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ISTRUZIONE
RICERCA

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1. EXECUTIVE SUMMARY

The Italian Integrated Environmental Research Infrastructures System (ITINERIS) is the national initiative, funded by the Ministry of University and Research through the National Recovery and Resilience Plan (NRRP), to strengthen coordination, integration and accessibility across the Italian environmental Research Infrastructure landscape.

ITINERIS brings together the Italian nodes of 22 Research Infrastructures and a national consortium of leading research organisations and universities responsible for their implementation and operation across environmental and related scientific domains.

The ITINERIS project has created a strategic asset that extends beyond the lifetime of the project itself: the ITINERIS HUB. Developed as the common operational layer connecting the Italian environmental Research Infrastructures, the HUB brings together interoperability services, coordinated access mechanisms, data and metadata services, governance functions and user-oriented capabilities into a single federated framework.

The ITINERIS HUB operates on top of existing national and European Research Infrastructures, complementing their own services, access pathways and sustainability arrangements. It provides a common integration and access layer that increases the visibility, accessibility and interoperability of existing resources while enabling the development of shared national services and coordinated access initiatives at national and European level.

By preserving the autonomy of participating Research Infrastructures while enabling them to operate as a coordinated ecosystem, ITINERIS HUB transforms a fragmented landscape into a coherent national capability.

This Business Plan focuses exclusively on the long-term sustainability and evolution of the ITINERIS HUB whose preservation and further development are essential to maintaining the value created by ITINERIS beyond the PNRR. This business plan does not address the sustainability of the individual Research Infrastructures, which remains within their own governance arrangements, funding mechanisms and development strategies.

The Business Plan identifies the governance model required to provide strategic direction, operational coordination and shared stewardship across participating Research Infrastructures. It also establishes a monitoring framework capable of assessing the long-term performance and value generated by the HUB, together with a financial model based on institutional support, competitive funding and the progressive development of collaborative services.

Beyond ensuring continuity, the Business Plan outlines the strategic pathway for the evolution of the ITINERIS HUB into a new permanent national Research Infrastructure dedicated to the integration and coordination of the Italian environmental Research Infrastructures for enhancing their visibility, interoperability, accessibility and collective impact.

The transition from project to operation represents, therefore, not the conclusion of ITINERIS, but the beginning of a new institutional phase. The long-term success of the ITINERIS HUB will depend on coherent governance, sustainable financing, systematic monitoring and the continued commitment of the participating Research Infrastructures to a shared national vision.

2. STRATEGIC CONTEXT AND LONG-TERM POSITIONING

Environmental research is increasingly required to address challenges whose scale, complexity and societal relevance extend far beyond the boundaries of individual scientific domains. Climate change, biodiversity loss, environmental degradation, ecosystem resilience, natural hazards and sustainable resource management all require the integration of heterogeneous observations, multidisciplinary expertise, advanced analytical capabilities and long-term data resources. Such challenges cannot be addressed by a single Research Infrastructure (RI), scientific community or institutional actor; they require diverse infrastructures and communities to operate as parts of a broader scientific ecosystem enabled by a common operational layer.

Italy possesses a rich and internationally recognised landscape of environmental Research Infrastructures. Through national investments, European programmes and the long-term commitment of scientific communities, these infrastructures have developed unique capabilities in atmospheric sciences, marine sciences, biodiversity, geophysics, ecosystem monitoring, environmental data management and related domains.

However, excellence at the level of individual infrastructures does not automatically translate into systemic integration. Before ITINERIS, the Italian environmental RI landscape was characterised by a condition common to many mature research systems: strong individual capabilities combined with limited coordination across organisational and disciplinary boundaries. Access mechanisms, digital services, interoperability frameworks and user engagement activities were often developed independently. While this did not reduce the scientific quality of individual infrastructures, it constrained the capacity of the system as a whole to generate additional value through collaboration, interoperability and shared use of resources.

ITINERIS was conceived to address this challenge by creating the conditions for autonomous Research Infrastructures to participate in a coordinated network to develop synergies while preserving their scientific missions, governance structures and institutional identities.

The project was implemented within the framework of the Italian National Recovery and Resilience Plan (NRRP), Mission 4 “Education and Research”, Component 2 “From Research to Business” by the national consortium coordinated by the National Research Council of Italy (CNR) and bringing together the major Italian organisations responsible for the operation and development of environmental Research Infrastructures: the National Institute for Nuclear Physics (INFN), the National Institute of Geophysics and Volcanology (INGV), the Italian Institute for Environmental Protection and Research (ISPRA), the National Institute of Oceanography and Applied Geophysics (OGS), the University of Florence (UNIFI), the University of Venice Ca’ Foscari (UNIVE).

These organisations have networked the national nodes of 22 Research Infrastructures; the Italian nodes of the ESFRI Landmarks ACTRIS, EMSO, Euro-Argo, ICOS and LIFEWATCH, from the ENV domain and ANAEE from the H&F domain and closely linked to the ENV domain; the Italian nodes of the ESFRI projects DANUBIUS, DISSCO, e-LTER, from the ENV domain, and EMPHASIS and EU-IBISBA from the H&F domain and also relevant for ENV; the EU RIs ECORD, EUFAR, Eurofleets, JERICO and SIOS, all from the ENV domain; and the national RIs ATLAS, CeTRA, Laura Bassi, and SMINO, from the ENV domain, and Geosciences and LNS, both from the PSE domain, that in ITINERIS support services in the marine domain

These Research Infrastructures contribute complementary capabilities in environmental observation, experimentation, monitoring, data management and scientific services, forming the comprehensive environmental research ecosystems at the national level.

Strategic Identity of ITINERIS

VISION: To create an integrated and synergistic ecosystem of Italian environmental Research Infrastructures, enhancing their collective role and overcoming the disciplinary and institutional barriers that limit collaboration, interoperability and open access.

MISSION: To promote a systemic and multidisciplinary approach to environmental research by enabling integration across infrastructures, data, services and scientific communities. Through common standards, interoperable frameworks, shared services and coordinated access mechanisms, ITINERIS strengthens the effective use of national environmental Research Infrastructures and supports collaborative research, innovation and evidence-based decision making.

The most important outcome of ITINERIS is not the creation of individual services, facilities or technological components, but the establishment of a common layer that enables federation across infrastructures. Throughout this Business Plan, the term ITINERIS HUB refers to this common integration layer, comprising the gateway, interoperability services, metadata resources, coordinated access mechanisms, governance functions and operational capabilities that enable federation across Research Infrastructures.

Through the ITINERIS HUB, users gain improved visibility and access to resources distributed across the ecosystem, infrastructures can collaborate more effectively across disciplinary boundaries, and digital assets become more discoverable, interoperable and reusable. In practical terms, ITINERIS HUB increases the collective value of existing investments by creating mechanisms through which capabilities developed within individual infrastructures can be shared, combined and amplified at a national scale.

The strategic significance of this achievement becomes particularly evident when viewed from the perspective of legacy. While infrastructure projects are often assessed through their immediate outputs—facilities, equipment, software or completed activities—the legacy of ITINERIS is better understood as a set of enduring capabilities that support the long-term operation and evolution of the ecosystem.

Scientific legacy: by facilitating interactions across domains and infrastructures, ITINERIS has strengthened the capacity of the environmental research community to address multidisciplinary questions that require integrated approaches. The ecosystem created through the project enables researchers to combine expertise, data, and services that would otherwise remain distributed across organisational and disciplinary boundaries. This capacity for integration constitutes a long-term scientific asset whose value will continue to increase as environmental challenges become more complex and interconnected.

Infrastructural legacy: investments carried out within the project have enhanced facilities, services and operational capabilities across participating infrastructures. However, the most important infrastructural outcome is not simply the strengthening of individual components but the creation of mechanisms through which those components can operate collectively. It is precisely this capacity for collective operation — enabling resources, data and expertise distributed across multiple organisations to be combined and used as parts of a single system — that generates capabilities exceeding those of any individual participant. The resulting system possesses capabilities that no participating infrastructure could develop independently.

Harmonization and interoperability legacy: through the implementation of FAIR principles, metadata harmonisation activities, semantic resources, and shared digital services, the project has established the foundations of a federated digital environment supporting discovery, access, and reuse across multiple scientific domains. This digital layer represents one of the most strategic assets generated by the project, as it enables future integration, scalability, and collaboration.

Human capital legacy: the project has mobilised and developed specialised competencies in areas such as interoperability, FAIR implementation, data stewardship, semantic technologies, digital service management, access coordination, and governance. These competencies constitute a form of strategic infrastructure in their own right; however, unlike physical assets, they can rapidly disappear if continuity mechanisms are not established. Their preservation therefore becomes a central requirement for long-term sustainability.

Institutional legacy: ITINERIS has demonstrated that autonomous organisations with different missions, governance arrangements, and operational cultures can collaborate around common objectives without sacrificing their independence. This experience has produced deep relationships, mutual trust, governance practices, and coordination mechanisms that now constitute an essential part of the strategic capital.

Together, these dimensions converge in the ITINERIS HUB as a tangible expression of the project's legacy. This common layer constitutes the project's most important legacy and the foundation upon which future growth, integration and service development can be built. For this reason, the central question addressed by this Business Plan is how to ensure the long-term stewardship, governance and sustainability of the ITINERIS HUB beyond the project lifetime. The long-term ambition is to evolve the ITINERIS HUB as a national Research Infrastructure supporting the coordination and integration of the Italian environmental Research Infrastructure ecosystem.

3. THE ITINERIS MODEL

The model adopted by ITINERIS is based on a federated approach, with the ITINERIS HUB providing the common framework that enables separate Research Infrastructures to operate collectively within a shared national framework while preserving their scientific missions, governance structures and institutional identities.

This architectural choice is not only a technical solution but a strategic breakthrough. Environmental research requires the integration of diverse scientific domains, observational systems, datasets, facilities and expertise. Such diversity represents a major strength of the Italian environmental Research Infrastructure landscape, but it also creates challenges for discoverability, interoperability, access and coordination. A federated model allows these distributed capabilities to remain specialised and independently managed while benefiting from common mechanisms that support collaboration and integration. This approach generates a higher level of systemic value by building coherence on top of diversity, allowing to combine distributed capabilities without standardising them excessively or duplicating functions at the national level.

ITINERIS is organised around three interconnected layers that together enable the transition from a collection of individual Research Infrastructures to a coordinated national RI ecosystem.

At the foundational layer are the participating Research Infrastructures' national nodes, each led by a consortium partner. Throughout this Business Plan, participating Research Infrastructures refers to these national nodes unless otherwise specified. Together, they constitute the scientific backbone of ITINERIS, bringing together specialised facilities, observational networks, expert communities, long-term datasets and domain-specific know-how developed over years of investment and scientific work. Their strength lies not in uniformity, but in complementarity. By connecting capabilities across marine sciences, atmospheric sciences, biodiversity, geophysics, ecosystem monitoring and environmental data management, the network offers an unprecedented national asset for understanding environmental systems in their complexity.

The second layer comprises the integration environment established by ITINERIS HUB. This environment includes the digital, organisational and operational mechanisms that enable infrastructures to function as parts of a coordinated ecosystem rather than as isolated entities. Interoperability frameworks, metadata standards, semantic resources, common procedures, coordination mechanisms and shared

governance practices all contribute to this common layer. While often less visible than scientific facilities themselves, these functions are essential because they transform collaboration from an aspiration into an operational reality.

The third layer consists of the user-facing environment delivered through ITINERIS HUB, through which researchers, institutions and stakeholders interact with the Research Infrastructures' ecosystem. Through common discovery mechanisms, coordinated access procedures, digital services and collaborative environments, users can identify, access and combine resources distributed across multiple infrastructures without needing to navigate each organisation independently.

The value of the model emerges from the interaction between these three layers. Research Infrastructures contribute specialised capabilities, the integration environment enables coordination and interoperability, and the user-facing environment translates these capabilities into accessible services and opportunities for collaboration. Together they create a system whose value exceeds the sum of its individual parts.

At the centre of the model stands the ITINERIS HUB, the main asset generated through the project and the operational backbone that transforms a collection of autonomous infrastructures into a coordinated system.

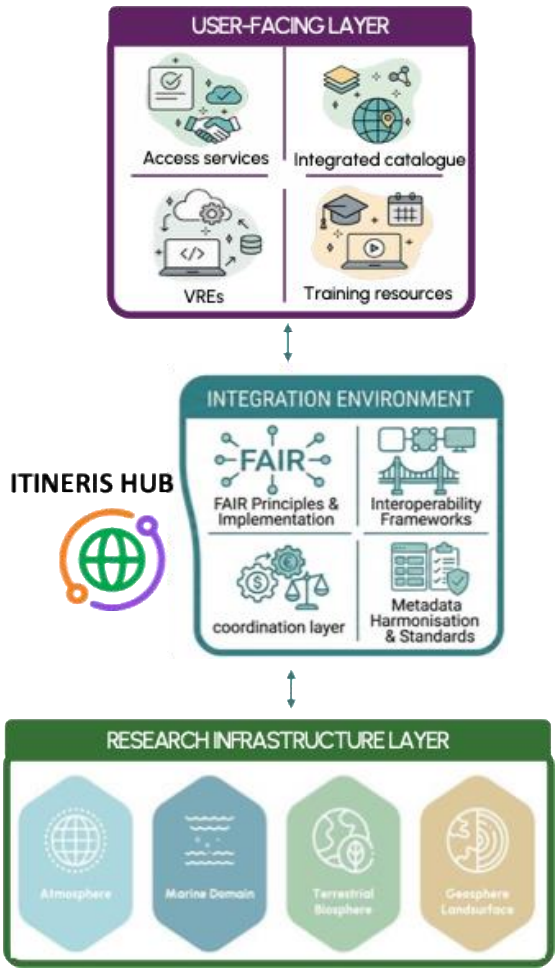

Figure 1 – Interconnected layers of the ITINERIS model

3.1 ITINERIS HUB

The ITINERIS HUB is much more than a digital gateway or a portal. It represents the shared environment through which participating Research Infrastructures become visible as part of a coherent national ecosystem and through which users can discover, access and combine distributed data, resources, services and expertise.

An important characteristic of the ITINERIS HUB is that it does not duplicate the repositories, digital platforms or services operated by the participating national and European Research Infrastructures. Instead, it acts as a federated gateway through which these distributed resources increase visibility and improve accessibility, while preserving their ownership and operational management within the respective infrastructures. At the same time, the common services developed through ITINERIS—such as interoperability tools, metadata services and coordinated access capabilities—can progressively be adopted and reused by participating Research Infrastructures whenever they provide added value at national or European level.

It provides a common entry point through which users can discover, access and navigate the capabilities, services and resources available across the network, which would otherwise remain distributed across multiple organisations, digital platforms and communication channels.

The HUB also performs a critical integration function. Environmental research increasingly depends on the ability to connect heterogeneous datasets, infrastructures and scientific domains. The HUB makes interoperability operational by providing the environment within which common standards, metadata frameworks, semantic resources and digital services can be effectively utilised. In this sense, interoperability is not merely a technical characteristic, but a practical capability experienced by users through the services accessible via the HUB.

Beyond its technical functions, the HUB also plays an important organisational role. It provides a common operational reference point for participating Research Infrastructures, supporting coordination activities, collaborative initiatives and the implementation of shared services. This role is particularly important in a federated environment where governance, responsibilities and resources remain distributed across multiple organisations.

Most importantly, the HUB enables capabilities that no individual infrastructure could provide independently. By connecting resources, communities and services across organisational and disciplinary boundaries, it creates the conditions for new forms of scientific collaboration, knowledge sharing and service integration. Its value therefore derives not only from the assets it contains but from the interactions it enables.

The scale of the ecosystem currently accessible through the HUB illustrates the practical significance of the integration effort achieved by ITINERIS. At the conclusion of the project, the HUB provides access to metadata describing more than 500,000 environmental datasets, over 300 research products, more than 600 training resources, 9 Virtual Research Environments supporting specific environmental research communities, and more than 60 service entries describing services, access opportunities and scientific capabilities provided by over 30 organisations operating across the participating Research Infrastructures and scientific domains, supporting physical, remote and hybrid access modalities.

These figures should not be interpreted as a definitive representation: the onboarding, harvesting and population processes associated with the HUB have only recently entered their operational phase following the completion of the core integration framework. As additional providers, datasets, services, resources and digital assets are progressively integrated, the volume, diversity and representativeness of the resources made available through the HUB are expected to increase significantly.

The strategic importance of the HUB therefore lies not only in the assets currently accessible through the platform, but also in its capacity to continuously aggregate, expose and connect resources distributed across the national environmental Research Infrastructure landscape. Conceived as a scalable and evolving integration infrastructure rather than a closed platform or static repository, the HUB is designed

to support the progressive onboarding of new resources, services and communities over time. While its current focus reflects the environmental domain addressed by ITINERIS, its architecture is sufficiently flexible to incorporate assets and capabilities from other scientific domains, creating the conditions for future cross-disciplinary research, innovation and collaboration at national and European levels.

3.2 Core components of ITINERIS HUB

ITINERIS HUB is not a single platform but a combination of interconnected components that collectively enable discovery, interoperability, collaboration and access. These constitute the common enabling layer upon which the ITINERIS model depends. Within this model, these components correspond to the four functional areas represented in the Integration Environment layer of the ITINERIS architecture (FAIR implementation, interoperability frameworks, metadata harmonisation, and coordination layer), which together provide the backbone of system-wide integration. User-facing functionalities are primarily delivered through the Service and Access Framework, which also integrates discovery and catalogue capabilities, and through Virtual Research Environments that provide the main operational space for users.

Coordination, governance and community networks

The coordination layer represents the overarching organisational dimension of the model, providing the governance structures, operational rules, and coordination mechanisms that ensure coherence across all other components of the ITINERIS HUB.

It encompasses governance arrangements, operational procedures, coordination mechanisms, community networks and specialised competencies developed throughout the project constitute equally important components of the common layer. These assets provide the organisational capacity required to sustain integration over time and ensure that collaboration remains effective beyond the project lifecycle.

Particularly important are the competencies developed in areas such as interoperability, FAIR implementation, metadata management, data stewardship, digital service provision, access coordination and governance. These capabilities represent a form of strategic infrastructure in their own right. Unlike physical assets, however, they can rapidly dissipate if continuity mechanisms are not established. Their preservation therefore represents a critical requirement for the long-term sustainability of the ITINERIS HUB.

The project has also generated a valuable network of relationships among Research Infrastructures, scientific communities and participating organisations. Through years of collaboration, partners have developed shared practices, common procedures and mutual trust that facilitate coordination and collective action. These intangible assets are difficult to replicate but are fundamental to the functioning of a federated ecosystem.

Taken together, the interoperability framework, metadata infrastructure, Virtual Research Environments, governance mechanisms, operational competencies and community networks form the enabling foundation of the ITINERIS HUB. They provide the capabilities through which the HUB operates, services are delivered and integration becomes possible.

Their collective value exceeds the sum of their individual components. Every improvement in interoperability increases the usefulness of available resources. Every enhancement of shared competencies strengthens the capacity of the ITINERIS HUB to evolve. Every new connection among infrastructures creates additional opportunities for collaboration and innovation.

Together, these components, anchored in the ITINERIS HUB, constitute the common layer whose preservation and evolution represent the central sustainability challenge addressed by this Business Plan.

Interoperability framework

Environmental research increasingly depends on the integration of heterogeneous datasets, observational systems and analytical approaches originating from different scientific domains.

Achieving this objective requires more than technological compatibility: it depends on a coherent interoperability framework capable of connecting distributed resources through shared architectures, common interfaces, metadata exchange mechanisms, semantic technologies, catalogue interoperability, harvesting services and coordinated onboarding procedures..

Within ITINERIS, the interoperability framework provides the technical and organisational infrastructure that enables participating Research Infrastructures to operate as a federated digital ecosystem while preserving their autonomy. It supports the discovery, exchange and integration of distributed resources, facilitates machine-to-machine interactions and enables cross-domain scientific workflows without requiring the replication of existing repositories or data services.

The interoperability framework should therefore be regarded as a strategic asset in its own right. Its value lies not in any individual technology but in its ability to connect previously disconnected resources and transform distributed resources into a coherent and usable ecosystem.

FAIR implementation

FAIR implementation constitutes a transversal capability of the ITINERIS HUB that translates FAIR principles (Findable, Accessible, Interoperable, Reusable) into operational requirements for data, metadata and digital services across participating Research Infrastructures.

FAIR implementation focuses on the internal quality and structure of the resources themselves, ensuring that data and services can be effectively discovered, accessed and reused across the ecosystem.

In operational terms, FAIR implementation supports the definition and adoption of shared metadata standards, data documentation practices, persistent identifiers, and minimum requirements for publication and onboarding of resources within the ITINERIS HUB. This ensures that datasets and services made available through the system are not only connected, but also usable in a consistent and machine-actionable way.

FAIR implementation therefore acts as the enabling layer that guarantees that interoperability mechanisms can function effectively, by ensuring that the resources exchanged within the ecosystem meet a common baseline of quality and semantic structure.

Virtual Research Environments

The Virtual Research Environments (VREs) developed through the project extends beyond the provision of computational resources or collaborative workspaces. VREs create integrated environments in which data, services, analytical tools and expertise can be combined to support complex scientific workflows spanning multiple disciplines and infrastructures.

By enabling researchers to work within shared digital environments, VREs transform interoperability into practical scientific capability. They facilitate multidisciplinary collaboration, support data-intensive research and provide mechanisms for using distributed resources as part of a coherent research process.

As environmental challenges increasingly require integrated approaches, VREs represent an important capability for supporting future scientific innovation and collaboration across Research Infrastructures and domains.

Service and access framework

While ITINERIS HUB and its common components provide the foundation of the ecosystem, services and access mechanisms represent the most visible manifestation of the value generated by ITINERIS HUB. Users may not directly perceive interoperability frameworks, governance arrangements or coordination mechanisms. They experience the ability to discover resources, access facilities, reuse data, collaborate through digital environments and obtain support for scientific activities.

ITINERIS HUB federates data, services, resources and access mechanisms originating from different infrastructures and organisations. The resulting framework combines both assets that remain under the responsibility of individual Research Infrastructures and resources developed in ITINERIS together common functions to support integration and cross-domain collaboration.

Therefore, the service portfolio can be organised into three broad categories: the datasets, facilities, observational systems, laboratories and specialised capabilities operated by the participating Research Infrastructures, which remain under their governance and responsibility; common "infrastructure" services of ITINERIS HUB including the catalogue, metadata, FAIR, interoperability and coordination functions that enable integration across infrastructures; user-facing integrated services that are the composite offerings that arise from combining RI resources and HUB services, such as cross-domain discovery, multidisciplinary workflows and coordinated access. The service portfolio should therefore be understood as an integrated service layer rather than as a catalogue of independent offerings. Its value derives not only from the individual resources available but from the ability to connect and combine them in ways that support multidisciplinary research, innovation and knowledge generation.

A central component of this framework is the **National Access Framework** (see Reference 8), the first coordinated national effort to provide access across a highly diverse environmental Research Infrastructure landscape. It was implemented and validated during the ITINERIS project, demonstrating the value of coordinated access mechanisms for users seeking to combine resources across infrastructures and domains.

Before ITINERIS, users typically interacted with infrastructures through separate procedures, different application mechanisms and heterogeneous access models. While appropriate for individual infrastructures, these arrangements often made the overall system difficult to navigate from the perspective of external users.

Access within ITINERIS is governed through a set of complementary instruments that collectively define the strategic principles, rules and operational mechanisms through which the ITINERIS HUB delivers coordinated access.

At the strategic level, the User Strategy (see Reference 8, Deliverable 2.1) ensures that service development, access provision and future investments remain aligned with the needs of researchers and stakeholder communities. The Access Policy (see Reference 8, Deliverable 2.16) establishes the common principles governing access to resources, promoting openness, transparency and alignment with the European Charter for Access to Research Infrastructures. Complementing these instruments, the ITINERIS HUB Data Policy (see Reference 8, Deliverable 2.20) defines the principles governing the management, discoverability, accessibility and reuse of data and metadata.

At the operational level, the framework is implemented through the ITINERIS Access Management Plan and Platform (see Reference 8, Deliverable 2.17 and 2.6), which supports the coordinated execution access procedures across participating infrastructures.

All these governance instruments are implemented through the National Access Framework, which translates strategic principles into coordinated procedures, workflows and access mechanisms applicable across participating infrastructures by providing common workflows and access management functionalities.

Within this architecture, the National Access Framework (see Reference 8, Deliverable 2.3), translates the strategic principles established by the governance instruments into coordinated procedures,

workflows and access mechanisms applicable across participating infrastructures, while the ITINERIS HUB provides the resource discovery and the operational environment through which these services are delivered to users.

Within this federated model, access to the same facilities and services may occur through different but complementary pathways, including the established access procedures of European Research Infrastructures and ERICs, as well as coordinated national initiatives supported by ITINERIS. These pathways do not represent separate sets of resources, but different governance and funding modalities applied to the same underlying scientific infrastructures. In this context, the ITINERIS National Access Framework complements European access schemes by supporting national-level coordination of access activities, particularly where integrated use of multiple Italian facilities, physical access campaigns, shared logistics and operational coordination are required. These aspects are not always fully addressed within European access programmes, which are primarily designed to support Trans-National Access to individual Research Infrastructures under their own governance frameworks. The ITINERIS approach therefore provides an additional coordination layer that facilitates integrated national access without replacing existing European mechanisms. At the same time, European Research Infrastructure resources remain fully accessible through their own governance frameworks, while the ITINERIS HUB makes them discoverable through a common metadata and service layer without duplicating the underlying repositories, data centres or access procedures.

The long-term objective is therefore not the complete standardisation but the sufficient coherence to allow users to navigate the system effectively. Improving the clarity, consistency and discoverability of access information will remain an important priority for the future evolution of the common framework.

4. USERS AND VALUE PROPOSITION

The long-term sustainability of the ITINERIS HUB ultimately depends on its ability to generate value for the communities it serves. The key question is therefore whether it creates benefits that would not otherwise emerge from the independent operation of the participating Research Infrastructures.

This question is more important than the number of participating infrastructures, the complex architecture or the volume of services offered. ITINERIS HUB remains sustainable only when it solves real problems for identifiable communities and generate benefits that justify the resources required to maintain them. Understanding the value proposition of the ITINERIS HUB therefore requires moving beyond a description of users and services to examine how value is created through integration.

4.1 User groups

The diversity of the ITINERIS HUB user groups reflects the diversity of environmental challenges themselves. Users include academic researchers, research groups, universities, public research organisations, environmental agencies, governmental bodies, policy-support actors, international initiatives, students, technology developers, private-sector and different organisations interested in environmental services and expertise. Different user communities interact with ITINERIS HUB in different ways. Some require access to observational facilities. Others seek datasets, analytical tools, training resources or specialised expertise. Increasingly, many users require combinations of resources that span multiple scientific domains.

USER GROUP	VALUE PROPOSITION & BENEFIT
 RESEARCH AND ACADEMIC COMMUNITIES	Research and academic communities, constitute the primary user of the ITINERIS HUB. Their main needs concern easy access to facilities, datasets, expertise and tools, as well as support for multidisciplinary collaboration and reuse of resources. ITINERIS HUB creates value for them by improving discoverability, reducing fragmentation, and enabling integrated scientific workflows across domains, supporting scientific capacity, improving access to shared services and reinforcing national research excellence.
 RESEARCH INFRASTRUCTURES	Participating Research Infrastructures are both providers and beneficiaries of the HUB. Their needs include greater visibility, harmonised access practices, stronger interoperability and reduced duplication of effort across common functions. ITINERIS HUB creates value for them by generating economies of scale through coordination, strengthening their positioning in national and European research ecosystems, and increasing opportunities for collaboration and funding.
 PUBLIC AUTHORITIES & POLICY STAKEHOLDERS	Public authorities and policy stakeholders need accessible, interoperable and actionable evidence. Their requirements include near-real-time or decision-relevant data, understandable outputs, and tools that can support environmental governance, risk management and evidence-informed policymaking. ITINERIS HUB creates value for them by making research capabilities more visible and usable, and by translating scientific resources into operational support for policy and territorial decision-making.
 INDUSTRY	Industry represents a strategic non-academic user group. Its main needs include access to specialised facilities, validation and testing environments, data, and opportunities for technology transfer and co-development. ITINERIS HUB creates value for industry by acting as an interface between research and market-oriented innovation, enabling access to experimentation, benchmarking and the development of more reliable and scalable solutions.
 INTERNATIONAL ORGANIZATIONS	International organizations and international initiatives need operational access to data and services, integration with global workflows, and collaboration across national and European research ecosystems. ITINERIS HUB creates value for them by improving interoperability, supporting the operational use of RI outputs, and strengthening cross-border cooperation and visibility.

4.2 Value proposition

The distinctive value proposition of the ITINERIS HUB lies in its capacity to transform a fragmented landscape of advanced but disconnected infrastructures into a coordinated national ecosystem. By serving as the common integration layer connecting users, resources, services and infrastructures across organisational and disciplinary boundaries, the HUB reduces fragmentation, increases visibility and accessibility, and generates forms of scientific and operational value that no individual infrastructure could produce independently. In doing so, it creates the conditions for future collaboration, innovation and value creation at both national and European levels.

The starting point of the value proposition is the recognition that fragmentation generates costs. These costs are often difficult to quantify because they are distributed across organisations, projects and scientific communities rather than appearing in a single budget line. Researchers spend time identifying facilities, expertise, datasets and services dispersed across multiple infrastructures. Research Infrastructures invest resources in maintaining separate communication channels, promoting their services independently and addressing challenges that are often common. Public institutions and external stakeholders frequently encounter a landscape rich in capabilities but difficult to navigate. In all cases, fragmentation reduces efficiency and limits the return on existing investments.

The value generated by ITINERIS HUB begins reducing these inefficiencies. By providing a common framework for discovery, access and interoperability, it lowers the transaction costs associated with scientific collaboration and resource utilisation. Facilities, datasets, expertise and services become easier to identify and access. Digital resources become more discoverable, interoperable and reusable. Scientific communities become more connected. Existing capabilities can therefore be utilised more effectively without requiring the creation of entirely new infrastructures or services.

However, the value generated by ITINERIS HUB extends well beyond efficiency gains. Environmental research increasingly depends on the ability to combine heterogeneous observations, datasets, analytical methods and disciplinary perspectives. Climate adaptation, biodiversity monitoring, ecosystem resilience, pollution assessment and natural hazard management all require forms of integration that individual infrastructures cannot provide alone. The common layer established through ITINERIS HUB creates the conditions under which previously disconnected capabilities can interact, generating scientific opportunities that would otherwise remain difficult or impossible to realise.

ITINERIS HUB therefore creates value at multiple levels. For researchers, it improves discoverability, access and opportunities for multidisciplinary collaboration. For participating Research Infrastructures, it increases visibility, interoperability and the utilisation of existing assets. For public authorities and policy-support actors, it provides a more coherent framework for accessing environmental knowledge, expertise and data resources. For the wider scientific community, it strengthens the capacity of the national environmental research system to address complex challenges through integrated approaches.

While these benefits are experienced by individual stakeholder groups, the strategic value of ITINERIS HUB is fundamentally systemic.

It creates benefits that cannot be fully attributed to any single service, infrastructure or activity. Value emerges from the interactions enabled by ITINERIS HUB and from the capacity of the network to transform dispersed capabilities into a coherent national asset. The more effectively infrastructures interact, the greater the value generated for all users. The more visible and interoperable resources become, the greater their utilisation and impact. The more communities participate, the stronger the network effects that support future growth and innovation.

Beyond its direct operational benefits, ITINERIS HUB is not only a service platform, but also a strategic public asset that supports the collective use of research investments and their translation into long-term societal impact.

4.3 User strategy

The ITINERIS User Strategy (see Reference 8, Deliverable 2.1), developed through a multi-step methodological framework and validated across the project lifetime, provides a solid empirical basis for the value proposition set out in this Business Plan. User communities have been identified, engaged and tested through coordinated access mechanisms, thematic panels and capacity-building activities, demonstrating that ITINERIS HUB responds to concrete societal and scientific needs across research, policy, industry and international cooperation.

In this perspective, the user base should be understood not as a static list of categories, but as a dynamic community whose needs and expectations continuously inform the evolution of ITINERIS HUB and its service portfolio. The implications are twofold. First, value creation depends on the ability to make services, data and access pathways understandable and usable for heterogeneous audiences, adopting tailored approaches. Second, long-term sustainability depends on systematic analysis of user behaviour, user satisfaction and emerging demand patterns, so that the evolution of ITINERIS HUB and its service portfolio can be continuously driven by actual use and strategic relevance.

The transition from project implementation to long-term operation requires, therefore, a corresponding transition in service management. During the project phase, the primary objective was the development and integration of services. In the post-project phase, the focus shifts towards service governance, prioritisation and continuous improvement. This implies the adoption of portfolio-management practices capable of monitoring service usage, user satisfaction, operational sustainability and strategic relevance.

Such an approach is particularly important within ITINERIS where services originate from different infrastructures and evolve at different speeds. Some services perform foundational functions essential to the operation of ITINERIS HUB, while others address specific scientific communities or emerging needs. The objective is not simply to maintain a catalogue of services, but to ensure that the service portfolio delivered through the HUB continues to evolve in alignment with user demand, technological developments and strategic priorities.

For this reason, the long-term sustainability of ITINERIS HUB depends not only on maintaining infrastructures and platforms, but also on preserving the capacity to deliver a coherent, reliable and evolving portfolio of services capable of generating value for its communities over time.

5. GOVERNANCE AND OPERATING MODEL

The governance model defined in this Business Plan applies exclusively to the ITINERIS HUB. In this model the Research Infrastructures committed to the its long-term operation collectively defines its priorities, coordinate its development and assume shared stewardship of its core assets, steering its evolution towards a permanent national Research Infrastructure. The conclusion of the ITINERIS project therefore marks a fundamental transition from project governance to infrastructure governance.

The National Research Council of Italy (CNR), as coordinating institution of the ITINERIS project, provides continuity between the project implementation phase and the long-term operational framework. CNR conceived, designed and coordinated the development of the ITINERIS HUB: as custodian of this shared asset, CNR hosts and maintains its physical and digital infrastructure and provides the core coordination functions required to safeguard its operation, support its evolution and ensure the continuity in collaboration with the participating Research Infrastructures.

The long-term governance model shall be organised as a multi-level framework combining strategic, scientific, technical and operational responsibilities.

- The Scientific Coordinator, provides the overall scientific leadership of the ITINERIS HUB, ensuring that its evolution remains aligned with the scientific priorities of the participating Research

Infrastructures and with national and European research strategies. The Scientific Coordinator promotes and supports strategic planning, represents the infrastructure within the scientific community and chairs the Research Infrastructures Board.

- The Infrastructure Manager is responsible for the operational management of the ITINERIS HUB. The role includes coordinating the implementation of strategic priorities, supervising day-to-day operations, managing the Coordination Office, overseeing service delivery, monitoring performance and ensuring the continuity and evolution of the common infrastructure.
- The Research Infrastructures Board (RIB) is composed of representatives of the Research Infrastructures actively contributing to sustainability, development and operation of ITINERIS HUB. The Board provides the scientific and technical interface between ITINERIS HUB and the participating Research Infrastructures, ensuring that priorities, interoperability developments and service evolution remain aligned with the needs of the national and European RI landscape.
- Distributed Service Network. The operation of the ITINERIS HUB is supported by a distributed network of technical and scientific experts across the participating organisations and Research Infrastructures, operating within a coordinated framework to deliver and continuously evolve the core services of the HUB, including data integration and interoperability, Virtual Research Environments, the service catalogue and the access services, thereby ensuring the continuity and progressive development of the common service layer.
- Advisory Board: provides on request independent scientific and strategic advice on the long-term development of ITINERIS HUB, emerging technologies, international positioning and future research priorities.
- User Forum: represents the perspective of the scientific community and other stakeholder groups, providing structured feedback on user needs, service quality, emerging requirements and future priorities.

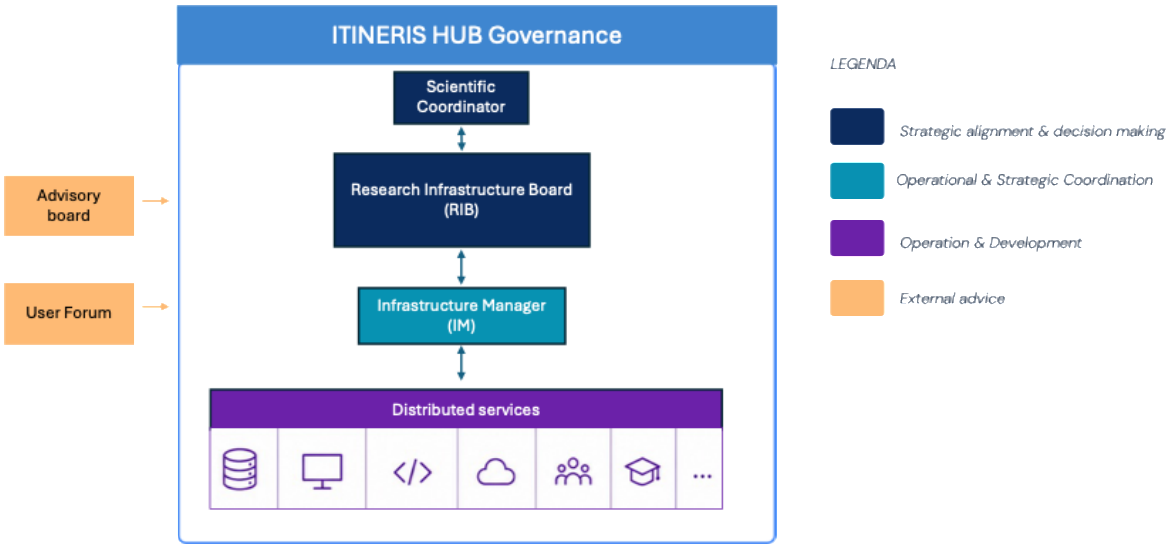

Figure 2 - ITINERIS HUB Governance

Decision-making authority shall rest with the Research Infrastructures committed to the continuity and development of ITINERIS HUB, while other project partners remain engaged through their obligations under the continuity agreement regarding the maintenance of the project's outputs and through their respective operational contributions.

6. FINANCIAL SUSTAINABILITY MODEL

The financial sustainability model presented in this Business Plan focuses exclusively on the long-term continuity and evolution of the ITINERIS HUB as the operational and common asset developed within the project, along with its interoperability services, metadata management systems, coordinated access mechanisms, Virtual Research Environments, governance functions, operational coordination activities and the technical and scientific competencies required to maintain and evolve these functions over time.

These assets constitute the integration layer that enables participating Research Infrastructures to operate as a coordinated national ecosystem, increasing visibility, facilitating access, supporting interoperability and enabling collaboration across scientific domains. Because these functions operate across organisational boundaries, they cannot be sustained by individual Research Infrastructures acting independently.

This Business Plan does not address the long-term financial sustainability of the scientific infrastructures, observational systems, laboratories and other distributed assets strengthened through the ITINERIS project. These investments have now been embedded within the participating Research Infrastructures and are expected to be maintained through their respective institutional, national or European sustainability mechanisms, depending on the governance model of each infrastructure. This represents a major strength of the ITINERIS model, as it ensures the long-term continuity of the scientific resources, datasets, services and research products that feed the ITINERIS HUB. The financial sustainability challenge addressed here therefore concerns the common integration layer that connects these distributed resources into a single operational ecosystem.

The financial sustainability model is based on the long-term operational estimates developed during the ITINERIS design phase and updated to reflect the transition from project implementation to operational continuity. It is grounded in the Research Infrastructure lifecycle approach defined by ESFRI (see Reference 3), ensuring that estimates are aligned with the different phases of development, operation and consolidation of distributed infrastructures.

The estimates provide a baseline for assessing the resources required to preserve the ITINERIS HUB, referring exclusively to the resources needed to ensure the operational continuity during the ten years following project closure. All projections are based on current prices, without making any evaluation of future inflation rates. Estimates do not include possible future needs that may arise once the ITINERIS HUB enters full operational regime: in particular, they do not account for a potential increase in demand, the expansion of user communities, or the development of new functions and services that may become necessary in response to emerging scientific priorities and evolving stakeholder needs. Such developments are expected to be accompanied by dedicated funding opportunities and/or additional revenue streams specifically supporting their implementation and should therefore be considered separately from the baseline operational costs presented in this Business Plan. At the same time, financial sustainability cannot be assessed exclusively through ex-ante projections. Several key variables—including user adoption, service demand, interoperability usage, stakeholder engagement and cross-domain reuse of services—can only be evaluated through operational experience. For this reason, the first post-project operational phase should also function as a period of evidence generation during which assumptions regarding costs, demand and resource requirements are progressively validated.

6.1 Financial Plan

The financial estimates reported below refer to the resources required to ensure the long-term continuity of the ITINERIS HUB over the 10 years starting from the end of the ITINERIS project.

Costs

The financial sustainability of the HUB cannot be reduced to standard ICT maintenance logic applied to isolated systems. It requires instead the preservation over time of a fully integrated technology stack, supported by dedicated personnel and recurring operational expenditures.

Personnel in the estimate accounts for the executive management of the network, the administrative personnel for coordination, the technical personnel required to manage the HUB applications, repositories and interoperability services, the technical personnel needed to operate and maintain the ICT backbone and its core components, as well as the staff required to further develop ITINERIS HUB and ensure continuity of service.

Extraordinary maintenance costs include preventive and corrective maintenance, predictive maintenance and technological upgrades, as well as the replacement or renewal of critical ICT components within the assumed four-year refresh cycle.

Recurring costs include: costs for ordinary maintenance, the software stack, licenses, hosting environments and operational support required to keep the distributed digital backbone functioning; consumables, mainly costs related to generic office supplies, everyday materials; utilities and operational services, mainly energy consumption, cloud and hosting-related utilities, and other operational inputs needed to keep the data infrastructure and equipment functioning.

Table 1 – Estimated operational costs of ITINERIS HUB over 10 years

Funding Source	Amount in 10 Years
Personnel	20 FTE / year
Extraordinary maintenance	20.0–24.0 Mln €
Recurring costs	3.0 Mln €

Revenues

The long-term operation of the ITINERIS HUB requires a diversified funding model. No single funding source is expected to provide sufficient stability to support the common operational layer over time. Financial sustainability therefore relies on a balanced combination of institutional commitments, competitive funding and, progressively, revenues generated through advanced services and collaborative activities.

A significant element supporting the sustainability of ITINERIS HUB is the formal commitment established among the participating organisations. Under the partnership agreement signed under Article 15 of Italian Law 241/1990, the partners agreed to continue their collaboration for at least ten years beyond the completion of the project and to contribute to the preservation and operation of the resources developed through ITINERIS. While such commitments do not replace the need for dedicated funding mechanisms, they provide an important institutional guarantee for the long-term continuity of ITINERIS HUB.

Competitive funding represents a complementary pillar. The RIs participating in ITINERIS demonstrated their ability over the years to attract grants from competitive calls (national and/or European funds) and develop contracts with national and international agencies for the provision of commercial and R&S services. Considering the leverage effect due to the increased attractiveness and potential of ITINERIS HUB, its long-term sustainability can be envisaged through the positive contribution of EU and national competitive projects (~50%) and revenues from collaboration agreements and provision of services (~5%) emerging from the progressive development of advanced services capable of generating additional resources.

Table 2 – Estimated revenue for ITINERIS HUB by source over 10 years

Funding Source	Share of total costs
Institutional funding	50%
Competitive National and European projects	45%
Service provision and collaboration agreements	5%

7. RISK FRAMEWORK

The sustainability challenge facing ITINERIS HUB concerns the continuity of the common layer that enables participating Research Infrastructures to function as a coordinated ecosystem. It does not primarily concern the sustainability of the individual infrastructures themselves, which retain their own governance arrangements, funding mechanisms and development strategies. The focus is therefore on preserving the capabilities embedded by the HUB that create value through integration, interoperability and coordination.

The principal risk is therefore the gradual erosion of the integration capacity created through the project. A weakening of governance, coordination, interoperability services, technical competencies or stakeholder engagement would not threaten the existence of individual infrastructures but could progressively reduce the value generated through federation. For this reason, risk management should be embedded within the governance framework of ITINERIS HUB through a limited set of strategic indicators capable of monitoring the health of the common layer and providing an early-warning mechanism for decision makers to address them before they compromise performances of ITINERIS HUB.

The framework presented below identifies the main strategic risk categories, associated mitigation measures and key indicators to support long-term sustainability.

A more detailed quantitative assessment should be undertaken after the first post-project operational cycle, when additional operational evidence becomes available.

RISK AREA (Strategic Level)	POTENTIAL IMPACT	EARLY WARNING INDICATORS (Examples)	MITIGATION MECHANISMS (Examples)
1. Continuity of the ITINERIS HUB	• Loss of integration, coordination and interoperability would reduce the value generated by the federation.	• Decreasing participation of Research Infrastructures • Reduced engagement in governance activities • Lower use of common services and HUB • Declaring cross-domain collaborations	• strengthen governance and stewardship through the appropriate governance bodies • Maintain interoperability services • Foster community engagement and visibility
2. FINANCIAL SUSTAINABILITY	• Lack of stable and adequate resources would undermine the continnity of coordination, services and governance functions.	• Absence of dedicated long-term funding • Delays in resource allocation • High dependence on short term projects • Insufficient coverage of operational costs	• Diversify funding sources • Seek institutional recognition (e.g. RI status) • Establish multi-year commitments • Develop value-added services where appropriate
3. COMPETENCY RETENTION	• Loss of critical expertise would reduce the ecosystem's ability to evolve, maintain quality and innovate.	• Reduction of key personnel • Limited knowledge transfer activities • Ageing workforce without succession plan • Decrease in training and capacity building	• Retain key staff and critical roles • Promote knowledge transfer and documentation • Invest in training and capacity building • Create career paths within the ecosystem
4. OPERATIONAL PERFORMANCE	• Reduced service quality or interruptions would negatively effect user trust and ecosystem attractiveness.	• Service interruptions or degradations • Increased response times • Decrease in user satisfaction • Backlog in support or maintenance requests	• Implement service monitoring and SLAs • Ensure adequate operational resources • Standardize operational procedures • Strengthen user support functions
5. TECHNOLOGICAL EVOLUTION	• Technological obsolencence or lack of updates could compromise accessibility, interoporability and security.	• Outdated technologies or platforms • Delays in upgrades and maintenance • Security vulnerabilities • Decrease in compatibility with external systems	• Maintain a technology roadmap • Plan regular updates and maintenance • Adopt open standards and best practices • Monitor emerging technologies
6. INSTITUTIONAL COMMITMENT	• Reduced engagement or unclear responsibilities could weaken collective decision-making and contemity.	• Decreased participation in governance bodies • Changes in organisational priorities • Lack of clarity in rules and responsibilities • Delays in decision-making processes	• Formalize cormaliments (e.g. Art.15 agreement) • Ensure transparent governance • Define clear roles and responsibilities • Maintain regular communication and alignment
7. EXTERNAL CHANGES	• Changes in the scientific, technological or policy landscape may affect relevance and demand for services.	• New emerging user needs • Changes in policy or funding landscapes • New competitors or alternative solutions • Shifts in scientific priorities	• Monitor external trends and policies • Engage with users and stakeholders • Ensure adaptive planning and flexibility • Foster strategic partnerships

Figure 3 - ITINERIS risk framework

8. MONITORING FRAMEWORK

The transition of ITINERIS from a project-funded initiative to a sustainable national capability requires not only governance, funding and operational continuity, but also the ability to monitor whether the ITINERIS HUB continues to generate value over time. Performance measurement should therefore be regarded as a strategic management function rather than a reporting exercise.

Research Infrastructure indicators typically focus on scientific outputs, service provision or infrastructure utilisation. While these remain relevant, they are not sufficient to assess the performance of a federated ecosystem. The primary objective of ITINERIS is not simply to deliver services but to increase the collective effectiveness of participating infrastructures through integration, interoperability and coordination. Consequently, the KPI framework must focus on the health and evolution of the ITINERIS HUB, in line with relevant international standards provided by OECD[1]and ESFRI[2].

The purpose of the framework is threefold:

- to provide evidence on the value generated by ITINERIS HUB;
- to support governance and strategic decision-making;
- to identify emerging risks and priorities for intervention.

For this reason, the proposed KPI framework focuses on a limited number of key indicators capable of capturing the most important dimensions of ITINERIS HUB performance. Their primary function is to support decision-making and adaptive management throughout the post-project phase. A decline in interoperability indicators, for example, may signal the need for additional investment in integration activities. Reduced participation in governance processes may indicate weakening institutional engagement. Similarly, growing user demand may justify further service development and expansion.

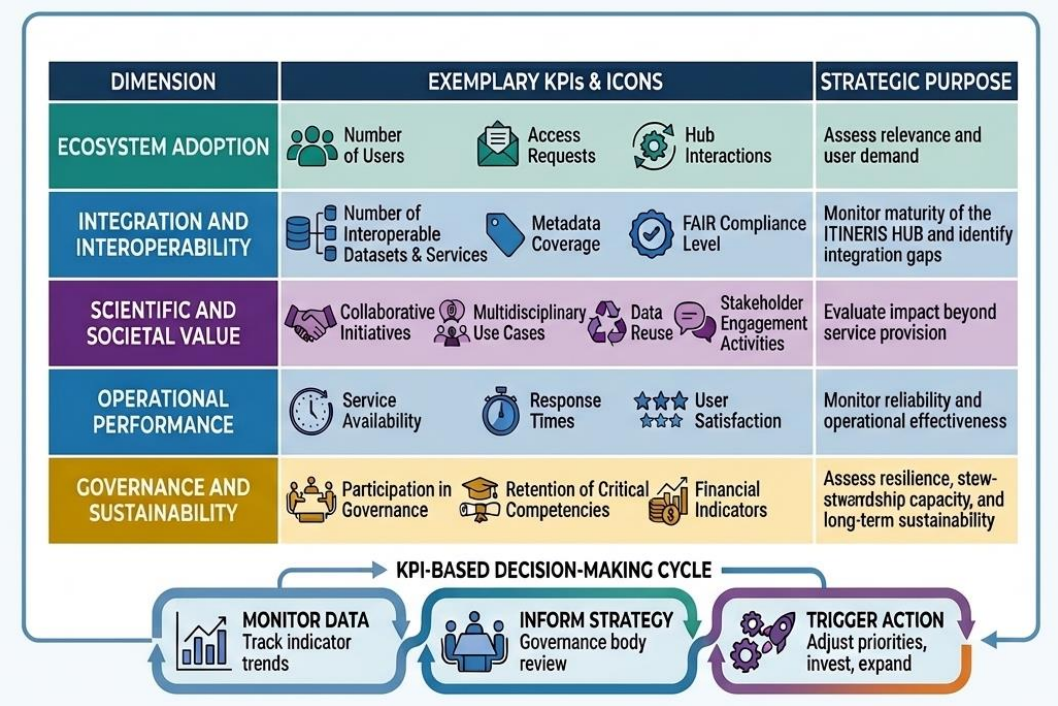

Figure 4 - ITINERIS monitoring framework

A complete assessment of the ITINERIS HUB performance will only become possible after the transition to the operational phase. Many strategic indicators, particularly those related to long-term adoption,

[1] OCSE. Reference framework for assessing the scientific and socio-economic impact of research infrastructures
[2] ESFRI, ESFRI Landmark Monitoring 2022-2024

sustainability, cross-domain collaboration and socio-economic impact, require observation over multiple years. For this reason, the KPI framework should be regarded as an evolving system that will be progressively refined as additional operational evidence becomes available.

Beyond scientific production and service provision, the KPI framework should also progressively incorporate indicators capable of capturing the broader public value generated by the ITINERIS HUB, including support to environmental policies, societal engagement, technological innovation, capacity building and contributions to national and European strategic priorities.

The KPI framework should be implemented through a structured annual monitoring process coordinated by the ITINERIS HUB Coordination Office. KPI data should be collected, consolidated and analysed on a yearly basis to support reporting to the governing bodies, assess progress against strategic objectives, identify emerging risks and inform future planning.

9. STRATEGIC ROADMAP

While KPIs provide evidence, the roadmap provides direction. The roadmap should not be interpreted as a rigid implementation plan but as a framework for prioritisation, guiding decisions during the post-project phase. To capture the full complexity of the common layer enabled by ITINERIS, the strategy is measured and structured across four distinct dimensions: Governance, Services, Users, and Infrastructure, with varying levels of intensity for each phase.

The immediate priority following the conclusion of project funding is the preservation of the ITINERIS HUB and its interoperability services, governance functions, operational coordination mechanisms and critical competencies. Success during this phase is measured primarily through stability and operational continuity rather than growth.

Once continuity is secured, attention will shift towards strengthening the effectiveness of the ITINERIS HUB. Priorities include improving service quality, increasing user engagement, enhancing interoperability, refining governance processes and expanding the utilisation of existing capabilities. The objective is to promote mature and reliable operational services.

The final phase focuses on strategic growth. This may include the integration of additional communities and infrastructures, the development of new services and Virtual Research Environments, stronger alignment with EOSC and European initiatives, and the exploitation of emerging scientific and technological opportunities. Expansion should, however, remain conditional upon the preservation of the core functions and coherence of ITINERIS HUB.

These phases should not be interpreted as rigid chronological stages. In practice, preservation, consolidation and growth activities may coexist, although with different levels of priority and resource intensity over time. The roadmap, therefore, represents an evolution of strategic focus rather than a fixed implementation schedule.

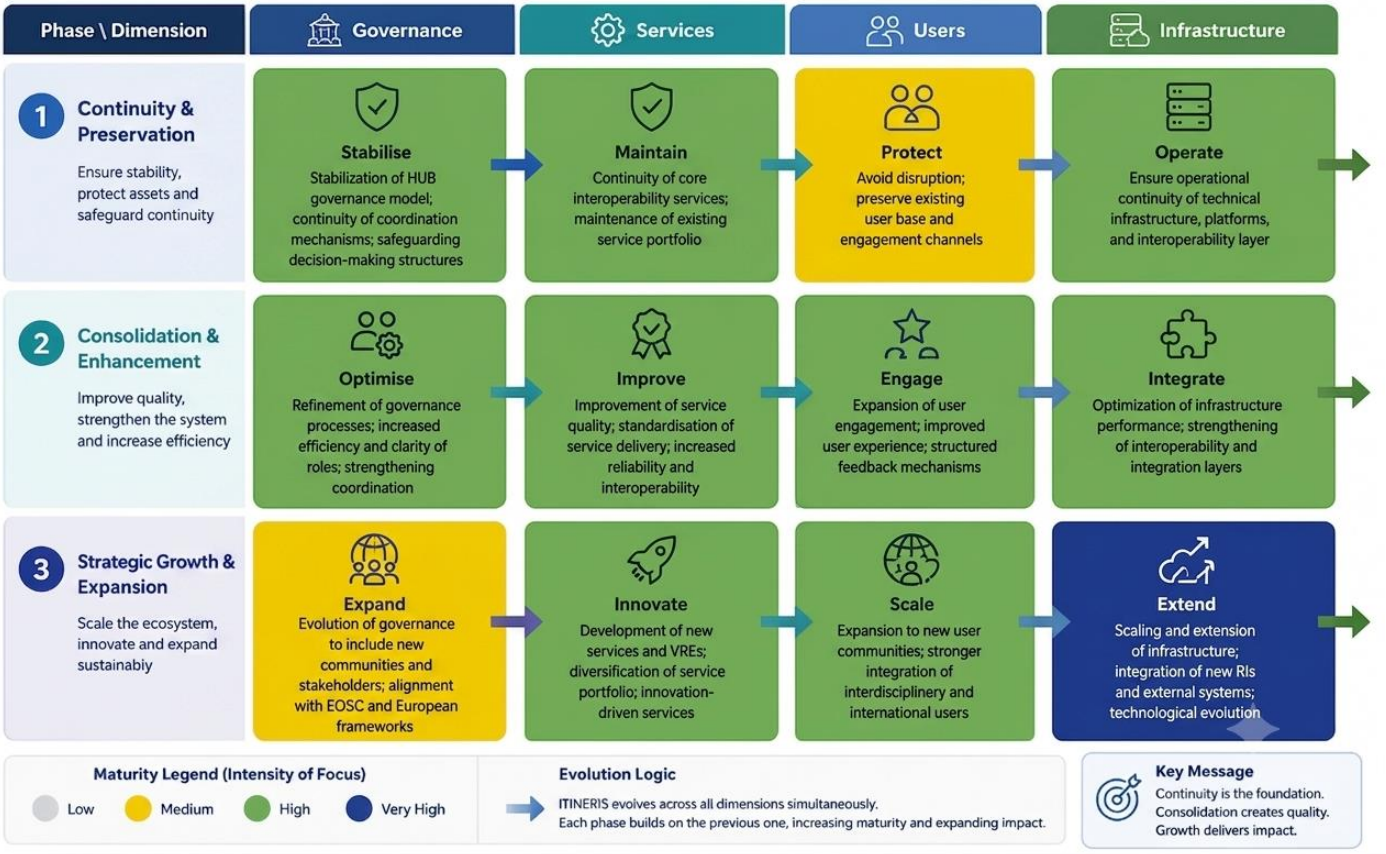

Figure 5 - ITINERIS roadmap matrix

10. CONCLUSIONS

The first operational phase of ITINERIS is decisive because it marks the transition from project delivery to long-term operation. Its main purpose is to preserve and consolidate the ITINERIS HUB, along with its interoperability services, access mechanisms, governance functions and coordination activities.

During this phase, the principal challenges concern the stabilisation of governance arrangements, the mobilisation of sustainable resources and the continued onboarding of providers, datasets, services and digital assets. The transition to the post-project phase should focus, therefore, on a limited number of strategic priorities.

The first priority is the consolidation of the governance framework. This includes defining the composition and responsibilities of the governing bodies and establishing activity plans. Governance should provide a stable framework for shared stewardship while remaining capable of adapting to evolving scientific, technological and institutional contexts.

The second priority concerns financial sustainability. The financial model presented in this Business Plan should be regarded as a baseline for the first operational phase, combining institutional support, in-kind contributions and competitive funding opportunities that may be mobilised through the consolidation and expansion project. Particular attention should be devoted to preserving the digital backbone and the core functions of the HUB, ensuring the availability of the technical and organisational competencies required for continuity.

The third priority is the generation of operational evidence through monitoring and continuous onboarding of new providers, datasets, services and digital assets into the ITINERIS HUB. This is essential because the strategic value of the HUB depends not only on preserving what is already available, but also

on its ability to expand progressively and remain representative of the wider environmental research landscape.

The participating Research Infrastructures and their host organisations will continue to be responsible for the sustainability of their own facilities, services and scientific activities. At the same time, their continued commitment to the shared governance and development of the ITINERIS HUB will be essential to preserve the collective value generated through federation.

This Business Plan therefore represents more than a roadmap for post-project continuity. It provides the strategic framework for transforming the ITINERIS HUB from a successful project outcome into a permanent national research infrastructure for environmental research. Through coherent governance, systematic monitoring, sustainable financing and the continued engagement of participating Research Infrastructures, the HUB is positioned to evolve into a new national Research Infrastructure, strengthening coordination, interoperability and access across the Italian environmental research ecosystem while increasing Italy's contribution to the European Research Area.

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