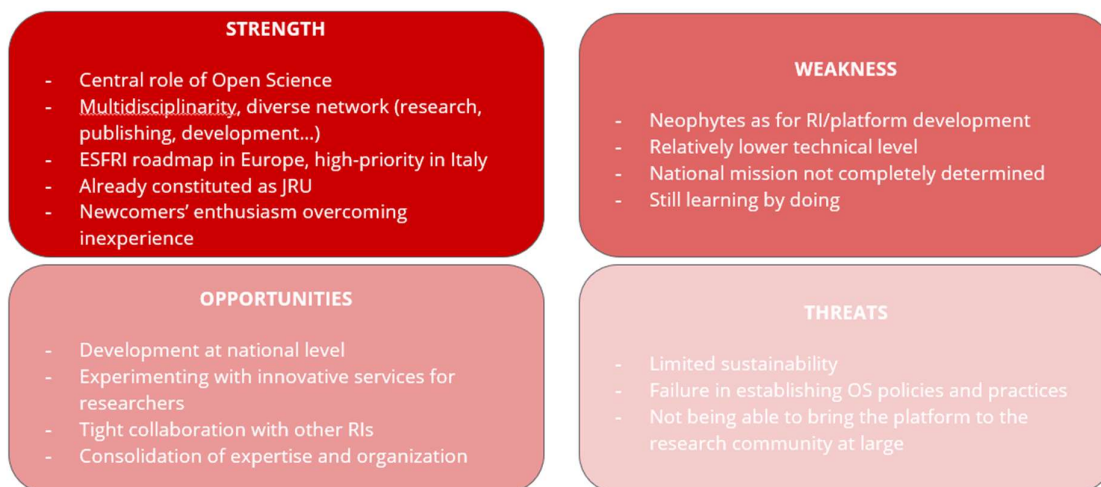


Figure 7- OPERAS-IT SWOT Analysis

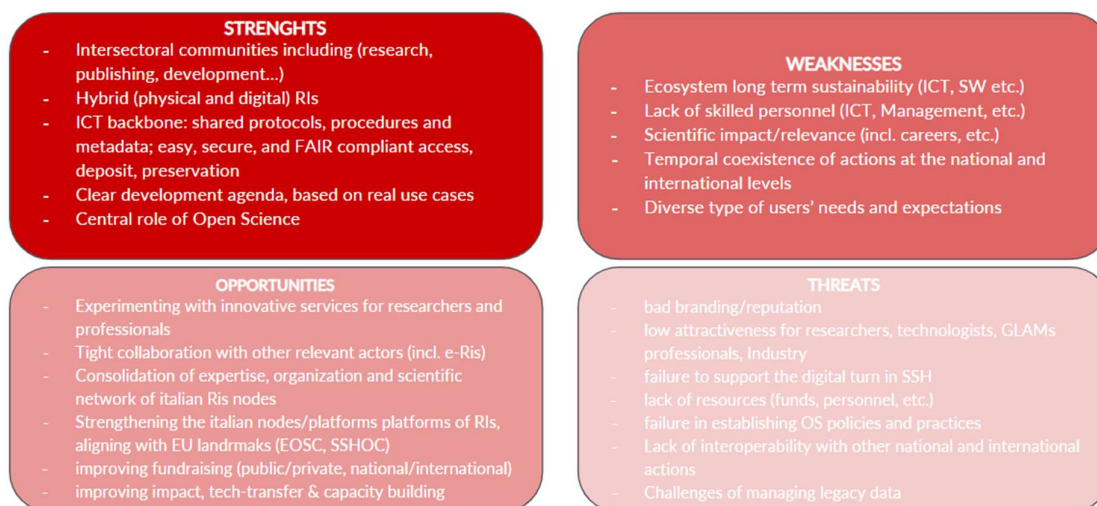


Figure 8- H2IOSC SWOT Analysis

Also following this analysis, the sustainability elements identified are reported below:

- demonstrated scientific leadership in Humanities and Social Sciences, and Cultural Heritage domains;
- long-term commitment by CNR through the RIs national nodes;
- coordinated operations;
- commitment of key personnel;
- close connection with the EU policy framework;
- ability to implement interfaces integrating computer and data management solutions to create interdisciplinary and open cooperation spaces for European researchers.

#### 1.4.2 METHODOLOGY

As regards the methodological approach followed in preparing the business model, we started from the analysis of the essential elements of a business plan according to the Osterwalder's CANVAS scheme, proceeding with an in-depth analysis of the following thematic blocks:

- Value proposition: we investigated first with the entire H2IOSC community and with the national coordinators of the RIs by submitting a specific questionnaire, and then, with the relevant research community and H2IOSC TNA/NA calls users, what the added value of the cluster was, in order to have different perspectives.
- Key elements: we asked the WPLs to carry out coordination work within their WPs (composed of personnel belonging to the various RIs) in preparing a list of possible services that the H2IOSC cluster can make available to the community and/ or third parties free of charge and/or requiring the payment of a fee. We have also asked them to indicate, for each "key activity/service": possible partners (public and/or private) who can help in its implementation, possible users (public and/or private) who may be interested in the same as well as possible competitors, public and/or private, in the realization of the same.

- Cost analysis: we asked our researchers and engineers to carry out an analysis of sustainability costs over a 5-year period and a 10-year period starting first from the costs associated with the data centers acquired with NRRP funds, then considering those related to the platforms used for the operation of the H2IOSC services, and finally taking into account the costs of the services included in the federated catalogue.

- Revenues analysis: we created a Sustainability Hub to investigate potential revenue streams from regional, national and international contributions, and, together with our researchers who provide H2IOSC services, carried out a benchmark analysis aimed at identifying the market value of applicable fees. Based on the researchers' expertise, we also developed a forecast of the potential demand for services.

- Key resources: we analysed at project central management level the physical, intellectual, human and financial resources that the participating institutes can make available for the cluster.

#### 1.4.3 KEY RESOURCES

Below there is a description of the most important resources needed to make the H2IOSC business model work. In particular, those that we have identified as core resources are:

- National Nodes (national infrastructures and research teams): the national nodes, with their local infrastructures and research teams, are the essence of the H2IOSC. The research teams have the ability to work horizontally (broad multidisciplinary, in groups, nationally or transnationally) or vertically (in depth monodisciplinary, in one or more groups, nationally or transnationally) to tackle complex challenges, or identify new enabling technologies.
- Stakeholders (Public and Private).
  - a) public funding from the participating CNR Institutes will contribute to supporting the functioning of the cluster, as regards the in-kind personnel made available for H2IOSC and the running costs linked to the functioning of the data centers and platforms used;
  - b) international, national and regional public contributions will directly support the participating CNR Institutes, guaranteeing the maintenance and continuous updating of cutting-edge equipment and innovative services, also in line with the strategic development objectives of H2IOSC;
  - c) possible private stakeholders, such as companies, will be contacted to support the development of the cluster, in the form of medium-term partnerships, or as users;
  - d) other partnership (e.g. Italian Ministry of Culture, Universities).

In addition:

- Equipment: scientific instrumentation and technological equipment purchased with NRRP funds from the participating institutes which must be maintained in in state-of-the-art conditions for the purpose of the cluster. For this reason, practices to lower the costs will also be established, such as the evaluating co-development strategies with industry.
- Human resources: H2IOSC can count on experience and resources to maintain a dynamic environment with the aim to manage the activities during 10 years, offered, in principle by

in-kind contributions for personnel costs from the involved Institutes, even if personnel can be specifically contracted or seconded for the purpose.

## 1.5 H2IOSC GOVERNANCE

H2IOSC is a scientific collaboration between several institutes belonging to the CNR and which are involved in the operation of the Italian nodes of the four research infrastructures mentioned. The federation was born as a project in the context of which governance is assigned to a Project Management Board (PMB).

The PMB of the project, chaired by the Scientific Coordinator, is composed by the Infrastructure Manager, the Financial Officer, the National Coordinators of the participating Research Infrastructures and the CNR-DSU Director. The PMB is in charge of the approval of the work plan, possible changes of the Operating Units (if required) and of the budget allocation within Operating Units and RIs (if required). The PMB meets in order to get a frequent update of each Operating Unit's activities and status of work in the Work Packages, with the aim to enable early detection of any problems, delays, and to take appropriate measures in the case of possible risks.

The PMB is assisted by an External Advisory Board (EAB) which is composed by representatives of major stakeholders in the Social Sciences and Humanities research domain, more specifically by two delegates per participating Research Infrastructure and one delegate from EOSC. The main task of the EAB is to provide the PMB with international-level advice and evaluation both on the quality of the services and on the quality of users admitted to have access the RIs, and, where appropriate, to help align the project with researchers' needs and expectations.

Once the activities of the project financed by the Italian Government have been concluded, and at least for the period in which participation in the cluster continues to be exclusive to CNR Institutes, the governance of the federation created will in any case be managed at the level of collaboration between the participating Institutes of the RIs through the creation of a decision-making Body, made up of representatives of the RIs involved and the CNR-DSU Director, which will have to take responsibility for ensuring a series of actions in order to guarantee the operation of the federation itself with the support of the Infrastructure Manager and staff hired specifically for H2IOSC activities and/or belonging to the participating CNR Institutes, as reported below.

- Governance and structure of H2IOSC. The main objective is to define a regulatory framework to govern the participation of the CNR Institutes as well as other public and private entities in the RIs national nodes for the purposes of H2IOSC. In addition to the provision of a decision-making Body, and an External Advisory Board, it is appropriate to provide for the establishment of a Service Operation Team composed of representatives of participating RIs at territorial Nodes level.
- Sustainability of H2IOSC. It aims to underpin the medium- to long-term sustainability of the initiative through the updating of the business plan, accompanied by an enlargement strategy and a training plan for RI managers and access providers as the federation enters its operational phase
- Access and digital services. It aims to ensure that H2IOSC operates effectively, continuing to act as an "observatory" of the needs of the H2IOSC community, building on: a) a user-oriented catalogue of services; b) an updated user strategy and c) a dedicated access policy.



- Assessment of procedures and assessment of services provided. The objective is to update the necessary documents for the quality operation and management of H2IOSC (Risk Management Framework and Quality Plan included).
- Communication, dissemination and cooperation. It aims at consolidating the participant communities and raising awareness of the role of H2IOSC in supporting them. It will boost the visibility of the federation by a) developing a sound communication and dissemination strategy, b) encouraging open science practices and c) strengthening cooperation with other RIs, projects and initiatives of interest.

The legal framework within which H2IOSC cluster will carry out its activities in the future will depend on the possible inclusion of subjects other than the institutes that belong to the CNR and on the type of solution that the latter itself wishes to adopt in.

## 2. H2IOSC USERS STRATEGY

### 2.1 The H2IOSC Value Proposition

As previously mentioned, in developing the business model we investigated, first of all, the so-called H2IOSC value proposition, i.e. the description of what creates value for a specific segment of users.

In doing this and always in consideration of the context described, we decided to take a participatory approach by involving the entire H2IOSC community (permanent staff, temporary staff, doctoral students), because they have been and may continue to be in the future, users of these services, by asking a series of questions to understand their point of view. The questionnaire was conducted in two distinct moments, at the beginning of January 2024 and in mid-February, i.e. at the conclusion of the H2IOSC General meeting held in Rome. The idea of resubmitting the questionnaire arose from the fact that, during the General meeting, ad hoc sessions dedicated to National and International RIs Landscape and to RIs champions were organised, during which valuable insights and ideas on the future of the cluster emerged.

The questions asked in the second survey were the same as in the previous one, but we asked participants:

- to confirm the answer given previously in the form if nothing had changed in their perception of the Added Value of H2IOSC;
- to update the answer in case there have been changes in perception and highlight it in the form.

We ask you to contribute to the definition of the "Value proposition" of the H2IOSC cluster by answering the following question

Which elements, in your opinion, represent an added value of the H2IOSC federation? Please provide short and concise answers to the above question, explaining the advantages/benefits of the H2IOSC cluster. E.g. in terms of performance/cost reduction/accessibility/usability, etc..:

- ☐ More opportunities for collaboration between researchers and infrastructure
- ☐ Simplified and shared access to research resources and data
- ☐ Increased impact and visibility of research activities
- ☐ Increased possibilities for technological innovation in SSH
- ☐ Long-term sustainability and resource management
- ☐ Other

Figure 9- Value proposition H2IOSC community survey

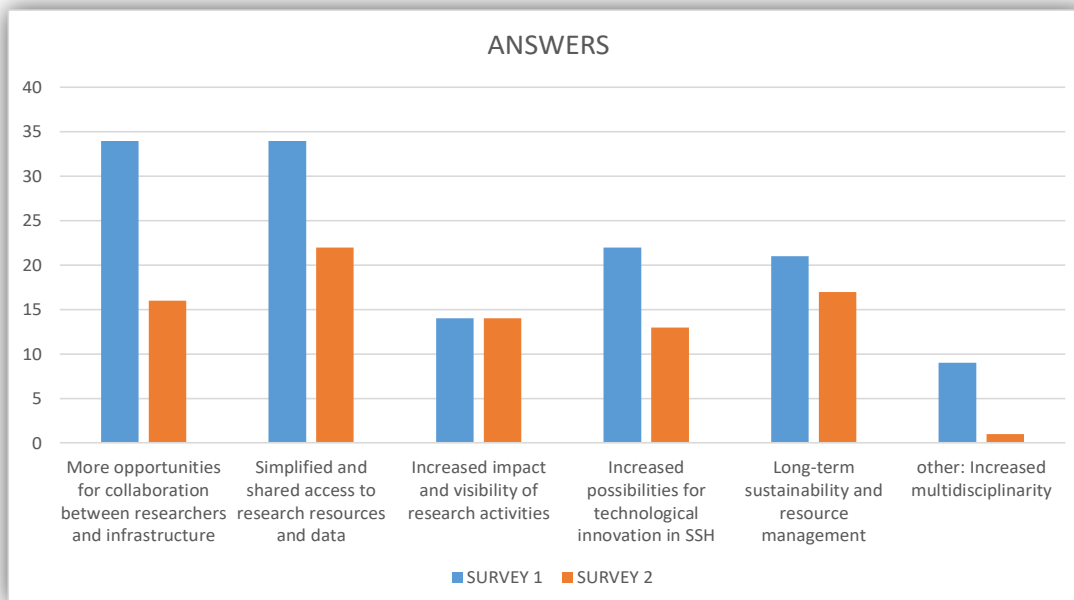


Figure 10- Answers to the Value proposition H2IOSC community survey 1 and survey 2

From what emerges from the figure above, 47 people responded to the first submission of the questionnaire and 33 people responded to the second.

16 out of 33 people said they had changed their answer.

The answers that received the lowest percentage of responses in the second survey, are the following:

- More opportunities for collaboration between researchers and infrastructure;

- other: Increased multidisciplinary.

Finally, the answer that received the highest percentage of responses in the second survey is the following:

- Increased impact and visibility of research activities.

To get a different point of view, more specifically from the perspective of the four national nodes, we asked to the National Coordinators to answer the following questions:

- what the national node offers to the H2IOSC federation;
- what the H2IOSC federation offers to the national node.

Below are the answers collected.

<b>Added value bringing to H2IOSC</b>
Experience and competence in research infrastructure at EU level governance
Set of ready to use services for the Marketplace
Best practices for the Marketplace
Central role of Open Science
Multidisciplinary, diverse network (research, publishing, development...)

Table 2- Added value bringing to H2IOSC

<b>Opportunities getting from H2IOSC</b>
Extended partnership: synergies and involvement; possibility to increase fund raising
Developing attractive and innovative services/new technologies
Funds, people, instruments to reinforce the RI; sustainability for next 10 years
Consolidation of expertise and organization

Table 3- Opportunities getting from H2IOSC

With the aim to explore the value proposition from the “external users” perspective, we asked first of all the relevant research communities: “What do you expect the RIs participating in the Cluster offering to your community in terms of resources, technologies, services, etc?”

Below are the answers collected.

Building networks of scholars to exchange good practices
Updating on available resources
Help in choosing applications
Complete and useful metadata for research purposes
Possibility of accessing open data for reuse
Open access to data

Table 4- Answers external research community Users

We also investigated the value proposition in occasion of the participation to the first and second TNA/NA calls to the H2IOSC selected users.



We ask you to contribute to the definition of the "Value proposition" of the H2IOSC cluster by answering the following question

How has the service provided by the H2IOSC Cluster created or can it create added value to the research you are conducting? :

- ☐ Enabled access to advanced and reliable digital tools/resources provided by research infrastructures
- ☐ Improved the quality or efficiency of our research processes and data with the help of H2IOSC technologies and expertise
- ☐ Facilitated collaboration with other researchers who belong to research infrastructures
- ☐ Supported the development of innovative research methodologies adopting the FAIR principles
- ☐ Other

Figure 11- Value proposition TNA/NA users survey

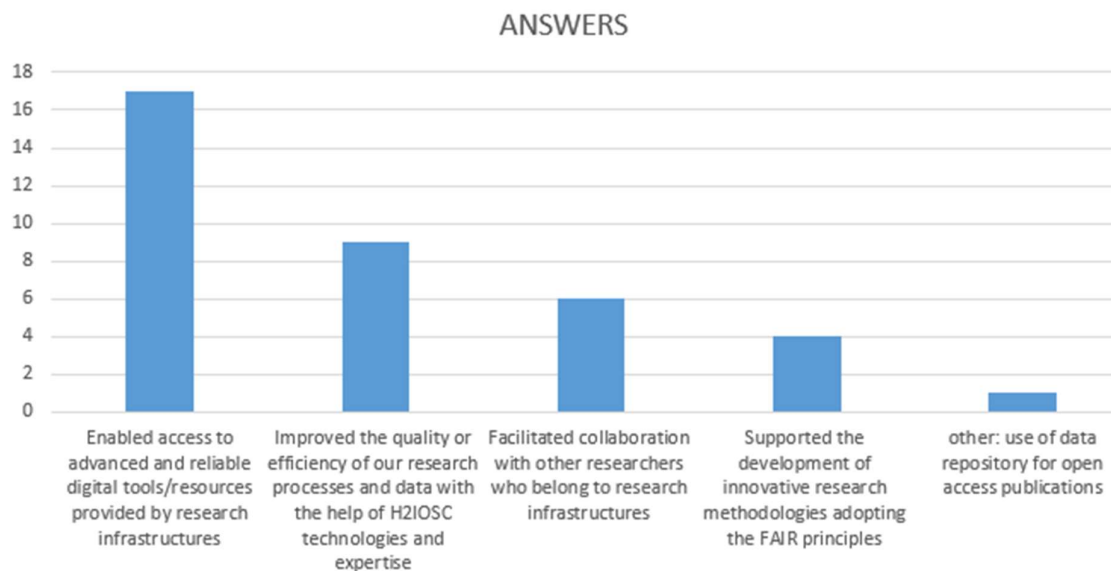


Figure 12- Answers to the Value proposition TNA/NA calls users survey

At the moment, the answers of 19 users to the services exposed in the first and second TNA/NA calls of H2IOSC have been collected.

A cluster of research infrastructures is therefore a solution to deliver innovation and scientific breakthrough, increasing the accessibility with a visible entry point and simplification of the procedures. The key elements of H2IOSC's marketability, summarized below, include its

capacity to manage complex projects, the provision of a unique entry point and integrated system, and the excellent quality of its services.

#### H2IOSC's Elements of Marketability

Access to an exclusive portfolio of services and unique data: H2IOSC brings together excellent European linguistic, humanities, social science, and cultural heritage resources, providing access to advanced systems, high-quality data, state-of-the-art technologies, and excellent expertise. This ensures the quality-controlled delivery of all services.

Coordination of multiple facilities and services, even in different geographic locations, to respond to complex user requests: H2IOSC enables the building of initiatives using resources from several locations and optimize the service rendered.

Quality assured processes thanks to standard operational procedures, with the support of H2IOSC staff and Node liaison staff.

A single-entry point: the H2IOSC Marketplace centralizes all the information and access procedures.

Table 5- H2IOSC's Elements of Marketability

## 2.2 H2IOSC Services

H2IOSC provides access to a large variety of high-quality resources and services offered by its participating research infrastructures to a wide range of users and needs, for scientific, training, technological and innovation-oriented applications.

H2IOSC places its users (galleries, archives, libraries, museums, laboratories, researchers, professionals, curators, teachers, data stewards, PhDs) at the centre of its operations and strategic development.

A systematic approach is taken to involve users, ascertain their needs, provide clear and practical recommendations for services and processes development, and base continuous improvements on user feedback.

The user strategy is the provision of value in terms of services, assistance, knowledge, know-how etc., which H2IOSC can offer to users in response to their needs, based on the technical capabilities of its Research Infrastructures providers and in line with the overall H2IOSC mission.

As a living strategy, it is the result of continuous effort to find a proper combination and composition of the evolving user needs and the evolving H2IOSC capabilities.

The H2IOSC user strategy ensures that service development and improvement efforts meet user expectations and fulfill their needs and will continue to do so over the cluster life.

The following are the macro categories of services of the H2IOSC cluster catalogue, which can also be combined with each other in the offer to users.

TECHNICAL SERVICES	digital infrastructures essential for research and data management, including solutions for secure storage, high-performance computing, AI-powered content analysis, and advanced ICT services to support processing, sharing, and interoperability of
--------------------	--

	data within virtual and collaborative research environments.
DATA & DIGITAL SERVICES	software, tools, datasets, and pilot projects addressing the needs of those involved in the study, management, and valorization of cultural, linguistic, and historical heritage, including tools for remote monitoring, diagnostics, data extraction and analysis, and digital fabrication.
RESEARCH SERVICES	access to platforms (physical, digital, etc.) for carrying out scientific experiments/use of cutting-edge tools and equipment to support scientific excellence.
INNOVATION SERVICES	synergies of existing tools and new innovative research capabilities.
TRAINING SERVICES	free self-paced courses and platforms for sharing and downloading open-access training materials, tailored for people involved in the humanities, social sciences, and heritage science, to strengthen interdisciplinary skills and the use of Research Infrastructures.

Table 6- H2IOSC Type of Services

For each macro category of service, the main Partners, Competitors and Users are summarised in the following table.

TYPE OF SERVICES	PARTNERS	COMPETITORS	USERS
Technical Services	Other projects, Cultural & Creative Industries, Ministries (Culture, Research, Made in Italy), Tech Infra; Other RI, Italian Computing and Data Infrastructure	European Grid Infrastructure, Commercial providers	Research Communities, Universities, Galleries, Libraries, Archives, Museums
Data & Digital Services/Research Services/Innovation Services	Relevant ERIC, Research Institutes, IT companies, Galleries, Libraries, Archives, Regions, Universities	Commercial providers	Research Communities, Museums, Laboratories, Professionals, Data Curators
Training Services	ERIC training office, ICDI competence	Commercial providers	Teachers, Data stewards, PhDs

	center, Italian Data Stewards Network		
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Table 7- Main Partners, Competitors and Users

## 2.3 Data Policy and access

H2IOSC shall provide effective access for a wide user community to its resources and services, including high-quality data and digital tools, to foster innovation and to apply FAIR principles to data and metadata.

Indeed, H2IOSC is committed to promote the use of FAIR principles for scientific data, thereby ensuring that data produced using H2IOSC services is Findable, Accessible, Interoperable, and Reusable. Therefore, all data produced using H2IOSC services must be appropriately maintained, archived, and made openly available for (re-)use, if feasible for the research activity.

H2IOSC data and digital tools shall be available according to license conditions for both non-commercial and commercial purposes. The aim is to use a small defined suite of licenses with similar kind of principles for both H2IOSC data and digital tools. In Deliverable 1.1 *“Quality assurance plan, guidelines, project handbook”* the guidelines adopted by each RIs National Nodes are described, in details. However, reasonable restrictions that are still in line with open access principles may be implemented for specific data sets, especially when access to them could jeopardize a potential industrial/commercial use, violate the rules on personal data protection or on confidentiality for security reasons. These types of measures may include embargo periods (i.e. periods of time where an access restriction is applied to a piece of data and/or other research output, whereby the item will not be made available as Open Access until a predetermined time), authorisation procedures, specific contractual arrangements and licenses other than those recommended by the participating RIs.

The terms of use of the H2IOSC services will then be described in the Data Management Plan and reported next to each service in the H2IOSC Catalogue.

Users of H2IOSC data and digital tools are normally expected to make resulting publications available through open access repositories. Open source for software is encouraged and recommended, when possible. Users are also expected to cite H2IOSC when using H2IOSC data in publications.

H2IOSC shall respect and comply with any European and national legislation as applicable regarding the protection of personal data and privacy as well as copyright.

With regard to the methods of access to H2IOSC services, the following distinction must be made.

- **Open access resources:** access to these resources is free-of-charge.
- **Value-added resources:** for added-value resources and services (i.e.: services for scientific research and access to the technological infrastructure) a flexible model is used that considers different categories of users:
  1. Users of the scientific network: access, granted on the basis of scientific excellence and the potential impact of the proposed research project, involving a selection process, requires the payment of a contribution to cover the costs of providing the service.

2. Private users: access is guaranteed by paying a fee required for the use of specific services or features that enrich the basic offer of the infrastructure, such as advanced features, specialized support or customized solutions that meet specific needs. The fees help to cover the costs of development, maintenance, support and provision of these services.

The costs of services provided by H2IOSC are calculated according to the H2IOSC financial rules and may be adjusted on a regular basis.

The value of the contribution requested from users of the scientific community for the so-called added-value services is determined on the basis of the analytical cost of making the reference service available and the related overheads.

While, the potential fee, requested from private users for the above-mentioned typology of services may vary according to principles established by the H2IOSC Decision-making Body, for example as a function of a specific service, user (e.g., academic vs commercial user), user origin (within or outside Europe), or availability of funding (national funding, EU funding, etc.). All access to H2IOSC services and resources is channeled through a single interface, the H2IOSC Marketplace, that connects users to the whole H2IOSC services.

An on-line, interactive and regularly updated H2IOSC Catalogue of Services allows users to easily find all relevant information about the available services and access details (type, availability, modalities, costs, etc.).

A mechanism for user feedback, which is an essential part of the user-oriented approach of H2IOSC, will allow for regular collection of information from the users on the range and quality of the H2IOSC services.

## 2.4 H2IOSC as a cluster for innovation

By supporting innovation and knowledge transfer H2IOSC aims to create both technological and societal breakthroughs and economic impacts. Its services include training on demand or targeting specific user' groups and joint research activities.

H2IOSC strives at embracing the framework conditions that are the main drivers of EU innovation performance: human resources, attractive research system, specifically in the arts, humanities, linguistics, and heritage science sectors, and innovation-friendly environment.

H2IOSC continuously contributes to innovation by working on knowledge transfer with policy makers and privates, disseminating relevant research outputs on humanities and heritage science.

H2IOSC's medium- to long-term strategy is therefore aimed at achieving the following results: increasing technical and scientific capabilities and the number of researchers trained in advanced technologies, thus providing a tangible contribution to the sustainability and resilience of cultural systems through the use of innovative technologies; creating new services and tools in the arts, humanities, linguistics, and heritage science sectors and consequently expanding the number of users from the public and private sectors and the number of access; growing public-private collaborations and increasing the number of intellectual property registrations, patents, spin-offs, or commercial agreements; and strengthening Italy's role in the European context.



In pursuing the paradigm of innovation, we conducted an analysis of the level of TRL (Technology Readiness Levels) of our category of Data & Digital services, which also includes Innovative services (H2IOSC Pilots).

TRL levels indicate, indeed, a methodology for evaluating the degree of maturity of a technology.

TRLs are based on a scale from 1 to 9, where 9 represents the most mature technology, as shown in the following figure

TRL 1: Basic principles were observed

TRL 2: Technology concept was formulated

TRL 3: Technology concept was experimentally proven

TRL 4: Technology was tested in the laboratory

TRL 5: Technology was validated in relevant environment  
(in key technologies in the industry-oriented environment)

TRL 6: Technology was demonstrated in relevant environment  
(in key technologies in the industry-oriented environment)

TRL 7: System prototype was tested in real-life use

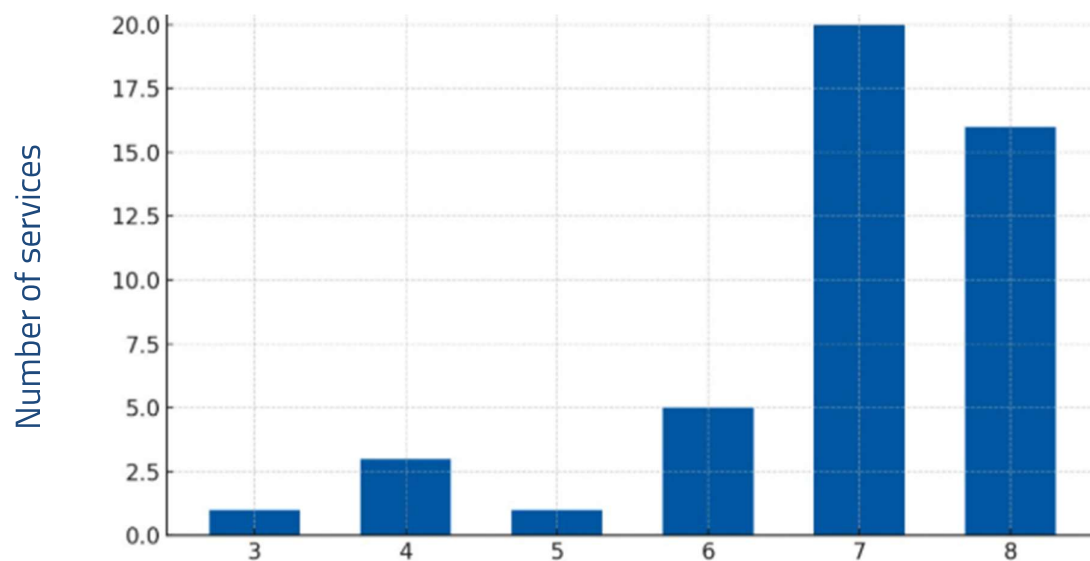
TRL 8: System was completed and qualified

TRL 9: System works in operational environment  
(competitive manufacturing in key technologies or aerospace)

Figure 13- TRL

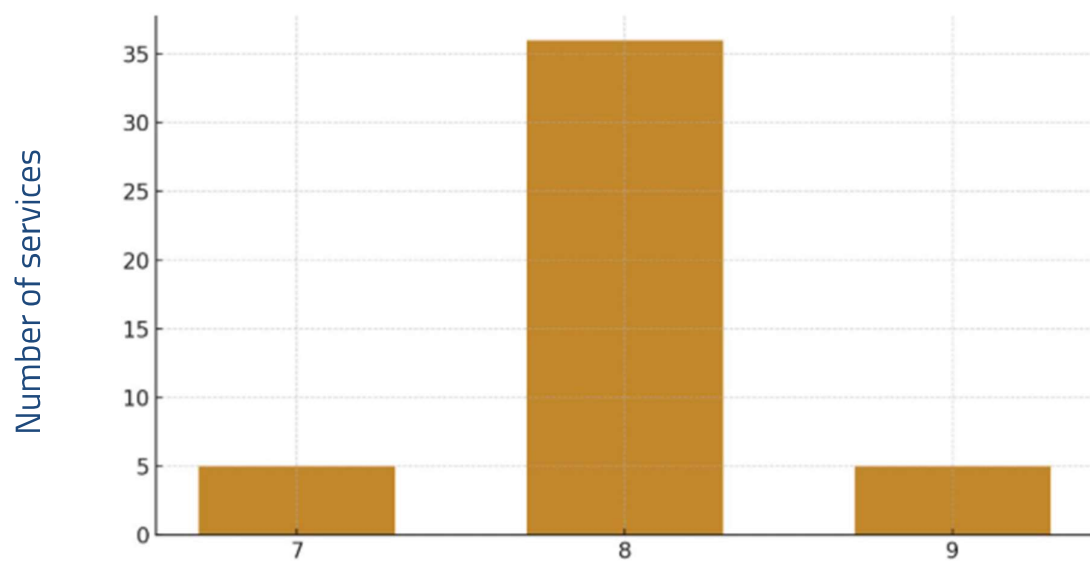
The following figures therefore show the number of Data & Digital services, recorded at the time of writing this version of the deliverable, for each TRL as reported in June 2025 and planned for October 2025 to be fully operational on the market.





TRL – levels detected in June 2025

Figure 14- TRL detected in June 2025



TRL – levels expected in October 2025

Figure 15- TRL expected in October 2025

## 2.5 Communication

The objective of the H2IOSC Communication Plan is to establish and promote the Cluster as a collaborative, federated initiative of its constituent research infrastructures at national level: CLARIN-IT, DARIAH-IT, E-RIHS.it, and OPERAS-IT.

The plan has the purpose to ensure effective communication with internal and external stakeholders, facilitating visibility, engagement, and adoption of the H2IOSC Cluster resources and services.

The following table shows the information related to the target audiences of the H2IOSC communication plan.

Cluster Bodies
<b>Decision-making Body:</b> Coordinators of the RIs National Nodes involved and the CNR DSU Director.
<b>External Advisory Board:</b> Delegates per European Research Infrastructure involved and possibly delegate from EOSC
<b>Service Operation Team</b> Representatives of participating RIs at territorial Nodes level
External Bodies and Institutions
<b>Science and Technology:</b> Researchers and academics in the arts, humanities, linguistics, and heritage science sectors; PhD programs EU projects (e.g. EOSC, SSHOC, ECHOES, PERCEIVE); National projects (e.g. PNRR PE CHANGES, PRIN and FIS); other RIs (ARIADNE, CERIC); PhD programs (e.g. PhD HS.it, PASAPMED, FROID)
<b>Members of Italian RI Nodes (Public and Private sectors):</b> <u>E-RIHS.it:</u> INFN - Italian National Institute for Nuclear Physics; ENEA - Italian National Agency for New Technologies, Energy and Sustainable Economic Development, <u>CLARIN-IT:</u> University of Siena - Department of Philology and Literary Criticism (DFCLAM); EURAC Research; FBK - Fondazione Bruno Kessler; The Archival and Bibliographic Superintendency of Tuscany; University of Naples "Federico II" - Department of Electrical and Information Technology Engineering - Inter-departmental Research Centre "URBAN/ECO"; Università Cattolica del Sacro Cuore (Milan); University of Parma; University of Padova; University of Ferrara - Centro Linguistico di Ateneo; University of Naples "L'Orientale" - Department of Literary, Linguistic and Comparative Studies (DLLC); Università di Bologna "Alma Mater Studiorum";



<p>Rut Foundation.</p> <p><u>DARIAH-IT:</u></p> <p>Prato State Archive;</p> <p>Museum of Palazzo Pretorio;</p> <p>The Archival and Bibliographic Superintendency of Tuscany;</p> <p>Central Institute for the Union Catalogue of Italian Libraries;</p> <p>Fondazione Ezio Franceschini;</p> <p>SISMEL - International Society for the Study of Medieval Latin Culture</p> <p>GARR - Italian Academic and Research Telecommunication Consortium</p> <p>INFN - Italian National Institute for Nuclear Physics;</p> <p>CINECA - Interuniversity Consortium for Automatic Computing of North-Eastern Italy</p> <p>ENEA - Italian National Agency for New Technologies, Energy and Sustainable Economic Development;</p> <p>University of Bologna - Multimedia Research Resource Centre</p> <p>Museo Galileo, Florence</p> <p>University of Pisa</p> <p>Sapienza University of Rome</p> <p>University of Siena</p> <p>University of Western Piedmont</p> <p>University of Napoli Federico II</p> <p>University of Rome 3</p> <p>IISG - Italian Institute for Germanic Studies</p> <p>Scuola Normale Superiore of Pisa</p> <p><u>OPERAS-IT:</u></p> <p>University of Turin;</p> <p>University of Bologna;</p> <p>University of Macerata;</p> <p>University of Messina;</p> <p>University of Milan;</p> <p>University of Rome Tor Vergata;</p> <p>Florence University Press;</p> <p>Lexis Compagnia editoriale srl (Turin);</p> <p>Net7 srl (Pisa).</p> <p><b>Institutional bodies:</b></p> <p>Multidisciplinary research centres of excellence, universities, museums, libraries, archives.</p> <p><b>Policy</b></p> <p>ESFRI; Italian Ministry of Culture (MIC); Italian Ministry of University and Research (MUR).</p> <p><b>Industry</b></p> <p>Companies, EU SMEs, National SMEs, Clusters, Competitiveness Poles, Industry associations in the humanities, linguistics, and heritage science sectors.</p> <p><b>General public</b></p> <p>Scientific journals and magazines; local press.</p> <p><b>International Organizations</b></p> <p>European Commission, CLARIN ERIC; DARIAH ERIC; E-RIHS ERIC, ICCROM, UNESCO, ICOMOS, IEEE.</p>
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Table 8 - Target Audiences

In particular, the H2IOSC communication plan aims to develop the following core messages:

- Fostering collaboration: H2IOSC represents the federated efforts of Italy's key research infrastructures to advance research in the humanities, linguistics, arts and heritage science sectors;
- Enhanced access: offering innovative tools, data centers, and virtual labs to foster interdisciplinary and groundbreaking research;
- Promoting sustainability: by pooling resources, H2IOSC ensures efficient use of research data, computational resources, digital tools, reducing duplication and fostering sustainable research practices. H2IOSC ensures, indeed, quality processes thanks to standard operational procedures, with the support of H2IOSC staff and Nodes liaison staff;
- Diversity and identity: while federated, the different expertise of CLARIN-IT, DARIAH-IT, E-RIHS.it, and OPERAS-IT are recognised, valued and maintained;
- Open science values: promoting transparency, accessibility, and reusability of resources in line with EU and global Open Science initiatives;

with the ambition of achieving the following goals:

- Build awareness of H2IOSC and its mission among researchers and institutions, increasing its visibility and that of its national nodes.
- Promote the use of H2IOSC's resources and tools to drive interdisciplinary research and accelerate the digital transformation in the humanities, linguistics, arts and heritage science sectors, with the aim to increase the number of users.
- Foster a sense of community and collaboration among stakeholders.

To achieve this, the plan includes strategies and channels for their implementation:

1. **Branding and identity** (Develop a visual identity for H2IOSC; Logo and visual guidelines; A slogan emphasizing collaboration and innovation; Ensure consistency across all communication materials).
2. **Online presence**
  - Website (A central portal for H2IOSC, linking to the specific sites of CLARIN, DARIAH, E-RIHS, and OPERAS, at national and European level; Features: mission, services, news, events, success stories, and resource access points).
  - Social Media (Dedicated profiles for H2IOSC on platforms like LinkedIn and Facebook; Regular posts highlighting collaborative achievements, events, and updates from each node).
3. **Content Development**
  - Publications (Newsletters featuring updates, research highlights, and funding opportunities; Blog posts and interviews with key researchers and stakeholders).

- Multimedia (Short videos and/or podcasts explaining the cluster's mission and resources; Infographics illustrating the services and tools, the federated model and its benefits).
  - Research Spotlights (Case studies showcasing interdisciplinary projects enabled by H2IOSC).
4. **Events and outreach** (Host annual conferences or workshops featuring contributions from the H2IOSC community; Organize webinars and training sessions on using H2IOSC tools and resources; Participate in national and international events related to humanities, linguistics, arts and heritage sciences sectors).
5. **Stakeholder engagement**
- Internal Communication (Monthly coordination meetings (online and in person) among the H2IOSC community to ensure alignment and information sharing; Collaborative platforms (e.g., Slack, Teams) for real-time communication; Publishing and disseminating scientific articles, reports, datasets, and other outputs by researchers affiliated with the H2IOSC Cluster via Open Access platforms like Zenodo.
  - External Collaboration (Partnerships with universities, cultural institutions, and international research initiatives; Policy briefings and updates for government and funding bodies).
6. **Media relations** (Issue press releases for significant milestones or discoveries; Build relationships with journalists involved in the humanities, linguistics, arts and heritage sciences topics; Prepare a media kit with key information about H2IOSC).

In the following table an overview of the mentioned strategies and their channels is reported.

Contents/Channels	Audience	Frequency
<b>Online</b>		
Website (updates and maintenance)	Internal and External	Daily
Newsletters	Internal and External	Every month
Blog posts and interviews	Internal and External	Every week
Short videos and/or podcasts	Internal and External	Every two weeks
Save The date (training, events, meeting)	Internal and External	When required
<u>Research Spotlights</u>	Internal and External	Every two weeks
Social media	Internal and External	Daily
Press releases/ Media kit	External	When required
<b>Offline</b>		
Brochure	External	When required
Poster	External	When required
Coordination meetings (in person and online)	Internal	Every month

Public events	External	When required
Scientific conference	Internal and External	Once a year

Table 9 - Strategies and channels

The efficiency of the described communication plan is guaranteed by a Monitoring and Evaluation System which includes:

- Metrics (Website traffic and resource downloads; Social media engagement as likes, shares, comments; Attendance and feedback from events and webinars; Collaboration inquiries and partnerships initiated);
- Feedback Mechanisms (Surveys to assess stakeholder awareness and satisfaction; Regular reviews of communication effectiveness with representatives from the H2IOSC community).

By implementing this communication plan, H2IOSC can establish itself as a leader in advancing open science in the humanities, linguistics, arts and heritage sciences fields, while maintaining the individuality and strengths of its constituent nodes.

### 3. FINANCIAL AND FUNDING FRAMEWORK

#### 3.1 Income and revenue

H2IOSC can count on several sources of income that will contribute to fund its operation. The H2IOSC total income can be categorized as follows:

1. National Nodes Core budget: This is constituted by Ordinary government funding (FOE). To be understood as financing of the "*FOE a valenza internazionale*", which is expected to be (partly) allocated for the reference period. This Core Budget serves the basic funding for H2IOSC operation, ensuring the continuous functioning of its Nodes. Indeed, H2IOSC is sustained through indirect funding mechanisms, with financial resources provided via the national nodes, rather than through direct centralised allocations.
2. EU research and national projects. To be understood as an estimated value based on the projects financed in the last 5 years (2019-2024), taking into account the fact that the trend of projects won in the recent period is confirmed. European research and national grants will provide additional funding for the development of specific H2IOSC activities and/or services, and for future investments, both at the cluster level and at the Nodes level.
3. Service fee: Forecast based on expected requests for access to technical, training and digital added-value services for which the payment of a contribution or fee is expected, calculated taking into account the analysis of the demand for services and the trend of services already operational requested. The contributions and fees are requested to cover mainly the costs associated with making the same services available.
4. Any other public and private revenues: in order to ensure full coverage of the costs associated with the correct operation of the national Nodes. Specifically, these funds include the FOE (Institutional Fund) to cover the cost of permanent staff and utilities

costs, as well as a revenue forecast for public-private partnerships that are planned to be activated in the long term and for which networking activities have been initiated during the project's life cycle.

### 3.2 Costs

The following are the cost categories identified and quantified within the H2IOSC project with the support of dedicated infrastructure staff.

1. Investment costs: The amount was estimated considering the 5-year life cycle of the hardware (data center) equipment acquired with NRPP funds, in order to maintain the cluster's high-performance and cutting-edge capabilities. For the data centers, it was therefore estimated that the same level of investment would be sustained at the end of the 5 years. For the platforms acquired with NRPP funds, a diversified valuation was applied, taking into account their complexity and technical specificities.
2. Running costs: The amount was estimated considering the potential maintenance and consumables costs, as well as utilities, for the first five years and ten years of the data centers, taking into account that these data centers (may) also consist of equipment previously acquired with non-NRPP funds, but whose maintenance was necessarily considered, for technical and functional reasons, in conjunction with the equipment acquired with project funds. The amount also includes technical support costs for the platforms over the same period and, finally, the maintenance and consumables costs associated with the services listed in the catalogue.
3. R&D costs: costs for research and development activities that are planned to be outsourced to suppliers in order to ensure the efficiency and performance standards required of H2IOSC platforms and services. Research and development activities related to the data centers and most of the platforms used are carried out by cluster personnel, the cost of which is reported under "manpower costs" item.
4. Manpower costs: The amount was estimated based on an analysis of the manpower requirements for the cluster's management and operations in the coming years. The analysis specifically considered the manpower required for the proper functioning of the data centers and platforms used for the purposes of the H2IOSC cluster, as well as for the proper provision of the services listed in the catalogue. It takes into account permanent staff already employed in the aforementioned activities and temporary staff who may be hired to upgrade certain services, based on the projects won.
5. Overheads: calculated as 7% of direct costs previously listed, to use the same percentage applied under the NRRP-funded project.

### 3.3 Five and Ten-year financial plan

The following is a complete table of projected revenue streams and expenses for the first 5 years and the second 5-year period post-NRRP, and overall for the 10-year period considered, taking into account the assumptions previously made and the fact that the forecasts will necessarily have to be monitored and updated based on the progress of the cluster's activities, its services, and other contingent situations.

H2IOSC Financial Plan (in kEuro)	Implementation phase (2026-2030)	Full Regime (2031-2035)	TOTAL Ten-year plan (2026-2035)
<u>Core Income and revenues</u>	25.929	48.832	74.761
<i>National Nodes Core budget</i>	1.700	1.700	3.400
<i>EU research and national projects income</i>	1.956	6.734	8.690
<i>Service fee</i>	878	1.173	2.051
<i>Other revenues</i>	21.395	39.225	60.620
<u>Core Costs</u>	25.929	48.832	74.761
<i>Investment costs</i>	0	15.682	15.682
<i>Running costs</i>	12.322	15.074	27.396
<i>R&amp;D costs</i>	1.451	1.451	2.902
<i>Manpower costs</i>	10.460	13.430	23.890
<i>Overheads</i>	1.696	3.195	4.891

Table 10– H2IOSC Financial Plan

### 3.4 Financial sustainability

Given the strategy implemented by the national nodes of the research infrastructures participating in H2IOSC, there is potential for a progressive generation of revenue for these nodes through the activation of sustainable and replicable service models, such as digital services for businesses and public administration. As previously mentioned, access to standard services will be guaranteed free of charge, while access to added-value services (i.e., customized services such as specialized technical support, co-design, etc.) will be offered in differentiated ways depending on the type of user: a contribution to cover costs will be required from users of the scientific network and a fee from business users.

The strengthening of technical, scientific, and infrastructural capabilities implemented with NRRP funds will allow the national nodes to significantly increase their attractiveness and competitiveness, potentially generating indirect revenue through participation in European projects and national/regional calls for proposals.

The maintenance, R&D, personnel, and software costs required for the full operation and provision of the services offered will be covered through a combination of competitive public funding, paid services provided by the cluster, public-private partnerships, and agreements with local authorities and businesses. The sustainability model aims for progressive economic and financial independence, with a return on public investment in terms of services, skills, and innovation.

## 4. IMPLEMENTATION

### 4.1 Operational priorities

The H2IOSC implementation phase will be a five-year period (2026-2030) dedicated to the functioning of the cluster, setting-up the user access and service provision, work on the governance and management tasks, increase the connection with new users, further develop strategies within H2IOSC and for international collaboration and public-private partnerships, and integrate H2IOSC at different strategic levels (national, European and internationally).

The target of the H2IOSC implementation phase is to ensure the long-term operations and sustainability of the cluster and its Nodes. The objectives of the implementation phase are:

- Datacenter and platform operations;
- Services development;
- Services access and provision;
- Governance and management coordination;
- Community engagement and attraction of new potential partners;
- International cooperation;
- Outreach and communication;
- Innovation and technology development activities;
- Socio-economic impact.

The following is the prepared implementation plan, composed of an equal number of strategic activities, to be developed in the first 5 years of operation of the post-NRRP decade with the related scientific and technological milestones.

STRATEGIC ACTIVITIES	DESCRIPTION	MILESTONES
Datacenter and platform operations	Many of the datacenters and platforms acquired and/or upgraded with NRPP funds will gradually become operational.	Definition and implementation of operational support; technical updates to meet the requirements of the RIs and the H2IOSC cluster; workflow development; validation of operational support actions; prioritization of operational support actions; initiation of selected operational support actions.





Service development	Service validation as part of service development. Definition of access and user feedback mechanisms as part of a quality assurance system for continuous improvement of access and services.	Continuous updating of the service catalogue; service validation (technical, financial, regulatory validation, and sustainability); definition of service delivery priorities; ongoing engagement with the user community.
Service access and provision	The first set of production services will be identified and launched, and user feedback will be collected.	Providing services (including user interface implementation, access management, and the review process); and creating a user forum to collect user feedback.
Governance and management coordination	The RIs participating in H2IOSC will facilitate the operation of the established governance committees to ensure the long-term sustainability of the cluster. Among the numerous management tasks, quality management systems will be established to monitor the H2IOSC performance.	Promote actions to ensure long-term financial commitment from the RIs involved; provide regular updates to the business plan; ensure coordinated action among the RIs participating in the cluster; manage the quality system for performance monitoring; and provide feedback on external evaluations.
Community engagement and attraction of new potential partners	Commitment of H2IOSC to the relevant scientific community and support for actions aimed at involving new potential partners.	Organize community engagement activities, including scientific conferences and technical development meetings; maintain an active collaboration network with relevant European RIs; and develop potential forms of public-private partnerships.
International cooperation	H2IOSC plays a key role in the fields of arts, social sciences, and cultural heritage. The participating RIs will continue to actively participate in international initiatives and collaborate with strategic liaison	Participation in collaborations and partnerships; exploration of new collaboration opportunities and connections at the national, regional, and international levels; positioning and

	partners. H2IOSC will be the central point of contact for these liaison and partnership activities.	collaboration in the RIs' operational domains and potential other domains.
Outreach and communication	Engaging the community and various stakeholder groups is an important task for H2IOSC. H2IOSC will strive to reach out to its users and stakeholders, as well as the general public, to explain the importance of its work to the community.	Develop the communications strategy; promote the visibility of RIs and cluster; create awareness-raising events and activities as well as targeted materials for various user groups and stakeholders; facilitate internal and external communications.
Innovation and technology development activities	The services offered to support innovation are designed to promote knowledge transfer with the aim of generating medium- and long-term technological and societal impact. These services may include, for example, on-demand or targeted training for specific user groups and joint research activities. During the implementation phase, H2IOSC will begin working on technological development and innovation activities, including promoting cooperation with the private sector, policymakers, and the general public.	Identifying development areas and services for collaboration with the private sector; promoting collaborative opportunities for technological development and new services; promoting H2IOSC as innovation platform; and improving the use of data and digital tools produced by H2IOSC for market-driven applications and decision-making.
Socio-economic impact	A series of socio-economic analyses (direct and indirect) are planned during the implementation phase.	Establish a methodology to analyze and measure the socio-economic impact of H2IOSC.

Table 11– Operational priorities

## 4.2 Milestones years 1-5

The planned Milestones for the foreseen activities undergoing during the 5-year implementation plan are presented in the following Table.



TASK Name	05-26	11-26	05-27	11-27	05-28	11-28	05-29	11-29	05-30	11-30
<i>Datacenter and platform operations</i>										
definition and implementation of operational support	X	X	X	X	X	X	X	X	X	X
technical updates to meet the requirements of the RIs and the H2IOSC cluster	X	X	X	X	X	X	X	X	X	X
workflow development	X	X	X	X	X	X	X	X	X	X
validation of operational support actions	X	X	X	X						
prioritization of operational support actions			X	X	X	X				
initiation of selected operational support actions					X	X	X	X	X	X
<i>Service development</i>										
continuous updating of the service catalogue	X	X	X	X	X	X	X	X	X	X
service validation (technical, financial, regulatory validation, and sustainability)	X	X	X	X	X	X	X	X	X	X
definition of service delivery priorities	X	X	X	X	X					
ongoing engagement with the user community	X	X	X	X	X	X	X	X	X	X
<i>Service access and provision</i>										
providing services (including user interface implementation, access management, and the review process)	X	X	X	X	X	X	X	X	X	X
creating a user forum to collect user feedback			X	X	X	X	X	X	X	X
<i>Governance and management coordination</i>										
promote actions to ensure long-term financial commitment from the RIs involved	X	X	X	X	X	X	X	X	X	X
provide regular updates to the business plan	X		X		X		X		X	
ensure coordinated action among the RIs participating in the cluster	X	X	X	X	X	X	X	X	X	X
manage the quality system for performance monitoring	X	X	X	X	X	X	X	X	X	X
provide feedback on external evaluations					X	X	X	X	X	X
<i>Community engagement and attraction of new potential partners</i>										
organize community engagement activities, including scientific conferences and technical development meetings	X	X	X	X	X	X	X	X	X	X
maintain an active collaboration network with relevant European RIs	X	X	X	X	X	X	X	X	X	X
develop potential forms of public-private partnerships	X	X	X	X	X	X	X	X	X	X
<i>International cooperation</i>										
participation in collaborations and partnerships	X	X	X	X	X	X	X	X	X	X
exploration of new collaboration opportunities and connections at the national, regional, and international levels	X	X	X	X	X	X	X	X	X	X
positioning and collaboration in the RIs' operational domains and potential other domains	X	X	X	X	X	X	X	X	X	X
<i>Outreach and communication</i>										
develop the communications strategy	X	X								
promote the visibility of RIs and cluster	X	X	X	X	X	X	X	X	X	X
create awareness-raising events and activities as well as targeted materials for various user groups and stakeholders	X	X	X	X	X	X	X	X	X	X
facilitate internal and external communications	X	X	X	X	X	X	X	X	X	X
<i>Innovation and technology development activities</i>										
identifying development areas and services for collaboration with the private sector	X	X	X	X						
promoting collaborative opportunities for technological development and new services					X	X	X	X	X	X
promoting H2IOSC as innovation platform					X	X	X	X	X	X
improving the use of data and digital tools produced by H2IOSC for market-driven applications and decision-making	X	X	X	X	X	X	X	X	X	X

<i>Socioeconomic impact</i>										
Establish a methodology to analyze and measure the socio-economic impact of H2IOSC	X	X								

Table 12– Milestones 2026-2030

### 4.3 Key performance indicators

Key Performance Indicators (KPIs) are quantifiable measures used to evaluate the success and effectiveness of a research facility or system or a cluster of research infrastructures in achieving its objectives. KPIs are critical for assessing, in general, operational efficiency, utilisation, impact, and sustainability of research infrastructures.

Characteristics of Effective KPIs:

- KPIs should be Specific, Measurable, Achievable, Relevant, and Time-bound to effectively gauge performance and drive improvement.
- KPIs should be customised to align with the specific objectives and mission of the cluster and its RIs.
- KPIs should be used to benchmark the cluster and its RIs against their own performance, rather than comparing different infrastructures.

Using KPIs offers numerous benefits to the cluster and its RIs, including:

- ensuring that all levels of the cluster are aligned with strategic goals;
- providing a quantifiable way to measure performance and progress;
- enabling data-driven decision-making by providing objective and relevant information;
- helping the cluster prioritises its efforts by identifying key areas of focus;
- serving as a monitoring tool to proactively identify potential issues and take corrective action before they escalate;
- enhancing accountability and transparency within the cluster.

Steps in Developing a Common Framework of KPIs:

- establishing clear strategic goals that are common across the cluster;
- choosing relevant KPIs that can effectively measure progress towards the strategic goals;
- ensuring that each KPI is directly linked to a specific strategic goal, providing a clear line of sight from performance measurement to strategic outcomes;

- developing a robust system for collecting and managing data to ensure accuracy and reliability of KPI measurements;
- clearly defining how each KPI will be measured and how often measurements will be taken to maintain consistency and comparability;
- developing a framework for reporting KPI results that is clear, concise, and accessible to all stakeholders;
- utilising visualisation techniques such as dashboards, charts, and graphs to effectively communicate KPI results and insights to stakeholders.

The specific KPIs for H2IOSC, listed below, are linked to its mission and functions and reflect the efficiency and quality of the main tasks for the years following the end of the project. They may be changed and integrated based on future needs that may arise.

INDEX	TYPE OF DATA	FREQUENCY
<b>OBJECTIVE: Enabling scientific excellence</b>		
User requests for access	Numerical	Twice a year
Users served	Numerical	Twice a year
Publications	Numerical	Yearly
Citations of publications.	Numerical	Yearly
<b>OBJECTIVE: Scientific progress</b>		
Datasets made available to the scientific and business communities for their use in research, innovation and technology transfer	Percentage	Yearly
Services used by scientific communities and businesses	Numerical/descriptive	Yearly
<b>OBJECTIVE: Sustainability and resilience of nodes</b>		
Continuity of services	Comments (users survey)	Yearly
Reliability of the cluster and its nodes	Comments (users survey)	Yearly
<b>OBJECTIVE: Economic impact</b>		



Users from the business sector and publications with the business	Percentage	Yearly
Revenue from commercial activities and paying users for services	Numerical	Yearly
Companies involved in innovation collaboration agreements	Numerical	Yearly
<b>OBJECTIVE: Innovation and technology transfer</b>		
PoCs requested and activated	Numerical	Yearly
Patents or IP generated	Numerical	Yearly
Technologies transferred to industrial partners or spin-offs	Numerical	Yearly
TRL (Technology Readiness Level) achieved	Level	Twice a year
<b>OBJECTIVE: Training</b>		
Master's and PhD students using the facilities and services	Numerical	Yearly
Training of people who are not members of the staff of the CNR Institutes involved	Numerical	Yearly
Company participants in training courses	Numerical	Yearly
<b>OBJECTIVE: Social impact</b>		
Public engagement events	Numerical	Yearly
Participation of H2IOSC in policy panels and forums	Numerical	Yearly
Internet hits (Google, social networks)	Percentage	Yearly

<b>OBJECTIVE: Reputational impact</b>		
Users and publications by ESFRI member and non-member country	Percentage	Yearly
Institutions and companies participating in the TNA/NA call	Numerical	Yearly
International interns	Numerical	Yearly

Table 13– KPIs

#### 4.4 Risk management plan

The risk management in H2IOSC is important – as in any research infrastructure, organisation, business, or project - the risks are the main source of uncertainty and potential threats to the operation, outcome and success. Risks can originate from external and internal sources and be of different nature. Risk management is the process of identifying, addressing, prioritising, and eliminating potential sources of malfunctioning of the cluster and the possible difficulties to achieve the objectives of the H2IOSC implementation phase. The risk assessment should be an integral and systematic part of the governance, management, planning and reporting processes and culture of the cluster. All the H2IOSC bodies have a role in the risk management by identifying, monitoring or reporting the risks and adopting risk mitigation actions. For the implementation phase, H2IOSC is using following risk categories that are reflecting its main activity categories and objectives. The risks are categorised in relation to:

- Economic factors;
- Strategic-organizational factors;
- Technical-technological factors.

A relatively simple risk management system will be implemented, checked regularly and kept up to date. Each identified risk should have a risk owner, located anywhere across the cluster, who is responsible for monitoring the development of the risk, estimating the probability of the risk and the severity of the effects in case the risk materializes. The risk owner updates the risk assessment system whenever needed and alerts the RIs coordinators and Decision-making body in case probability and impact of the risk passes a critical threshold (moderate) proposing mitigating actions. In the following Table an outline of the Risk Register is presented, to be updated taking into account the progress of the activities and other factors that may affect the operation of the cluster.

CRITICAL FACTORS		PROBABILITY	IMPACT	MITIGATION ACTIONS	STATUS
ECONOMIC FACTORS	i.e. Insufficient budget	(high/ moderate/ medium/low)	(high/ moderate/ medium/low)	i.e. use of overheads or contingency budget provision	.....
	i.e. Underestimation of real implementation costs	(high/ moderate/ medium/low)	(high/ moderate/ medium/low)	i.e. Update and revise the implementation	.....





					and business plan regularly. Revise the cost assessment, some of the services may not be implemented due to cost.	
STRATEGIC- ORGANIZATIONAL FACTORS	i.e. discontinuity of governance at the transition between implementation and operational phase of the cluster	(high/ moderate/ medium/low)	(high/ moderate/ medium/low)		i.e. support governance continuity	.....
	i.e. Dysfunctional governance	(high/ moderate/ medium/low)	(high/ moderate/ medium/low)		i.e. rules of operations, ensure communication	.....
	i.e. insufficient responsiveness of the Nodes	(high/ moderate/ medium/low)	(high/ moderate/ medium/low)		i.e. Review practices and address according to the Value proposition	.....
	i.e. Competition from other entities	(high/ moderate/ medium/low)	(high/ moderate/ medium/low)		i.e. collaboration, harmonization and integration of services	.....
	i.e. Not enough collaboration agreements concluded with key partnerships	(high/ moderate/ medium/low)	(high/ moderate/ medium/low)		i.e. seeking partnerships and creating concreted means for collaborations and identifying service provision.	.....
	i.e. Not enough visibility among targeted user groups.	(high/ moderate/ medium/low)	(high/ moderate/ medium/low)		i.e. Establish communication tasks working on targeting outreach activities and create different tools and materials to the user groups and stakeholders and facilitate internal and external communications.	.....
	i.e. The relevance and impact of H2IOSC not sufficiently communicated and promoted	(high/ moderate/ medium/low)	(high/ moderate/ medium/low)		i.e. Ensure that users have a proper way to acknowledge H2IOSC by request the users to cite H2IOSC datasets within the text of the publication and include a reference to them in the reference list.	.....
	i.e. H2IOSC does not have enough socio-economic impacts	(high/ moderate/ medium/low)	(high/ moderate/ medium/low)		i.e. Verify and strengthen communication and dissemination strategy and activities. Guarantee the full exploitation of H2IOSC results. Formulate a clear scientific	.....

				strategy and align it to the needs of the user communities. Ensure the needed resources and competence for promoting, analyzing and communicating impacts.	
	i.e. Not enough interest from the private sector to co develop new services with H2IOSC	(high/moderate/medium/low)	(high/moderate/medium/low)	i.e. Participate actively in technology and innovation events. Develop partnerships with private companies in the H2IOSC framework.	.....
TECHNICAL-TECHNOLOGICAL FACTORS	i.e. Access system underdevelopment	(high/moderate/medium/low)	(high/moderate/medium/low)	i.e. provide adequate resources, follow the process closely	.....

Table 14– H2IOSC Risk Registry

## 5. CONCLUSIONS

The deliverable is designed in the form of a business plan to better match the request from the Italian Ministry to develop a strategic plan for the H2IOSC cluster in order to demonstrate its sustainability over a period of 10 years starting from the conclusion of the project financed with funds from Next generation EU.

The construction of a business model for the H2IOSC federation has its own intrinsic complexity which derives from the fact that it cannot be configured as a model of a single project idea but of a model for collaboration of four distinct projects which have been established in the form of distinct research infrastructures at a European level and with nodes at an Italian level. These research infrastructures, in addition to operating in different domains and with methods that are not always homogeneous, have a different history, degree of technological maturity and a specific identity which translates into their autonomous strategic vision and mission. The Plan therefore aims to go beyond these differences and create a new strategy that brings new benefits to participants.

This plan is composed of two essential parts: a descriptive one which explains the project, the context and the strategy and the resources necessary to achieve the objectives of the plan; a numerical part in which the economic-financial projections examined in the descriptive part are provided.

Drawing up a business plan requires, however, several months of preliminary work, especially for all the work that needs to be done upstream, research work, market analysis, strategies, and finding costs, which only ultimately culminate in the final document.

This business plan was developed as a strategic document for the cluster to achieve the following specific objectives: strengthen and enhance the technological capabilities of the cluster and the national nodes of the four participating research infrastructures, as well as improve advanced digitalization, data interoperability, and the use of FAIR standards; develop

new high-tech services for the documentation, analysis, and valorization of resources in the cluster's core areas, and continue training and skills exchange activities through capacity building and open innovation; foster synergies between research, innovation, and businesses in the SSH sectors, and collaborate with businesses and startups to facilitate the adoption of innovative solutions; strengthen mechanisms for the valorization of intellectual property, the negotiation of public-private partnerships, and third-party services, and develop strategies for the broader dissemination of research results and technological innovations to relevant stakeholders and the public; foster internationalization by leveraging the services of the cluster's national nodes, including within the context of the ERICs to which they refer, to contribute to their positioning within the EOSC.

## 6. REFERENCES

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