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JERICO-DS DELIVERABLE

Joint European Research Infrastructure of Coastal Observatories - Design Study

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EXECUTIVE SUMMARY

After more than 10 years of fruitful partnerships, JERICO-RI aims to provide an integrated solution in Europe to face the challenges of the coastal marine systems due to natural and anthropogenic stressors by supporting, with high-quality integrated data of the coastal areas and related services, European initiatives such as the EU Marine Strategy Framework Directive, the EU Water Framework Directive, the Regional Seas Conventions such as OSPAR and HELCOM and consortiums such as ICES, among others.

The community identified the need to create a JERICO e-infrastructure**,** formerly known as e-JERICO, that would support JERICO-RI activities. Two phases laid the foundation and the concepts for the full-scale technical development of eJERICO: first, the JERICO Coastal Ocean Resource Environment Pilot (JERICO-CORE Pilot), was designed to respond to the necessity of creating a common digital framework that includes a Virtual Research Environment (VRE) and Thematic Services (TS). After this pilot phase, the Design Phase was the responsibility of JERICO-DS project supporting the Design Study towards a structured operational European RI included in the European Strategy Forum on Research Infrastructures (ESFRI) roadmap. WP3 from JERICO-DS studied the key aspects for the design, implementation, and operation of e-JERICO in the long term, based on the lessons learned from JERICO-CORE pilot.

This document, Deliverable D3.5: The e-JERICO Strategic Plan, presents the outcomes of the Design Phase and is the result of Task 3.7 of JERICO-DS whose objective was to develop the e-JERICO Strategic Plan aligned with the general JERICO-RI' strategy as well as with the strategies from national and international leading organisations and stakeholders in the coastal ocean. Accordingly, this deliverable D3.5 presents the e-JERICO Strategic Plan structured in four well defined phases: design, implementation, operation and closing.

After an initial introductory section, section 2 presents an in-depth analysis of the e-JERICO framework, including the analysis of the current status together with the gaps and experiences gained from the design and execution stages of the JERICO-CORE pilot, as well as the specific achievements developed in support of e-JERICO. The outcomes for a sustained e-JERICO have been also studied and include an analysis of the e-JERICO requirements, technical solutions, governance strategy and operational approach. Finally, five working streams along the process of implementing the e-JERICO roadmap have been identified and the developments of e-JERICO along the ESFRI Roadmap phases described in detail.

Section 3 describes the detailed e-JERICO project planning along the four phases described in the ESFRI Roadmap: preparatory, implementation, operational and closing. For each one of them, detailed milestones, initial planning and outcomes together with a useful visual summary are presented.

Section 4 presents the economic analysis, the schedule & resource planning for the different components of e-JERICO and, using different scenarios, shows for all of them the benefits and added value of synergies and collaboration between EU Research Infrastructures.

Section 5 explains the risk strategy and presents a mitigation plan, emphasising the project's proactive approach to managing potential challenges and uncertainties. Finally, section 6 outlines the major conclusions.

1. Introduction

The coastal ocean environments are important for our society because many communities depend to a large degree on oceans, seas, and coastal biodiversity for their livelihoods. They provide an inestimable source of economic, social, and cultural wealth. However, they are largely influenced by climate change and other local stressors such as pollution and overfishing. Understanding the impact of these global and local pressures requires managing and assessing observational marine and coastal data, models, and other resources involved in the creation, analysis, and management of reliable data.

To address this challenge in European Seas at different spatial and temporal scales, the **J**oint **E**uropean **R**esearch **I**nfrastructure network for **C**oastal **O**bservatory (JERICO) was established as an integrated pan-European multidisciplinary and multi-platform Research Infrastructure (RI) dedicated to develop a holistic appraisal of coastal marine system changes.

JERICO-RI therefore aims to provide an integrated solution in Europe to face the challenges of the coastal marine systems due to natural and anthropogenic stressors by supporting, with high-quality integrated data of the coastal areas and related services, European initiatives such as the EU Marine Strategy Framework Directive, the EU Water Framework Directive, the Regional Seas Conventions such as OSPAR and HELCOM and consortiums such as ICES, among others.

To reach these goals, several coastal marine RIs in Europe started JERICO in 2011 as a joint effort to perform a systematic approach to monitor, observe, explore, and analyse coastal marine systems in order to reach reliable information of their structure and functioning in the context of global change. This cooperation has been and is being pursued within a cluster of projects now for more than 10 years:

- JERICO (2011-2015, FP7) focused on harmonising and integrating infrastructures and technologies such as moorings, drifters, ferrybox and gliders and paved the way for JERICO-NEXT.
- JERICO-NEXT (2015-2019, H2020) strengthened and enlarged the JERICO network and the interconnection between physics, biogeochemistry and biology.
- JERICO-S3 (2020-2024, H2020) builds on JERICO-NEXT to enhance the current value and relevance of the JERICO-RI, through the implementation of the science and innovation strategy previously defined.
- JERICO-DS (2020-2023, H2020) supports the Design Study towards a structured operational European RI supported by the EU Member States (and associated members) and the European Commission (EC), and as a high-value RI at EU level as part of the European Strategy Forum on Research Infrastructures (ESFRI) roadmap.

The JERICO consortium is now an advanced community and aims to build and implement a sustained and efficient JERICO-RI. In its mission to provide valuable insights and recommendations to guide the ESFRI preparation phase in the early stages of the project, JERICO-DS will leverage EU and nations legacies with coastal national RIs, propose innovative design solutions and business plan scenarios, selecting the ones that would optimally respond to national strategies and the pan-EU strategy of JERICO-RI.

For this purpose, the community identified the need to create a **JERICO e-infrastructure**, formerly known as **e-JERICO,** that would support JERICO-RI activities. Two phases laid the

foundation and the concepts for the full-scale technical development towards the ESFRI roadmap: a pilot phase and a design phase. As explained briefly below, these two phases happen during the JERICO-S3 and JERICO-DS projects.

First, the e-JERICO pilot was developed in the context of the JERICO-S3 project. This pilot, commonly referred to as the JERICO **Coastal Ocean Resource Environment** Pilot (**JERICO-CORE Pilot**), was designed to respond to the necessity of creating a common digital framework that includes a Virtual Research Environment (VRE) and Thematic Services (TS).

Following this initial pilot phase, the design phase was the responsibility of WP3 of JERICO-DS that studied the key aspects for the design, implementation, and operation of e-JERICO in the long term, based on the lessons learned from JERICO-CORE pilot. The interaction of the JERICO-RI team with the stakeholders was also key for the implementation and development of the roadmap from different perspectives including the collection of further requirements at different levels, from European to national and regional levels. Key aspects complemented the analysis of these requirements were access, and security policies, metrics, data management, and operation plans. This document, the e-JERICO Strategic Plan - Deliverable D3.5 - presents the outcomes of this design phase, and is the result of task 3.7 of JERICO-DS which was described as follows in the DoW:

> ***Task 3.7: Design of the e-JERICO implementation roadmap (M12 - M36) (SOCIB, SMHI, All nations)***
> *This task will create the e-JERICO Strategic Plan that will establish clear initiatives for action plans to (1) fulfil the implementation phase of the e-needs for the ESFRI roadmap 2021, (2) implement the e-JERICO technical design and operational plan, and (3) allow and encourage evolution of scientific and technical requirements for future implementations. The outcomes from Task 3.1 e-JERICO Requirements, Task 3.2 Policies, Task 3.3 Technical Design, Task 3.4 Operational Plan, Task 3.5 e-JERICO added value products data management plan, and Task 3.6 KPIs, will be incorporated in the e-JERICO Strategic Plan during the development of the overall Business Plan created in Task 4.8-D4.3. The e-JERICO capability development, and progress along the e-JERICO implementation roadmap, will be communicated through the consortium and the user community as part of the JERICO-RI communication strategy (Task 6.4).*

Therefore, task 3.7 aims to develop the e-JERICO Strategic Plan of course aligned with the general JERICO-RI' strategy as well as with the strategies from national and international IT facilities, including Blue-Cloud, aiming to be the marine part of the EOSC (European Open Science Cloud), SeaDataNet, EMODnet and the Copernicus Marine Service, among others. Accordingly, task 3.7 established initiatives to: (1) Fulfil the preparation and implementation phases of the needs for the ESFRI roadmap; (2) Prepare the operational phase of the ESFRI roadmap; and (3) Allow and encourage evolution of scientific and technical requirements during the operation phase.

This deliverable D3.5 therefore presents the e-JERICO Strategic Plan along the design, implementation, operation and closing phases. The report is structured as follows: Section 2 presents an in-depth analysis of the e-JERICO framework, which includes the analysis of the current status and describes the working streams and distinct phases of the e-JERICO Strategic Plan. Section 3 describes a detailed project planning, covering critical milestones and outcomes derived from the JERICO-S3 and JERICO-DS initiatives. Section 4 explores the essential aspects of funding including cost estimates, budgets estimates to e-JERICO in various funding scenarios and the current sources of funding. Section 5 explains the risk

strategy and presents a mitigation plan, emphasising the project's proactive approach to managing potential challenges and uncertainties. The last section presents the conclusions of this analysis.

2. Framework of e-JERICO

2.1. Analysis of Current Status

2.1.1. JERICO-CORE Pilot

The development of an e-infrastructure for JERICO activities was a request from stakeholders at the end of JERICO-NEXT and was accordingly included in JERICO-S3 and JERICO-DS projects. JERICO-S3 successfully designed and implemented an initial step of the e-JERICO, the **JERICO-CORE pilot, which currently operates as a Virtual Access platform** within the framework of WP11 of JERICO-S3. The detailed implementation of this pilot can be found in deliverable D7.6 [1], "Documentation of JERICO-RI e-infrastructure and capabilities". This D7.6 deliverable describes the insights and experiences gained from the design and execution stages of the JERICO-CORE pilot.

The co-design process of JERICO-CORE pilot started with an in-depth exploration of the international context, involving engagement with stakeholders and key partners experienced in similar infrastructures. It encompassed an aggregation of requirements gathered during initial interactions, as well as the conceptual framework of e-JERICO, which emerged from these early stages. Deliverable D7.6 [1] includes the details of this co-design process with the analysis of the international landscape, incorporating interactions with stakeholders and experts from comparable infrastructure endeavours. It included a synthesis of needs and requirements identified during preliminary engagements, together with the development of the JERICO-CORE pilot's conceptual framework. Furthermore, deliverable D7.6 offered an in-depth review of current infrastructures and technologies that supported the architectural design of JERICO-CORE pilot and the long term e-JERICO infrastructure. D7.6 further explored the implementation aspects, shaped by the architectural plan, while taking into account the project's resource allocation and overall scope. This critical phase laid the groundwork for the JERICO-CORE fundamental concept [11], which led to the design study undertaken in WP3 of JERICO-DS.

The JERICO-CORE pilot was showcased during the JERICO-DAYS 2022[1] that took place from 28th to 30th June 2022 at the Hydrographic Institute, Lisbon. The demo session included a presentation [18] and a hands-on demonstration of the user interface, the capabilities of the catalogue API as well as various services that were implemented in the VRE. This demo served as a valuable tool for collecting feedback from users and experts, contributing to the definition of e-JERICO that will be implemented during the different phases of the ESFRI roadmap. In parallel, JERICO-DS conducted an in-depth study [4] of the existing solutions and state-of-the-art practices for this long term e-infrastructure.

As a result of the co-design process of the JERICO-CORE pilot, synergies were established with major international infrastructures such as the European Plate Observing System (EPOS), Blue Cloud (BC), the Integrated Carbon Observing System (ICOS), the DATA Observation Network for Earth (DataOne), the Australian Ocean Data Network (AODN), the Australian Geoscience Data Cube (AGDC), and the European Marine Biological Resource Center (EMBRC), among others. In particular, fruitful collaborations with EPOS ERIC and

[1] https://www.jerico-ri.eu/events/jerico-days-2022/

the Blue-Cloud initiative, have been established through two Memoranda of Understanding (MoU). These experiences not only provided inspiration and valuable references for designing an efficient infrastructure but also fostered collaboration and enhanced interoperability efforts showing the benefits of collaborating between EU infrastructures.

Moreover, the influence of the JERICO-CORE pilot extends well beyond Europe borders. A notable accomplishment of the JERICO RI team and the JERICO-CORE initiative is the proposal of the Coastal Ocean Resource Infrastructure System (CORIS) which expands the concept of e-JERICO to a global scale. CORIS was officially endorsed as a UN Ocean Decade Project in September 2022, as part of the CoastPredict Programme, co-designed with the Global Ocean Observing System (GOOS). As a core component of CoastPredict digital infrastructures, CORIS seeks to become an instrumental infrastructure for coastal ocean activities worldwide and opens avenues for funding opportunities to develop e-JERICO further. CORIS is at present actively searching for funding from the private and public sector. JERICO-RI is therefore leading international changes in the coastal ocean, fully aligned with the UN Ocean Decade transformational needs and the associated Challenges. In other words, EU Research Infrastructures are a pivotal contributor to coastal ocean research activities with a global impact.

2.1.2. JERICO-CORE Pilot Gaps

Despite the significant progress made, our experience with the JERICO-CORE pilot has highlighted areas that require further improvements for continuous and sustainable operations. These include:

- **Clear definition of metadata schema**:

  Efforts are needed to establish at the consortium level a comprehensive metadata schema for the information in the e-JERICO catalogue. This will ensure that the data and information are adequately represented to enable accurate assessment of JERICO activities. This is an issue of concern in the coastal ocean community for data and other types of resources including software, documents, best practices, services, etc.

- **Streamlining resource metadata collection**:

  Collecting resource metadata becomes complex when there is no enforced standard at the resource provider. While the JERICO-CORE pilot demonstrated the feasibility, additional effort is required to achieve real-time harvesting of metadata and provide resource providers with tools and mechanisms to enhance their metadata schema consistency. Metadata and data should be FAIR by design and construction.

- **Involvement of users and stakeholders**:

  The importance of engaging users and stakeholders in the development of e-JERICO cannot be underestimated. It is crucial to establish and maintain a dedicated user group and governance mechanisms to continuously gather their feedback and make them an active participant to the continuous improvement of the infrastructure.

- **Enhancement of tools to assess services**:

  Procedures and assessment tools should be implemented to monitor JERICO activities effectively, identify areas for improvement and allow continuous assessment and enhancement of JERICO services.

- **Tracking and supporting Data Management Plan (DMP) flows**:

  It is essential to establish mechanisms to track and support the flows of DMP, ensuring that data, services, and tool providers are appropriately recognized and supported throughout the process as requested by EU Open Science Policy. Furthermore, guaranteeing the FAIRness of data flow is critical. This not only enhances the usability and efficiency of the data but also ensures its alignment with international standards of data management. Again, FAIRness by design and construction is needed.

  To support the tracking t of the degree of FAIRness, incorporating tools like FAIR metrics and FAIR data assessment tools - such as for example Fair EVA developed by EOSC Synergy EU funded project - is essential. These tools can provide quantitative insights into how well data adheres to FAIR principles, allowing for continuous improvement and adherence to best practices in data management.

- **Creation of custom interfaces**:

  Developing custom interfaces will significantly enhance the user experience and improve the overall efficiency of JERICO activities. Tailoring interfaces to specific needs and requirements will contribute to a smoother and more effective workflow.

- **Definition of data security and access policies:**

  Robust data security measures are vital to protect sensitive information and maintain the integrity and trustworthiness of the infrastructure. Access policies ensure that data is accessible to authorised users in a way that promotes collaboration and innovation, while adhering to ethical and legal standards.

2.1.3. JERICO Achievements Supporting e-JERICO

There have been significant achievements in the JERICO projects that contribute to the development of long-term sustained e-JERICO by laying the foundation for the development of a robust and effective e-infrastructure. These accomplishments include:

- Improved **assessment** of JERICO activities:

  Efforts have been made to enhance the evaluation and assessment of various aspects of JERICO activities. First, the JERICO-S3 WP5 defined a set of KPIs [3] to allow improvement of the performance of the observing platforms. Next, the JERICO label was defined under JERICO-NEXT task T2.6 and reviewed in deliverable D5.2 of JERICO-DS. These indicators play a crucial role in maintaining the quality and reliability of outcomes delivered by JERICO partners. The e-JERICO infrastructure will use these indicators in conjunction with the information of JERICO platforms and other assets of the catalogue to support the assessment of JERICO-RI activities.

- Definition of **data flow**:

  The JERICO-S3 and JERICO-DS projects have successfully implemented comprehensive guidelines and frameworks to streamline data flow efficiently. Key among these is the Data Management Plan (DMP) outlined in JERICO-S3's Deliverable D6.1 [6], which focuses on the management of observational data. This plan is complemented by strategies for handling the flow of advanced products generated by services operating within e-JERICO. In Deliverable D6.1, there is an

extensive discussion on ensuring data FAIRness and numerous actions are described to facilitate data archiving and long term maintenance.

In addition, this D6.1 deliverable addresses strategies to enhance the interoperability and reuse of the collected data, thereby optimising the efficiency and effectiveness of data management in these projects. The successful implementation of these initiatives, such as the data flow definition and the provision of VA services, has been exemplified by the HFR (High-Frequency Radar) community. They have demonstrated adherence to defined standards and data flow protocols, serving as a noteworthy example within the JERICO framework.

- Advancement of **Virtual Access (VA)** and **digital services**:

  JERICO has been successful in providing VA since the JERICO-NEXT project. JERICO-S3 has further improved this by introducing a comprehensive VA framework that allows continuous monitoring of VA services provided by partners. Additionally, the Virtual Access Metrics System (VAMS) allows automatic on-going assessment of the performance of VA providers. This framework and advancement in VA activities are explained in deliverables D11.1 [16] and D11.2 [17].

  JERICO-S3 VRE has been made available for collaborative development of services supporting JERICO activities. **The JERICO-CORE pilot still provides a VRE** hosted by D4science infrastructure as a virtual laboratory (VLab) of Blue Cloud. This development continues in the context of the Blue-Cloud2026 project by developing three JERICO TSs that will be integrated in the JERICO-CORE VLab.

  In the context of JERICO-DS, 5 service offices and 18 expert centres were identified as central parts to create Thematic and Technical services for the ESFRI roadmap based on the experience acquired in JERICO-S3 [2].

- **User strategy** and **stakeholder engagement**:

  The JERICO-S3 project has made significant advancements in understanding and engaging its stakeholders and users. Deliverable D9.1 [12] played a pivotal role by identifying key user profiles and delving into the socio-economic context surrounding the RI, along with the scientific requirements met by JERICO's infrastructures.

  Building on the foundations mentioned, Deliverable D9.2 [13] leverages the insights from D9.1 to craft a tailored **JERICO User Engagement strategy, focusing on the application and utilisation of JERICO-RI products and services**. Further deepening this analysis, Deliverable D4.1 [14], in collaboration with JERICO-S3 WP9, conducted a more comprehensive user and stakeholder analysis, demonstrating an integrated approach to stakeholder engagement.

2.1.4. JERICO-DS WP3 Outcomes for a Sustained e-JERICO

By addressing these areas of improvement, WP3 of JERICO-DS has contributed and aims to significantly enhance the functionality, usability, and impact of the sustained e-JERICO infrastructure. A series of documents resulting from WP3 provide a comprehensive analysis performed within this framework, as outlined below:

- **Requirements analysis**:

  Task 3.1 in collaboration with partners, national stakeholders and experts of external organisations, defined the user requirements and the objectives of e-JERICO main

system and its services. MS13 [5] compiles these requirements. Task 3.7 accounts for these requirements and sets up a plan to provide a continuous interaction with stakeholders and adjustments of these requirements during the preparation and subsequent phases of the ESFRI roadmap.

- **Technical analysis**:

  Task 3.3 assessed the technical feasibility including the availability technologies and the marine landscape in relation to the existing data and information infrastructures. In particular, it proposes an architecture (figure 1) with specific components that must be developed in order to respond to the requirements identified by task 3.1. This architecture will be used to estimate the budget of e-JERICO in section 3.2. The details of the outcomes of task 3.3 were reported in deliverable 3.2 [4].

  Likewise, task 3.5 outlined the management of advanced products in deliverable D3.4 [6] to complement the data management plan that was sketched in JERICO-S3 WP6 D6.1 deliverable [7].

  Furthermore, task 3.7 proposes a plan to guarantee that JERICO partners, users and other stakeholders are involved in the co-design and co-implementation of the initial e-JERICO infrastructure and future improvements. This plan is explained in detail in this document.

- **Governance analysis**:

  Task 3.2 defined the security and access policies of e-JERICO in deliverable D3.1 [8]. This analysis is especially important for defining mechanisms to integrate and use services and in general the approach to operate the e-JERICO infrastructure and elaborating the economic analysis for the operation of the infrastructure. Task 3.7 addresses other aspects related to the assessment of the infrastructure, coordination and engagement with stakeholders.

- **Operational analysis**:

  Task 3.4 studied the current context to ensure a sustainable operation of e-JERICO. A preliminary operational Plan for e-JERICO service delivery, including a framework to elaborate future agreements between JERICO partners delivering services and data was included in deliverable D3.3 [9].

  Milestone MS19 [10] reported the work done in task 3.6 defining the KPIs to be considered to assess the performance and interest of e-JERICO main framework and services. Task 3.7 complements this by defining the environment and processes to respond to the indicators and improve e-JERICO based on user feedback.

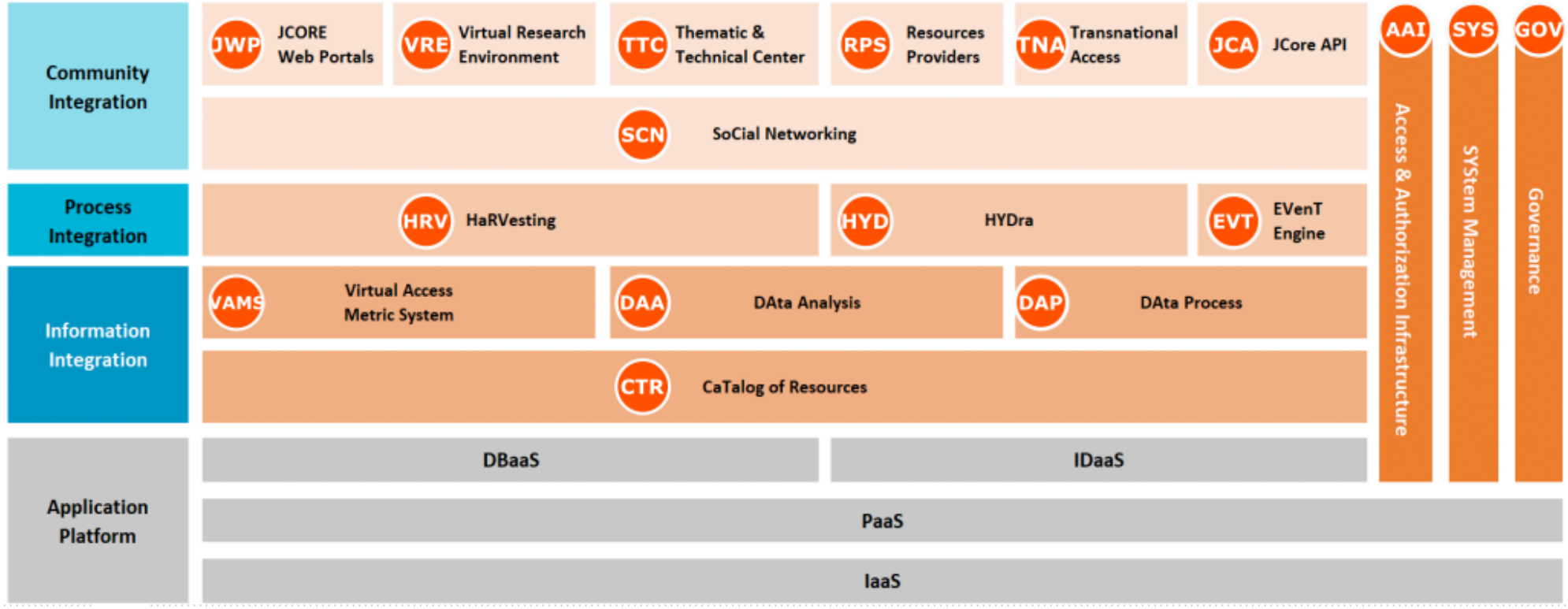

Figure 1: e-JERICO Service Architecture - Stacked View

In summary, WP3 outcomes related to e-JERICO Design Study include an analysis of the e-JERICO requirements, technical solutions, governance strategy and the operational approach. This deliverable, **D3.5 e-JERICO Strategic Plan,** compiles the key outcomes from WP3 work summarised above and provides a roadmap with an **economic analysis**, the **risk assessment**, the **schedule & resource planning** and the **stakeholder engagement**. The roadmap is based on working streams responding to the four aspects described above and the need to integrate services to e-JERICO that are implemented by the JERICO-RI. We describe these streams in the following section.

2.2. Working Streams for the e-JERICO developments

Based on the aspects highlighted in the previous section, four aspects that are important for the e-JERICO roadmap can be drawn: co-design and co-development, operation, interoperability and services integration. It is natural to consider four working streams for each of these aspects. Additionally, we have included a governance stream that will allow the coordination between these four streams and guarantee stakeholder engagement along the roadmap. Thus, we finally identified five streams of work that we briefly describe below:

- **Governance Stream**:

  To establish the structures and processes for managing the virtual infrastructure and ensure that all the elements of the development, operation, interoperability and stakeholders involvement are integrated to provide the best framework and services for all JERICO activities.

- **Co-Design & Co-Development Stream**:

  To set up the strategy and sound environment to guarantee the involvement of JERICO stakeholders in order to deliver the appropriate framework and provide the benefits of such an ecosystem to the entire range of partners considering similarly other inputs from other working streams through the governance stream.

- **Operation Stream**:

  To operate the e-infrastructure and establish the structures and processes to collect feedback from users and provide them to the governance stream to make sure that they are considered in future updates of the main e-JERICO infrastructure and services.

- **Interoperability Stream**:

  To establish and assure standards and support for integration and interoperability with JERICO RIs, other relevant international infrastructures, and information providers. This encompasses European Blue Data Infrastructures (BDI) such as EMODnet, Copernicus Marine Service, SeaDatanet, EuroBis, and other JERICO partners, including infrastructures related to the Digital Twin of the Oceans (EDITO, ILIAD, DITTO).

- **Service Integration Stream**:

  To design, deliver, and integrate services from the Thematic and Technical Centers to e-JERICO main framework in collaboration with JERICO partners and stakeholders.

These five working streams will have different roles and responsibilities along the process of implementing the e-JERICO roadmap and will vary depending on the phase of the project. More details about the role of the working streams is available in section 3 (Project

Planning). We explain in the next section the phases of e-JERICO developments in line with the phases of the ESFRI roadmap.

2.3. Development of e-JERICO along ESFRI Phases

The ESFRI Roadmap Guide (page 10) explains the lifecycle of the RIs and the associated needs and targets according to the time and status of the project.

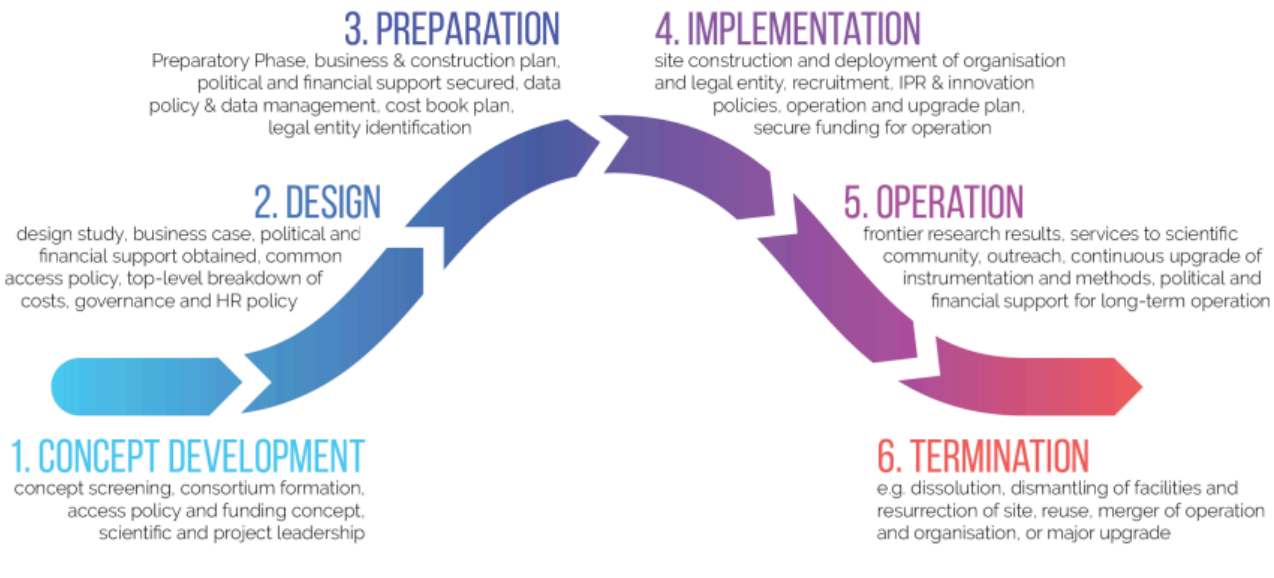

Figure 2: Lifecycle approach of RIs in the ESFRI roadmap

The lifecycle of a RI in the ESFRI Roadmap is divided into several phases (see figure 2) as follows:

- **Scientific Concept**:

  The development of JERICO-RI concept emerged naturally from the collective efforts of coastal ocean scientific communities, who converged around distinct scientific necessities and goals. This inception is deeply rooted in the innovative multi-platform and multidisciplinary methodologies and practices developed during the JERICO, JERICO-NEXT, and JERICO-S3 projects.

  These projects have been instrumental in pioneering approaches to tackle scientific questions and address the needs from society based on existing capabilities across Europe. Moreover, the insights gained from these initiatives have significantly influenced existing National RIs, paving the way for the current strategies aimed at substantial upgrade in capacities, enhancement in coordination and potential integrations. The development of the JERICO-CORE pilot happens in this context to support scientific and technological activities.

- **Design Phase:**

  The Design Phase involves validating the scientific concept and technical feasibility, analysing the potential user base (including science and innovation sectors), and developing a business case and rationale for an international consortium. JERICO

Design Study (JERICO-DS) performed this feasibility analysis in tight collaboration with institutional, national, and international institutions.

The Design Study also includes an initial review of the RI's position in the broader RI landscape, the e-JERICO needs, and the data management and policies which were performed in the context of JERICO-DS WP3 and previous projects. In this context we defined the system concept and gathered the initial requirements, assessed the feasibility of e-JERICO, defined the objectives and identified the stakeholders and their involvement. This has been presented in section 2.1.4 (Sustained e-JERICO Design Study, WP3 Outcomes).

- **Preparatory Phase**:

  The goal of the Preparatory Phase in the ESFRI roadmap is to evolve JERICO into a fully operational RI. This step is pivotal in laying the groundwork for the JERICO-RI's future functionality and sustainability. The design of e-JERICO is integral to the preparatory phase, as it involves planning and creating the digital backbone that will support the RI's scientific activities, data management, and overall operational efficiency.

  Co-designing with stakeholders e-JERICO during the preparatory phase is crucial as it establishes the necessary digital capabilities and infrastructure needed for the RI's effective functioning. Tangible technical solutions will be provided based mainly on deliverable D3.2 [4] and considering conclusions from other work of WP3, and aligned with other EU and international RI. The data security policy shall be taken into account as from the design phase and shall remain a steady concern throughout the whole e-JERICO life cycle. The outcome of this phase will be a specific architectural design.

  With the JERICO-CORE pilot, JERICO-S3 anticipated this phase because the development and testing of a prototype helps to demonstrate and evaluate key aspects of the final e-JERICO. Once the final design is defined, resources will be allocated and the team created for the implementation of the design.

  In this phase, we will use the detailed description and design of the JERICO services to complete the technical design resulting from JERICO-DS as well as the preliminary planning, budget, risk analysis and mitigation strategy presented in this document. Besides, roles, responsibilities and communication channels will be decided.

- **Implementation Phase**:

  In the Implementation Phase of distributed RIs within the ESFRI roadmap, the central focus is on establishing a cohesive network that seamlessly connects the Central Hub with various national nodes. This phase is characterised by intensive negotiations and strategic planning to ensure uniformity and functionality across the distributed sites.

  The implementation of e-JERICO will be key in the process of integrating these nodes. During the coding part progress will be monitored and quality measures implemented. As for the other phases, the Governance Stream will need to guarantee that the communication and coordination happens regularly and effectively to assure a smooth execution and stakeholder engagement.

- **Operational Phase** (when the RI begins operations):

Once the project implementation is completed, e-JERICO will be put in use. In its operational phase, JERICO-RI will commence its full functionality, significantly enhancing pioneering research and providing superior services for outstanding coastal ocean scientific achievements, thereby meeting the demands of its users.

This phase will stimulate the exchange of knowledge among early career scientists and trainees, which in turn will elevate the prestige of their associated educational and research organisations. It will have the capacity to generate spin-offs and start-ups, as well as to draw in corporate collaborators, thereby creating a fertile ground for innovation.

Typically, a twenty-year operational period unfolds prior to the necessity of major upgrades but the intervals for e-JERICO upgrades tend to be considerably shorter and will require regular inputs from stakeholders. Along this phase, the co-development and operational streams will be responsible for upgrades, maintenance, monitoring, and support activities to ensure optimal performance.

During all the phases, training plays a key role to help users to make the best use of e-JERICO. In particular, during the operational phase, training and knowledge transfer will be conducted to enable staff to operate e-JERICO effectively and fruitfully engage partners and stakeholders. This is particularly important because co-development will be particularly active during the operational phase in order to respond to evolving needs of the system.

- **Termination Phase**:

  The termination of JERICO-RI will involve various processes such as the dissolution of the organisation, the dismantling of facilities, addressing safety concerns, and restoring the original site. These transformations leverage the existing technological infrastructure, logistics, human resources, and organisational framework of the original RI.

  Managing e-JERICO during this phase will involve ensuring the long term preservation and accessibility of scientific data, deciding the fate of technological equipment and software, and transferring knowledge and expertise to international sustained bodies. The process will require careful planning, both financially and logistically, to effectively handle the decommissioning or repurposing of digital and technological assets, thereby safeguarding the RI's legacy and contributions to the scientific community and society.

  Activities will be closed requiring the preservation of the project outcomes (data, products, information, documentation), final documentation, reviews and assessment of the system success against predefined metrics. Additionally, lessons learned will need to be documented as a reference for future projects. From a governance point of view, recognition and celebration happen before contracts are closed.

3. e-JERICO Project Planning

Previous section explains the context of the implementation of the JERICO-CORE project, the design study of e-JERICO and the phases and working streams for its implementation. In this section, we describe the following steps to be carried out to complete the outcomes from previous JERICO projects. Figure 3 overviews these steps for each phase of e-JERICO during each phase of JERICO-RI in the ESFRI roadmap.

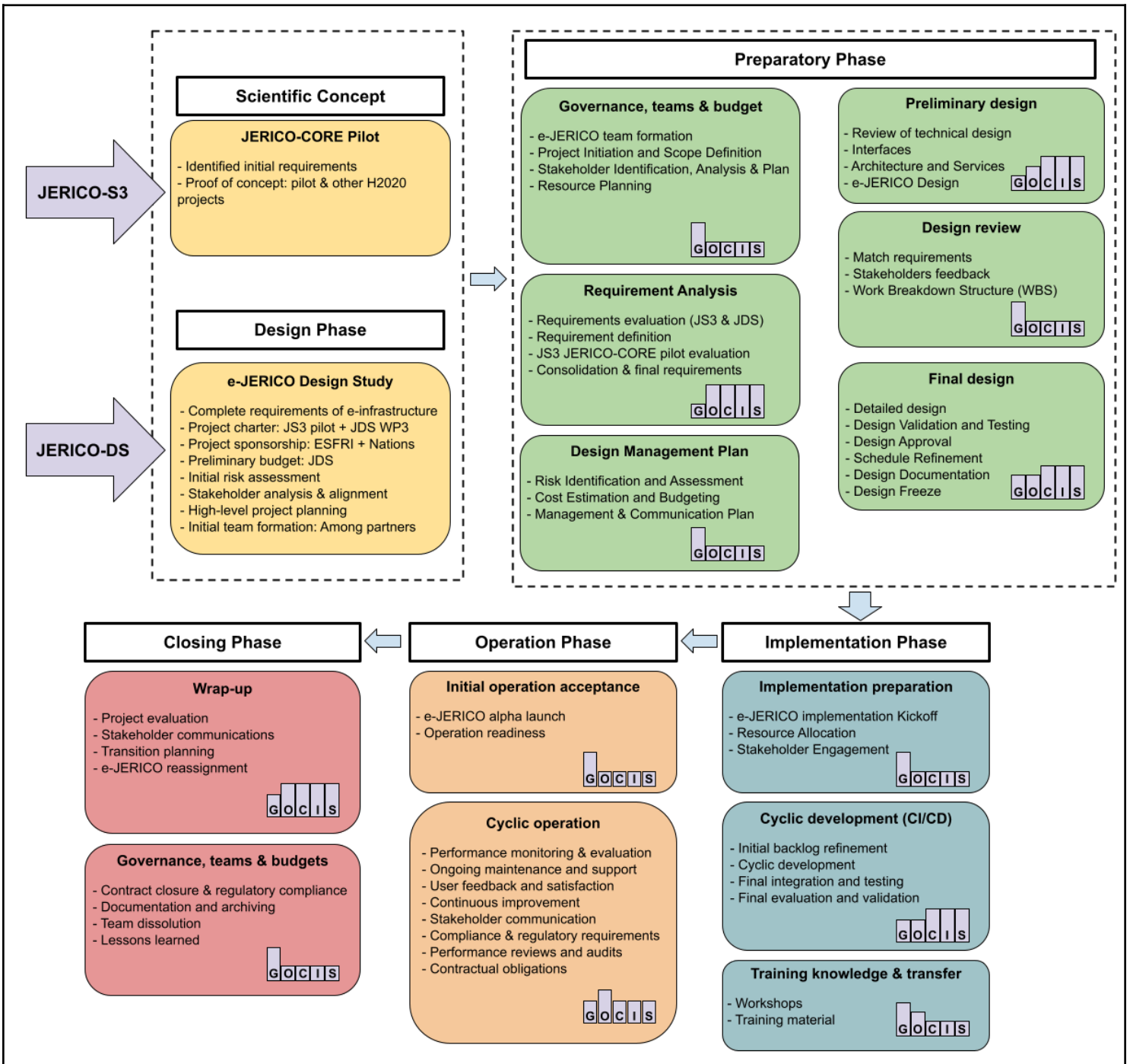

Figure 3: Overview of Milestones and significant achievements throughout the e-JERICO development across ESFRI phases showing the impact of the five working streams outlined in Section 2.2.

This figure outlines the key objectives required to achieve specific milestones and the involvement of each working stream. The bar diagram accompanying each milestone illustrates the relative weight of contribution from the Governance (G), Operational (O), Co-design and co-development (C), Interoperability (I), and Service (S) streams. This nomenclature will be used along the document. Sections 3.1 to 3.4 further describe the steps sketched in figure 3.

3.1. Preparatory Phase

3.1.1. Milestones

As the e-JERICO development project is organised and prepared for execution, milestones occur related to governance, requirements and design as follow:

Governance, team and budget:

- **e-JERICO Team Formation**:

  The team for each one of the streams is formed according to the expertise of the members. This happens early in the process in order to allow the achievement of the rest of the objectives.

- **Project Initiation and Scope Definition**:

  This milestone marks the official start of the planning phase. This work consists of defining the project's objectives, scope, and constraints as well as identifying key stakeholders and their roles. It helps establish boundaries and sets expectations regarding deliverables and project outcomes.

- **Stakeholder Identification, Analysis and Plan**:

  Each working stream will use the previous work resulting from JERICO-S3 and JERICO-DS to identify all relevant stakeholders and establish effective communication and engagement strategies. It includes identifying communication channels, defining communication frequency, addressing stakeholder engagement strategies and establishing the appropriate contracts and Memoranda of Understanding (MoU).

- **Resource Planning**:

  The necessary resources for the project are allocated, including personnel, equipment, facilities, and budget. It ensures that the project has the required resources to execute the planned activities defined in the project initiation.

Requirement Analysis:

- **Existing Requirements Evaluation**:

  This part of the process focuses on collecting and evaluating the requirements that were defined in JERICO-S3 (D7.6 [1]) and JERICO-DS (D3.2 [4]). Working teams should verify that they fit the scope and expectations defined during the previous milestone.

- **Requirements Definition**:

Each working team will engage stakeholders to define functional, technical, and user requirements. It establishes a clear understanding of the project objectives and constraints from a technical point of view which complement the outcomes of *Project Initiation and Scope Definition* milestones during the planning phase.

This step focuses on gathering project requirements from stakeholders to complete the requirements collected in JERICO-S3 (D7.6 [1]) and JERICO-DS (D3.2 [4]). Interviews, workshops or surveys will be conducted following the plan from the stakeholder identification and analysis milestone. The result will ensure a comprehensive understanding of the project's functional, technical, and operational requirements.

- **JERICO-CORE Pilot Evaluation**:

  The plan from the stakeholder identification and analysis milestone will also be used to engage stakeholders in the evaluation of the JERICO-S3 pilot. This evaluation will result in a list of requirements and gaps that will be incorporated into the requirement analysis.

- **Consolidation and Final Requirements**:

  The requirements are finalised and documented as an input of the design phase. The Governance Stream compiles and summarises the conclusions of the work between stakeholders and the working streams during the requirement and pilot evaluation.

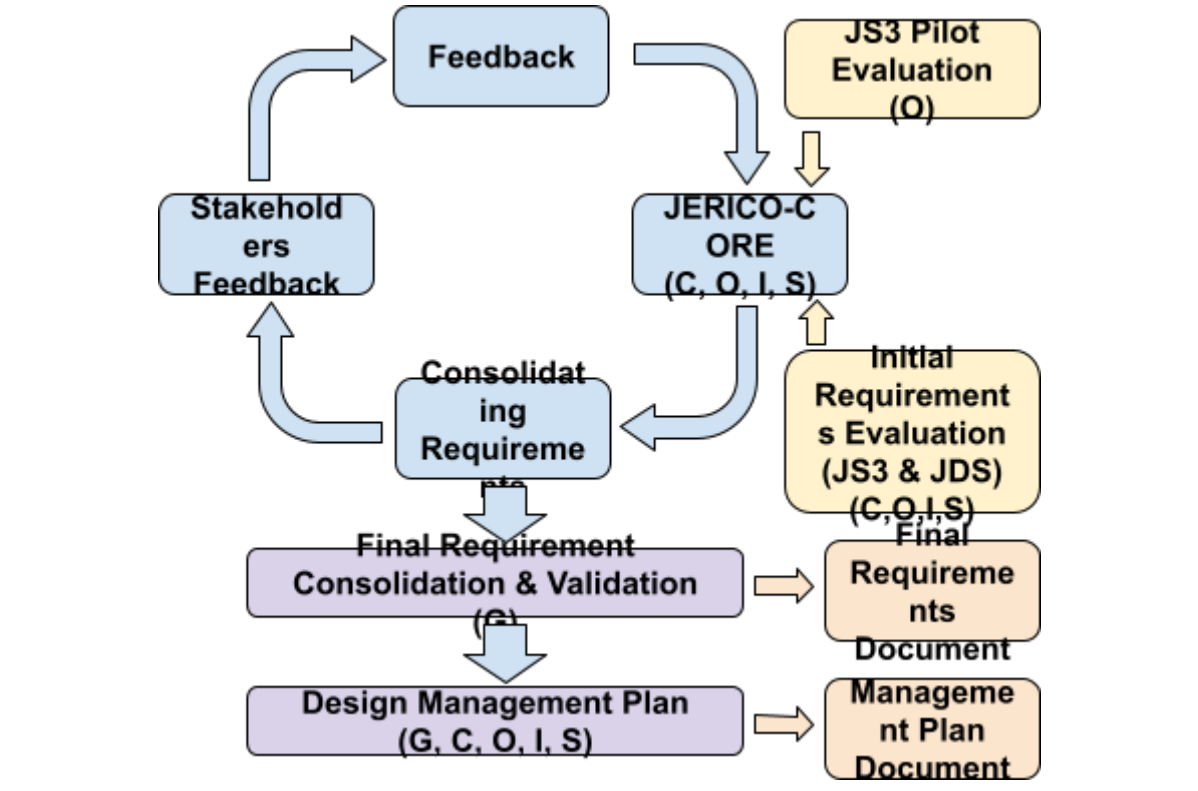

Figure 4: Iterative e-JERICO development stages and stakeholders feedback process

The requirement analysis involves a series of iterative discussions and collaborations between stakeholders and the e-JERICO working streams (see Figure 4). These interactions lead to the consolidation of results, which serve as valuable inputs for the creation of a comprehensive management plan to guide the design phase.

Design Management Plan

- **Risk Identification and Assessment**:

  The results of the initial risk milestone (see Funding and Risk Management) will be completed to mitigate risks and address them based on the identified requirements and scope of the project.

- **Cost Estimation and Budgeting**:

  The preliminary budget (see Funding and Risk Management) will be completed to develop a project budget and financial plan, ensuring that the project remains within the allocated budget.

- **Management and Communication Plan**:

  This milestone focuses on developing a management and a communication plan to ensure effective functioning among and between working stream members. It must include planning for quality management throughout the project and defining quality standards, establishing quality control processes, and developing a quality assurance plan.

The outcomes of the requirement analysis and the design plans in this phase are the **Requirements** and the **Design Management Plan documents** (see section 3.1.2) that will be used for the design of e-JERICO that will take place in a second stage of the preparatory phase. Following the results of the requirements and plans the team will work towards co-designing e-JERICO with stakeholders. We have structured the design into three distinct steps, enabling a progressive evolution of the design for e-JERICO. The resulting design will serve as the solid foundation for its implementation. While minor adjustments to the final design may be made during the implementation phase, it is essential that the design is carefully crafted to effectively address the specified requirements and accommodate evolving technologies, without necessitating any significant changes.

Preliminary Design:

The preliminary design phase focuses on key components that are integral to e-JERICO. This step marks the development of the initial design concept of the e-JERICO infrastructure. It involves reviewing the different design alternatives that were addressed in JERICO-DS, and creating concept sketches or diagrams to visualise potential solutions. It will require an initial refinement of the JERICO-CORE pilot and e-JERICO basic concepts and components. These components include:

- **Interfaces**:

  The design will address the interfaces between different components of e-JERICO, as well as their integration with external infrastructures. This ensures seamless communication and interoperability. The interfaces span (1) the interfaces between the various data centres distributed across the different JERICO sites/institutes/countries and the central e-JERICO infrastructure (2) the interface between the different functional entities of e-JERICO and (3) interfaces with external initiatives (VRE, EMODnet, CMEMS, DITTO, etc)

- **System Architecture**:

A robust and well-defined architecture for the main system will be developed, facilitating the integration of various services, the resource catalogue, and the assessment capabilities. This architecture forms the backbone of e-JERICO.

- **Services**:

  The design will encompass the services and interfaces that support scientific, technical, and societal activities. These services play a vital role in providing the necessary functionalities and tools for users.

The design of these components will be synthesised into a draft of the e-JERICO technical design, aligning with the outcomes of JERICO-DS deliverable D3.2 [4]. This process will leverage the insights gained from the JERICO-S3 pilot and may involve the creation of mock-ups, wireframes, or prototypes to validate the feasibility and functionality of the proposed design.

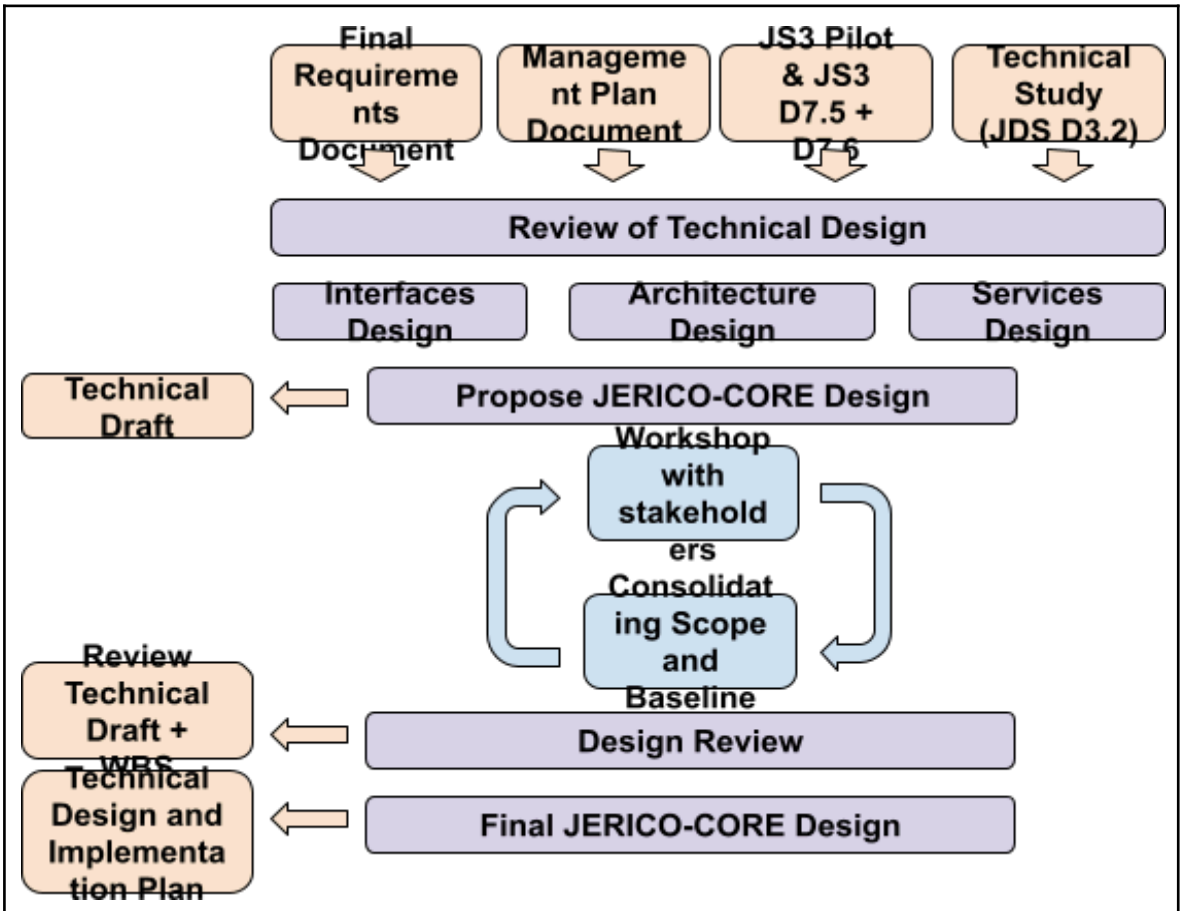

Figure 5: Stages of the e-JERICO design from requirements. The design process incorporates stakeholder input and technical evaluation.

The preliminary design will be iteratively refined through workshops involving the working streams and stakeholders of each stream. Figure 5 illustrates the iterative nature of this process. The results of the preliminary design will be reviewed in subsequent milestones, fostering collaboration with stakeholders to ensure a comprehensive and effective design.

Design Review:

- **Match Requirements**:

  This stage will ensure that the requirements that were collected during the planning phase are accounted for in the preliminary design.

- **Stakeholders Feedback**:

  This milestone involves conducting a formal review of the preliminary design. It includes presenting the design to stakeholders, receiving feedback, and making necessary revisions or refinements based on the review outcomes.

- **Work Breakdown Structure (WBS)**:

  This step marks the creation of a hierarchical breakdown of the implementation tasks and activities that are required to implement the preliminary design. The WBS helps define the project's structure, identify dependencies, and allocate resources to successfully completing e-JERICO.

Final Design:

- **Detailed Design**:

  The development of detailed design specifications and plans includes creating comprehensive design documentation, such as technical drawings, specifications, or architectural plans, depending on the nature of the project. It must consider the outcomes from the preliminary design and the refinements of the design review.

- **Design Validation and Testing**:

  It is crucial to test and validate the design to ensure that it meets the required standards, functionality, and performance. This process includes conducting design reviews, simulations, or testing prototypes to identify any design flaws or areas for improvement. Validation should also ensure alignment with policies, risk plans and management plans.

- **Design Approval**:

  This milestone signifies the formal approval of the design by stakeholders and governance stream. It involves obtaining sign-offs or approvals to proceed with the implementation phase based on the finalised design.

- **Schedule Refinement**:

  This action focuses on creating a schedule and plan to implement the approved design. It should take as an input the established WBS and include sequencing tasks, estimating durations, and establishing dependencies to develop a realistic and achievable project timeline.

- **Design Documentation**:

  It is imperative to address the document update as well as the detailed design task based on the feedback of the validation and schedule refinement tasks. It ensures that e-JERICO and services design-related information is properly documented for the implementation phase.

- **Design Freeze**:

  This step marks the completion of the design phase and the establishment of a finalised design. It signifies that further design changes or revisions are limited, allowing for the subsequent implementation phase to begin. It ensures that the design is transferred and appropriately explained to the implementation team and stakeholders.

The outcomes of the design process in this phase are two documents describing the **technical design** and **the implementation plan**. The technical document is drafted during the preliminary design milestone phases and updated later during the design review phase. The final design phase will produce the final document with the description of the architecture, interfaces and services as well as the implementation plan which will include a schedule of the implementation.

3.1.2. Outcomes

- The **Requirements document:**

  Includes the list of requirements and the way they respond to the general scope defined at the beginning of the planning phase. The requirements should include a description of the purpose and the importance to facilitate and prioritise features during the design and implementation phases. It should also include a comparative analysis with the requirements that were established during the JERICO projects.

- The **Design Management Plan document:**

  Includes the outcomes of the resource planning, the risk assessment, the budget analysis and the management and communication plan.

- The **Technical Design document:**

  Includes the outcomes of the technical design including the architecture, components, functionalities, workflows of systems of e-JERICO and a set of initial services to be integrated. The interoperability stream should make sure that the technical design shows the interfaces to external infrastructures such as EOSC, EMODnet, Copernicus InSitu, and Blue Cloud.

- The **Implementation Plan document:**

  Describes how design meets requirements and provides a summary of the co-design process and communication mechanisms. It should also describe the implementation cycle including timelines, procedures/methodologies and software supporting tools such as DevOps solutions, software repositories, task and incident management platform as well as the development and testing environments.

3.1.3. Initial Phase Planning

The successful completion of various key milestones will mark the progress and achievement of the design and development activities, as outlined below. Table 1 presents the timeline for these milestones along with the corresponding resource requirements necessary to accomplish the specified objectives of the preparatory phase.

Preparatory Phase:	Working Streams	Duration (Months)
Governance, teams and budget ready		
e-JERICO Team Formation	G	3
Project Initiation & Scope Definition	G	5
Stakeholder Identification, Analysis & Plan	G	4
Resource Planning	G	1
Requirement analysis		
Existing Requirements Evaluation (JS3 & JDS)	T	2
Requirements Evaluation	T (,A)	4
JERICO-CORE pilot evaluation	O (,A)	3
Consolidation and Final Requirements	A	3
Design Management Plan		
Risk Identification & Assessment	A	3
Cost Estimation & Budgeting	G	2
Management and Communication Plan	G	3
Preliminary design		
Review of JS3 and JDS Technical Designs	T	3
Interfaces Definition	T	3
Architecture & Services Design	T	5
e-JERICO Design	T	4
Design review		
Match requirements	G	2
Stakeholders feedback	A	4
Work Breakdown Structure (WBS)	A	3
Final design		
Detailed design	A	3
Design Validation and Testing	G	2
Design Approval	G	2
Schedule Refinement	G	2
Design Documentation	T	4
Design Freeze	G	2

Table 1: e-JERICO Development Timeline outlining the key phases and associated tasks in the development process, including governance formation, requirement analysis, preliminary and final design, along with the corresponding working streams and duration in months for each task.

3.2. Implementation Phase

3.2.1. Milestones

During the implementation of e-JERICO, there are several important milestones that will mark the progress and successful execution. The process contains initial and final work to start and wrap up the implementation tasks but most of the implementation approach

focuses on a continuous integration and development as recommended by the JERICO-S3 deliverable D7.6 [1].

Implementation Preparation:

- **Project Kickoff**:

  This milestone marks the official start of the project implementation phase. It involves reviewing project objectives and goals to the working streams, and clarifying roles and responsibilities.

- **Resource Allocation**:

  It is crucial to allocate the necessary resources, including personnel, equipment, and materials, to the implementation teams. It ensures that the working streams have the required resources to begin executing the implementation activities.

- **Stakeholder Engagement**:

  Engaging with stakeholders involves communicating project plans. As explained below, the implementation procedure involves stakeholders in decision-making, and allows them to address any concerns or feedback. It will also involve setting up a communication plan with stakeholders through the product owner who will be in charge of aligning e-JERICO developments with the stakeholders' needs and priorities.

Cyclic Development (CI/CD):

The development of e-JERICO follows an iterative approach, where each cycle produces incremental deliverables of the infrastructure in a collaborative process involving working streams and stakeholders. This iterative development should be defined in the implementation plan (frequency, communication mechanisms, process,...) allowing for continuous improvement and adaptation to evolving feature needs and circumstances.

The primary objective is to deliver value to stakeholders through frequent iterations following agile sprints methodologies, incorporating feedback and adjusting priorities as needed. The cycles are defined by recurring milestones, ensuring progress and accountability throughout the development process as follow,

- **Backlog Refinement**:

  This milestone involves creating and refining the backlog based on the tasks and schedule described in the implementation plan created in the design phase. The refinement consists of a prioritised list of user stories, features, and tasks. The backlog is continuously updated and refined based on product owner inputs and team feedback at the beginning of each cycle.

- **Cycle Planning**:

  Development planning occurs at the beginning of each cycle. Working streams select in collaboration with the product owner a set of prioritised items from the backlog to be worked on during the upcoming cycle. The team breaks down the selected items into smaller tasks and estimates the effort required to complete them.

- **Cycle Execution**:

  During the execution phase, each working stream develops, tests, and integrates the selected backlog items. The work is typically organised into short iterations following Agile methodologies, of duration described in the implementation plan document written in the design phase.

- **Continuous Integration and Testing**:

  Following the implementation plan document ensures that the code changes are frequently and automatically integrated and tested into a shared repository. This practice was explained in JERICO-S3 deliverable D7.6 [4] along with some recommendations.

- **Cycle Review**:

  At the end of each cycle, a review is conducted by the product owner to showcase the completed work to stakeholders. Feedback is gathered, and adjustments may be made to the product backlog or development direction based on stakeholder input.

- **Cycle Retrospective**:

  The retrospective is a meeting held after the review, where the working stream teams reflect on the development work. Lessons learned, areas of improvement, and process adjustments are discussed to enhance the team's performance in future cycles.

- **Release**:

  The release to production may happen at the end of each cycle or at different periods depending on the decisions described in the implementation plan.

At the end of the implementation phase, a final validation will be made in order to validate the product that will be delivered for operation. The validation outcome will include:

- **Final Integration and Testing**:

  Integrating different e-JERICO components, systems, or modules and conducting comprehensive testing to ensure their functionality and compatibility. It includes activities such as system integration testing, user acceptance testing, or performance testing.

- **Final evaluation and validation**:

  Working stream teams and stakeholders will be involved in this process. It will ensure that the developed e-JERICO infrastructure responds to the expectations of all stakeholders, the requirements defined in the planning phase and the design resulting from the design phase. Optionally, changes of the design could be suggested based on the experience acquired during the implementation phase. This evaluation will be done through workshops involving the working streams and stakeholders of each stream.

<u>Training and Knowledge Transfer:</u>

- **Workshops**:

To facilitate the knowledge transfer and the co-development processes, workshops will be conducted, bringing together working stream teams and relevant stakeholders from each stream. This collaborative approach will foster effective communication and enable informed decision-making throughout the development journey. It will also be critical for the operation team to be trained before the transfer to operation.

- **Training and Material**:

  This milestone focuses on providing necessary training and documents to users or stakeholders and facilitating knowledge transfer to them about the project's outputs or systems. It ensures that users are equipped with the knowledge and skills to effectively use e-JERICO and contribute to the development of new services and applications responding to their science interests and societal needs. Moreover, training is key to guaranteeing that the system is transferred appropriately to operations.

3.2.2. Outcomes

The outcomes of the implementation phase are five documents:

- The **implementation document**:

  Describes all the features that were implemented in the e-JERICO main system and the services that were integrated. This document should identify the gaps and divergence of the implementation compared with the original plan at the end of the design phase.

- The **e-JERICO service manual**:

  Describes all the services. This document should describe the current services and the procedures to create and integrate new services to e-JERICO.

- The **e-JERICO manual:**

  Describes the main systems, the interfaces, information system and endpoints from a user perspective.

- The **implementation evaluation document:**

  Describes the lessons learned during the implementation phase. It includes the results and summary from the workshop and the training process including a list of created materials.

- The **operational guide:**

  Describes the mechanisms and procedures to be considered during the operational phase. The operational plan will also contain a description of the security and access policies to e-JERICO and the integrated services. These policies will be a continuation of the ones described in JERICO-DS D3.2. This full documentation provides a comprehensive reference for the staff responsible for operating e-JERICO.

  This operational guide should incorporate a troubleshooting section, that describes all the anticipated errors, mistakes and problems as well as a set of procedures to be

followed in order to restore the e-JERICO systems as fast as possible after the issue is detected.

3.2.3. Initial Phase Planning

Table 2 presents the timeline for these milestones along with the corresponding resource requirements necessary to accomplish the specified objectives of the implementation phase. Because the implementation process is iterative following agile development, the time periods along the process will be specified in the implementation plan document.

Implementation Phase:	M1	M2	M3	...	M48
Implementation preparation					
Project Kickoff	A				
Resource Allocation	G				
Stakeholder Engagement		A			
Cyclic Development					
Initial Backlog Refinement			C,I,S		
Cyclic development				C,I,S	
Final Integration and Testing					T
Final Evaluation and Validation					A
Training and Knowledge Transfer					
Workshops				G,O	A
Training and Material				G,O	A

Table 2: e-JERICO implementation phase activities, including preparation, cyclic development, and training, with corresponding tasks scheduled across cyclic developments.

3.3. Operational Phase

3.3.1. Milestones

The operational phase of e-JERICO begins when the implemented infrastructure transitions into its fully functional state, making it accessible to the entire community. In contrast to the limited access during the implementation phase, the operational phase marks a significant milestone in the JERICO-RI ESFRI roadmap, as the infrastructure becomes widely available.

To ensure continuous improvement and user satisfaction, robust feedback mechanisms should be established, allowing users to provide valuable insights and suggestions during this phase. This feedback-driven approach enables ongoing refinement and optimization of e-JERICO to better meet the needs and expectations of its user community that will be collected by the JERICO User Committee.

This process will be implemented following the recommendations of the deliverable D3.3 [9] that are based on ISO/IEC 20000 standards and ITIL best practices. This deliverable provides the context to operate e-JERICO in an efficient manner and to collect feedback of user experience. The operational phase includes the following milestones:

Initial Operation Acceptance:

- **e-JERICO Alpha Launch**:

  This milestone marks the official deployment of e-JERICO to the JERICO community. It implies the transition from development to operational use.

- **Operational Readiness**:

  This step ensures that all necessary preparations, infrastructure, resources, and support systems are in place to ensure the smooth operation of e-JERICO as described by the operational guide outcome of the implementation phase. It includes activities such as setting up operational procedures, conducting training programs, and establishing maintenance and support mechanisms.

  In this evaluation we will similarly define a policy that states the frequency of the service evaluation (both in terms of user feedbacks & expectations but also in terms of continuous improvement of the information security); the way to prioritise the identified developments, to plan the development and to implement them (including the transition in the operation).

Cyclic Operation and Update:

The operations and further development occurs, as for the initial implementation, in cyclic processes that are defined in the operation plan resulting from the implementation phase. This cyclic process involves various aspects as:

- **Performance Monitoring and Evaluation**:

  e-JERICO's performance is regularly monitored, measured, and evaluated against predefined KPIs or metrics. It involves tracking the infrastructure's operational efficiency, effectiveness, and overall success based on the expected functioning described in the operational manual which is constantly reviewed during the operational phase.

- **Ongoing Maintenance and Support**:

  This work focuses on providing continuous maintenance, support, and updates to respond to incidents that need immediate assistance. It includes activities such as addressing issues or bugs, performing routine maintenance, and implementing software updates or patches.

- **User and Stakeholders Feedback and Satisfaction**:

  Workshop and surveys will be organised to gather user feedback and assess user satisfaction with e-JERICO. They will help identify areas for improvement and provide valuable insights for enhancing e-JERICO based on user experience. Other mechanisms to report incidents or feedback can be considered using appropriate tools used by software development communities such as gitlab.

- **Continuous Improvement**:

  The continuous improvement process will follow the same mechanisms as the one used during the implementation phase described in the implementation document and refined in the operational plan. It involves analysing feedback, identifying areas for enhancement, and implementing iterative changes to optimise the infrastructure's operations and outcomes. Remaining features during development will be implemented under this effort.

- **Stakeholder Communication**:

  Maintaining effective communication with stakeholders includes regular updates, progress reports, and addressing any concerns or queries raised by stakeholders throughout the operation phase.

- **Compliance and Regulatory Requirements**:

  The governance stream should constantly ensure that the project operates in compliance with applicable laws, regulations, and industry standards. It involves monitoring and addressing any regulatory changes, data privacy considerations, or legal obligations that may impact the project's operations.

- **Performance Reviews and Audits**:

  Conducting periodic external performance reviews and audits is important to assess the infrastructures' adherence to quality standards, operational efficiency, and alignment with organisational goals. It helps identify areas of improvement and ensures compliance with established benchmarks.

- **Contractual Obligations**:

  If there are any ongoing contractual agreements associated with JERICO-RI obligations, the governance stream should ensure the fulfilment of contractual obligations, meeting service-level agreements, and ensuring contract compliance throughout the operation phase. This includes following policies described in the operational plan.

3.3.2. Outcomes

The operational phase of e-JERICO will yield a series of comprehensive **reports** at the conclusion of each operational cycle. These reports will encompass a summary of the enhancements made to e-JERICO and its services, including the successful addition of new services and an evaluation of the performance of existing ones. Additionally, the reports will provide valuable insights into the overall infrastructure's progress. To ensure a holistic perspective, the reports will include relevant information on the interactions between working streams, stakeholders, and any auditing teams involved in the process. By documenting these interactions, we aim to foster a collaborative and transparent environment throughout the operational phase.

Moreover, the reports will address any contractual or legal obligations, detailing essential information in alignment with regulatory requirements. In fact, the objective of these reports

is to present a clear and comprehensive account of the developments achieved during each operational cycle. By analysing the data and outcomes, the working streams will be able to continually improve the functionality and efficiency of e-JERICO and its services. These reports will also help identify opportunities for further optimization and fine-tuning.

3.3.3. Initial Phase Planning

Table 3 presents the timeline for these milestones along with the corresponding resource requirements necessary to accomplish the specified objectives.

Operation Phase:	M1	M2	...
Initial Operation Acceptance			
e-JERICO Alpha Launch	A		
Operational Readiness		G,O	
Cyclic Operation and Update			
Performance Monitoring and Evaluation			O
Ongoing Maintenance and Support			T
User and Stakeholders Feedback and Satisfaction			O
Continuous Improvement			T
Stakeholder Communication			G,O
Compliance and Regulatory Requirements			G
Performance Reviews and Audits			G,O
Contractual Obligations			G

Table 3: This table outlines the schedule of activities during the operation phase of e-JERICO, including initial operation acceptance, cyclic operation and updates, along with their respective timelines marked from Month 1 (M1) onward.

3.4. Closing Phase

3.4.1. Milestones

In anticipation of the completion of the e-JERICO project when decommissioned or JERICO-RI terminated, there will be some specific milestones that will mark the closure of the project as follow,

Wrap-up:

- **Project Evaluation**:

  Before proceeding with decommissioning, it is important to evaluate the project's performance, outcomes, and objectives. This work involves conducting a thorough review to assess the e-JERICO infrastructure's success, lessons learned, and any remaining tasks or deliverables.

- **Stakeholder Communication**:

Communicating the decision to decommission e-JERICO to relevant stakeholders is a significant item. This includes informing project team members, clients, and other stakeholders about the reasons for termination and outlining any next steps or alternative plans.

- **Transition Planning**:

  It is important to develop a transition plan to ensure a smooth handover or transfer of any project-related activities, responsibilities, or assets. It involves identifying suitable arrangements for ongoing support, maintenance, or any necessary transfers of knowledge, materials, or resources.

- **e-JERICO Reassignment**:

  This milestone entails making decisions regarding the transfer of software and data repositories, servers, services and products. It includes properly documenting and archiving project-related materials, records, documentation and other relevant information for future reference or audit purposes.

Governance, teams and budgets:

- **Contract Closure and Regulatory Compliance**:

  Contractual agreements associated with the e-JERICO are reviewed and closed. It may include fulfilling contractual obligations, settling financial matters, and obtaining necessary approvals or sign-offs for contract closure. The team should ensure compliance with relevant regulations and legal obligations and address any compliance requirements associated with the termination or decommissioning process, such as information preservation or data privacy regulations.

- **Team Dissolution**:

  The dissolution of the working streams and the reassignment of team members to other projects or roles when necessary. It involves conducting team wrap-up meetings, acknowledging team members' contributions, and facilitating a smooth transition for team members.

- **Lessons Learned**:

  Reflecting on the project's experiences, challenges, and successes is an important milestone. It involves capturing lessons learned from the project and documenting them for future reference or for improving future projects.

3.4.2. Outcomes

At the end of the closing phase, a set of documents should be created to provide a complete record of e-JERICO activities, facilitating knowledge transfer to future projects, and ensuring compliance with organisational and regulatory requirements. These documents will help stakeholders understand the impact of e-JERICO in JERICO-RI activities. The list of outcomes are the following:

- **Closure Report**:

  This comprehensive report summarises the project's objectives, scope, achievements, challenges, and outcomes. It includes an assessment of the infrastructure's performance, lessons learned, and recommendations for similar projects.

- **Lessons Learned Report**:

  This document captures the experiences, insights, and best practices gained during the project's execution. It outlines what worked well and what could be improved for similar projects in the future.

- **Final outcomes and dissemination plan**:

  All project deliverables, including reports, documentation, software, products, or any other tangible outcomes, should be finalised and stored for future reference. It should include a plan for sharing the project's outcomes and results with relevant stakeholders and the wider community, as applicable as well as guidelines for properly archiving project documentation, data, and records for future reference and compliance with organisational or regulatory requirements.

- **Stakeholder Feedback Report**:

  Feedback gathered by working streams from stakeholders will be collected and summarised in a final report that includes their satisfaction with the project's outcomes and processes.

- **Financial Closure Report**:

  A financial summary that includes the final budget, expenditures, and any outstanding payments or invoices. It ensures that all financial obligations are met.

- **Resource Release Plan**:

  A plan outlining the release and reallocation of project resources, such as personnel, equipment, and facilities, to other projects or organisational needs.

- **Contractual Closure Documents**:

  If the project involved contractual agreements with external parties, documents confirming the fulfilment of all contractual obligations and the closure of contracts. This contractual closure document should contain acknowledgments and recognition of the efforts and contributions of team members and stakeholders who were part of the project.

3.4.3. Initial Phase Planning

The table below presents the timeline for these milestones along with the corresponding resource requirements necessary to accomplish the specified objectives.

Closing Phase:	M1	M2	M3	M4	M5
Wrap-up					
Project Evaluation	A				
Stakeholder Communication	G				
Transition Planning		A			
e-JERICO Reassignment			G		
Governance, teams and budget					
Contract Closure and Regulatory Compliance			G		
Team Dissolution				G	
Lessons Learned					G

Table 4: Timeline of the wrap-up activities for the closing phase of e-JERICO, including project evaluation, stakeholder communication, and governance tasks, spread over a five-month period (M1 to M5).

4. Resource Analysis and Funding

Funding for each milestone is a critical aspect that determines the financial support required to achieve the project's goals at different stages. This section addresses the financial considerations of e-JERICO, including funding details and allocation. Additionally, it outlines the risk assessment and mitigation strategies to ensure the project's successful execution while minimising potential challenges and uncertainties.

Both the budget and the risk assessment and mitigation plan are dynamic documents that will undergo regular review and adjustments as the project progresses and new information becomes available. In the following sections, we identify the most relevant and clear funding actions, associated costs, as well as risks and corresponding mitigation measures.

4.1. Costs Overview

The technical design study in Deliverable D3.2 [4] examines various e-infrastructures, assessing their feasibility for the e-JERICO project. It categorises criteria into two groups: the first group evaluates technical and functional viability, ensuring the successful development of e-JERICO; the second group assesses development difficulty and associated technical and functional risks, highlighting uncertainties in project development.

This study provides a detailed, scored analysis of these platforms, particularly focusing on their alignment with e-JERICO's main goal: integrating development with established research e-infrastructures. The analysis indicates that the Blue Cloud infrastructure is most suitable and aligns well with e-JERICO's objectives, reinforced by JERICO's existing collaboration with Blue Cloud. This collaboration includes an MoU under JERICO-S3 for integrating the JERICO-CORE pilot into Blue Cloud, and JERICO's contribution to the Blue-Cloud2026 project, offering three TS and integrating the JERICO-CORE catalogue as a general service.

In calculating the budget for the implementation and operation of e-JERICO, we can consider three distinct development scenarios, each reflecting different levels of funding and project scope. These scenarios will help in understanding the financial implications of various development paths and aid in strategic planning. The first scenario, the 'worst-case scenario', assumes minimal funding, focusing on development based solely on the existing pilot project. This scenario represents the most constrained budget, where only basic functionalities are maintained. The second, a 'medium/realistic case,' envisions a scenario where funding is adequate to meet the crucial requirements laid out by key stakeholders, balancing between cost and functionality. The third, the 'maximum/optimal case scenario,' assumes the availability of ample funding, allowing for the comprehensive development of all planned requirements and functionalities.

At this stage of the project, there are three factors that can alter the budget:

- **Technical Solution Choice:**

  From the options evaluated in the JERICO-DS Deliverable D3.2 [4], the chosen technical solutions, including EGI, EUDAT, EOSC, D4Science, and Blue Cloud, will significantly impact the budget.

- **Component Selection for Development:**

  Out of the 21 components proposed in the e-JERICO architecture (as presented in JERICO-DS Deliverable D3.2 [4] and illustrated in Figure 1), the specific components selected for development will affect the overall costs.

- **Development Scope of e-JERICO Components:**

  The extent to which each component of the e-JERICO architecture is developed will heavily influence the budget. This is directly tied to the breadth of services JERICO intends to provide.

To develop a more precise and realistic budget, we propose adopting Blue Cloud as the foundational infrastructure for e-JERICO. This approach requires us to calculate the implementation costs for services outlined in Deliverable D3.2 [4]. However, should Blue Cloud not be utilised, we could incur additional expenses. These might include the development of an alternative infrastructure, potentially costing up to 7 million euros (a figure based on the Blue Cloud project cost), or rectifying shortcomings in other options evaluated in D3.2.

The risk of Blue Cloud being unsuitable for e-JERICO is considered low, given the existing positive collaboration between JERICO and Blue Cloud. Furthermore, Blue Cloud plays a crucial role in sustainability as the ocean case of the European Open Science Cloud (EOSC), aligning with the European Commission's strategy for Europe's digital future in open science. Additionally, its increasing involvement in digital ocean twin projects like EDITO, which are integral to the EC's strategy for ocean studies, bolsters its suitability.

In this section, we present a first estimate of the cost of each component of the architecture. These costs vary depending on the desired level of complexity. For instance, the cost could be determined based on the number of TS to be implemented or the number of resource providers to be integrated. This modular costing approach enables us to adapt to different budget scenarios by selecting the appropriate components and their respective complexities.

For example, in a **'worst-case' scenario**, characterised by limited funding, a critical analysis of the proposed features will be necessary during the preparation phase. This analysis, conducted in consultation with stakeholders, would aim to prioritise the most vital features for development and integration based on the costs described in this section. Conversely, in an 'optimal' scenario, where resources are abundant, we could enhance the infrastructure's capabilities significantly.

This structure would involve integrating e-JERICO services, such as Transnational Access (TNA) and social media platforms, enhancing interoperability with related initiatives like digital twins, and incorporating additional technical and TSs. The feasibility and scope of these enhancements would be assessed in collaboration with stakeholders during the preparatory phase, aligning with the evolving needs and objectives of the project.

In managing the budget for e-JERICO, expenses are categorised into distinct groups to ensure comprehensive financial oversight. This structured approach to categorising expenses allows for efficient allocation of funds and precise financial tracking. The categories are shown in Table 5.

Code	Expenses Source	Description
DP	Development Personnel	Salaries and benefits for the team members involved in designing, developing and maintaining e-JERICO (C, I, S)
OP	Operation Personnel	Salaries and benefits for the team members involved in operating e-JERICO (O).
IF	Infrastructure	Expenses related to the physical infrastructure, servers, cloud services, networking, etc.
ST	External Software & Tools	Costs associated with software licences, development tools, and any third-party software required.
DM	Data Management	Expenses for management of e-JERICO information and support of data produced and managed by TTC. (C, I, S).
TS	Training & Support	Budget for training users and providing technical support.
CO	Communication & Outreach	Costs related to disseminating information about the e-infrastructure and engaging with the community and stakeholders.
CF	Contingency Fund	Allocate a portion of the budget for unexpected events or changes in project scope.

Table 5: Category of the type of expenses of the e-JERICO development, including development and operation personnel, infrastructure, software, data management, training, communication, and a contingency fund, with a brief description of each category.

At this juncture, contingency funds will not be calculated; they will be determined at the business strategy level, informed by a detailed risk analysis provided in subsequent sections. Expenditures related to communications, governance stream and travel expenses and training material will also be omitted, as they will be encompassed within a broader strategic framework.

However, we will incorporate estimates for training and data management, recognizing their critical role in bolstering both development and operational facets of the project as described in section 2.2 about the working streams. In the next section we describe the estimates of the cost based on the technical design studied in deliverable D3.2 [4] assuming the utilisation of Blue Cloud infrastructure as the foundational element.

4.2. Budget Estimates

4.2.1. Resources Estimates for e-JERICO Components

As explained in the previous section, the cost projections are rooted on the assumption that Blue Cloud is used as the baseline of e-JERICO. Deliverable D3.2 [4] proposes various infrastructure components as shown in Figure 1. In this section, we describe the cost estimates for each of the components of the e-JERICO architecture that was proposed in D3.2.

- **e-JERICO Web portal**

The Blue Cloud Gateway already provides a gateway portal that could be used as a main gate for JERICO users. Dedicated support will be essential to bridge the gap between the JERICO users and the Blue Cloud team. This support role, primarily administrative in nature, would equally require a fundamental understanding of software development. This knowledge is crucial to accurately interpret user requests and comprehend Blue Cloud's capabilities. We estimate that fulfilling this role would necessitate approximately **3 person-months per year** along the entire duration of JERICO-RI.

- **Virtual Research Environment**

The Blue Cloud environment already facilitates the creation of virtual labs and the deployment of services through the use of standard Docker containers on the D4Science Cloud Computing Platform (CCP). The JERICO VRE will incorporate these existing capabilities from Blue Cloud. However, to tailor it for JERICO's specific needs, particularly for the development of TTC services, additional installations of specialised tools and libraries will be required.

Although Blue Cloud and D4Science already provide foundational support for these activities, dedicated personnel will be necessary to identify the appropriate tools, liaise with IT support, and manage the dockerization of these tools. To effectively manage this process, we anticipate the need for a technical role, estimated at **6 person-months per year**, during the implementation and preparation phase. Additionally, **3 person-months per year** of a technical administrator will be required for ongoing operations in the e-JERICO phase.

Providing comprehensive training and support is essential to equip both users and TTC scientists and developers with the necessary skills and knowledge to fully utilise the VRE. This is not just about familiarising them with the system, but also about empowering them to leverage its full potential effectively. To achieve this, we anticipate the need for a dedicated commitment of **2 person-months per year** throughout both the implementation and operation phases of the project.

- **Technical and Thematic Centre**

The development of TTC is expected to take place within the Virtual Labs of Blue Cloud. The creation and content of the TTC will be largely influenced by the selection and design of the services to be developed. Consequently, the associated costs will vary significantly, depending heavily on the scope and specific plans for each TTC service. These services will be collaboratively designed and implemented by scientific teams working in tandem with the technical groups, as outlined in the 'working streams' section.

The experience during the JERICO-S3 and JERICO-DS projects showed that it is important to differentiate between the e-JERICO main system and TTC services that are integrated to e-JERICO or deployed in its VRE. There are various reasons for this distinction. Hosted services are developed by JERICO working groups to respond to specific scientific or societal needs. These groups are created in the context of Thematic Services or Technical Services.

On the other hand, the e-JERICO main system is a general framework that is capable of integrating all types of these services and at the same time provide the necessary

capabilities to interoperate with external providers and infrastructures. The budget considering these two aspects of development will depend on the complexity of the service implementation and integration. However, we can estimate an average of the cost based on the experience of the Blue Cloud 2026 project.

In the Blue Cloud 2026 proposal, 194 person-months have been allocated for the development and operation of 5 virtual labs over a 42-month project period. Leveraging this data, we can project an estimated budget for implementing and operating **each TTC** at approximately **11 person-months per year** throughout the lifespan of the JERICO-RI initiative.

To further enhance the effectiveness of e-JERICO, we will provide ongoing data management support and training. This is a crucial step to ensure the seamless creation and integration of TTC into the e-JERICO framework. Continuous support and training will not only aid in maintaining data quality and integrity but also facilitate the efficient use and integration of new data sources, thereby optimising the overall functionality and impact of e-JERICO. We estimate for each TTC an additional need of **3 person-months per year** for data management and **1 person month per year** for training along all the phases of JERICO-RI.

- **Resource Providers and Harvesting**

The Data Discovery and Access Service (DD&AS) within Blue Cloud currently connects various Blue Data Infrastructures (BDI) using a broker system. In a similar vein, e-JERICO aims to integrate additional coastal ocean providers of data and other types of resources such as software, services and documents. This integration will be achieved by incorporating more brokers and deploying harvesters to accumulate resource information into a comprehensive knowledge catalogue.

This catalogue will provide an overview of JERICO assets, enabling the assessment of metadata status, Key Performance and Impact Indicators (KPPIs, KIPI), FAIRness metrics, and other crucial measures that support JERICO's activities. The system will feature automatic harvester systems for gathering dataset information from BDIs linked to DD&AS and other sources, including OBPS, Github, CRAN, Seadatanet directories, and national JERICO RIs.

Moreover, it will also support providers in enhancing metadata quality and evaluating the FAIRness of information sources, ensuring the coherence and timely updates of the catalogue's content. Currently, pilot harvesters require upgrades to offer long term operational functionalities.

Further development is planned within the Blue Cloud 2026 initiative and OSTrails project. The preparation phase will necessitate additional development to realise full functionality, particularly for interfacing with multiple sources, including federated national RIs. Based on the Blue Cloud 2026 costs for integrating BDIs, we estimate the development of each new link. WP2 was allocated 211 person-months for integrating five new BDIs over the 42-month project duration, equating to 12 person-months per year per BDI.

Additionally, for the assessment services, an allocation of 2 person-months per year per BDI is needed. Therefore, we estimate the total cost at approximately **14 person-months per year for each resource provider** during the preparation and implementation phase. These costs will cover data management and training support. Operations will require **3 person-months per year for each resource provider.**

- **Transnational Access**

We plan to introduce a system designed to display available TNA (Transnational Access) platforms and facilitate the submission of proposals for these platforms, which can then be easily reviewed by evaluation panels. Currently, JERICO platforms are catalogued in Sextant. To enhance this system, we will develop an API for information retrieval, a user-friendly front end for resource visualisation and reservation, and a robust backend for managing requests and integrating them into the TNA scheduling database.

For these developments, which will utilise common web technologies, we anticipate the need for a full-stack developer. This role will be crucial during the design and implementation phases, requiring an estimated commitment of **2 person-months per year**. Besides, to ensure effective data management and user training, we will require the services of a data manager and a training support specialist. Each of these roles will necessitate a commitment of **3 person-months per year** throughout all phases of the JERICO-RI project

- **e-JERICO catalogue API**

We will develop an API that delivers essential information from the Resource Catalog, crucial for the TTC, as well as for data analysis and processing services. This API will be designed to integrate seamlessly with resource providers, enabling the retrieval of federated resources registered in the catalogue. Drawing on the insights gained from the JS3 pilot project, this new API will facilitate the integration of new resource storage solutions and the acquisition of federated resources.

The creation of this API represents a significant new development in our system. To ensure its successful development and subsequent operation, we anticipate the need for a developer dedicated to this project for approximately **1.5 person-months per year** along all the phases.

- **Social Networking**

Blue Cloud offers a range of features that are essential for effective collaboration and communication within JERICO-RI. These include a dashboard for sharing the latest news, a repository for hosting documents and outcomes from events, a forum for facilitating communication and information exchange among experts, and a workspace for storing and sharing files. Since these functionalities are already provided by Blue Cloud, no additional development is required.

However, to efficiently manage these tools, we will need to allocate resources for administration and support. Specifically, we plan to dedicate **one person-month per year** to administer the social space including to design, implement and execute the communication strategy. Additionally, **three person-months per year** will be responsible for training and support. These commitments will be sustained throughout all phases of JERICO-RI.

- **Hydra services**

The HYDra Services represent a critical middleware component designed to bridge the JERICO-RI with the e-JERICO platform. This integration is set to expand capabilities for the JERICO Community by leveraging a comprehensive network of sensors, actuators, and various monitoring devices scattered across the pan-European landscape. For instance,

these services would enhance early warning systems and facilitate the integration of digital twins and real-time TSs. Essential to this operation is a central hub that can gather and assimilate data from diverse platforms, utilising real-time data services like SensorThings.

The nature of this work bears resemblance to the functions of Resource Providers and Harvesting components, particularly in executing core foundational tasks with RT data. Thus, the creation of this central hub for RT data is estimated to be similar to the integration of a BDI, around **14 person-months per year** for design and implementation. Additionally, we can account for 2 **person-months per year** for the integration of each integrated platform which is anticipated to require considerably less effort. Operations will require **3 person-months per year for each resource provider.**

- **Event Engine**

To enhance data management and facilitate advanced analysis within JERICO, the introduction of an event system is proposed. This system will be pivotal in automating the flow of data from JERICO platforms throughout the entire process. This includes managing data from the platforms to data centres and aggregators, overseeing processes and analysis within e-JERICO, and coordinating the dissemination of information to aggregators. Such functionality has not been previously explored in JERICO projects, nor is it available in Blue Cloud. However, it will be tested as part of a pilot project within OSTrail.

Based on the outcomes of this pilot, further developments may be pursued to support the efficient management and assessment of JERICO's data flows. For the successful development and implementation of this event system, we anticipate the need for a developer allocated **6 person-months per year** during the preparation and implementation phases. Furthermore, to ensure smooth operation post-implementation, we will require a resource commitment of **2 person-months per year**.

- **Assessment Metrics System**

We are planning to implement a metrics system within e-JERICO, aimed at monitoring and evaluating the range of activities and assets within JERICO. This advanced system extends the framework of the Virtual Access Metrics System (VAMS) introduced in deliverable D3.2, and will be engineered to accommodate and support a broader spectrum of JERICO's activities. A key feature of this system will be a user-friendly dashboard, which will present JERICO users with a summary of general metrics.

In addition, the dashboard will offer insights into the current status of JERICO assets registered in the catalogue that will complement the access metrics already provided by Blue Cloud. Under WP2 and 5 of the Blue Cloud 2026 project, we will develop a prototype for assessing the JERICO catalogue. This prototype will then be expanded into a more comprehensive system that encompasses all basic metrics identified during the preparation phase.

To bring this system to fruition, we estimate a need for a developer, allocated **4 person-months per year**, during both the preparation and implementation phases. For ongoing operations, a maintainer will be required for **2 person-months per year**. Likewise, to ensure effective use and understanding of this system, we foresee a need for a manager dedicated to training and support, requiring **3 person-months per year**, sustained throughout all phases of the project.

- **Data Analysis**

We plan to establish an analysis system to support analysis processes in TTC with common libraries and tools such as specific Quality Control (QC) and Quality Assurance (QA) of data processed through JERICO's data flows. This system will facilitate both automatic and semi-automatic workflows, significantly enhancing the efficiency and reliability of our data processing.

Currently, there is no existing work supporting this level of integration within JERICO. Therefore, during the preparation phase, our focus will be on gathering information about the processes utilised by each JERICO-RI. This information will be instrumental in designing a comprehensive system that incorporates these varied processes.

Subsequently, in the implementation phase, we will develop and enact workflows based on these processes. For this extensive undertaking, we anticipate the need for a scientist or developer dedicated for **3 person-months per year per TTC** throughout both the preparation and implementation phases. Additionally, to ensure the smooth operation of this system post-implementation, a maintainer will be required for **2 person-months per year per TTC**. Alongside, a data manager will play a crucial role in overseeing data management across all phases of the project, with a commitment of **1 person-months per year per TTC**.

- **Data Process**

We are planning to develop a system to enhance data processing within the JERICO data flows. This system will support both automatic and semi-automatic workflows, thus improving efficiency and accuracy in data handling. At present, no existing framework supports this level of integration within JERICO. Therefore, our initial step during the preparation phase involves gathering detailed information about the data processing procedures employed by each JERICO RI. This crucial information will guide the design of a tailored system that encompasses and streamlines diverse processes of the TTC.

In the subsequent implementation phase, we aim to develop and integrate workflows based on these identified processes. For this significant developmental work, we envisage the need for a scientist or developer, dedicating **3 person-months per year per TTC** throughout both the preparation and implementation phases. Moreover, for the ongoing operation of this system, a maintainer will be essential, requiring a commitment of **2 person-months per year per TTC**.

Furthermore, the role of a data manager will be critical across all phases of the project, also necessitating **1 person-months per year per TTC**. This manager will oversee the comprehensive data management process, ensuring consistency and efficiency in the system's operation.

- **Resource Catalogue**

We aim to develop a scalable catalogue that features an interoperable metadata schema for coastal ocean resources. This catalogue will encompass a wide array of resources, including datasets, documents, software, services, and platforms, along with related information such as people, projects, and organisations. A key feature of this catalogue will be its operational capability and real-time updates.

At present, our existing catalogue from the JERICO-S3 pilot lacks the functionality for real-time updates within a scalable framework. However, a design proposal was developed

during JERICO-S3 for JERICO-DS to address this need. Moving forward, our objective is to implement this design. This includes the integration of an interoperable metadata schema and scaling the system with a different datastore.

To realise this vision, we anticipate the need for a developer, dedicating **3 person-months per year** during both the preparation and implementation phases. In addition, for ongoing operations, a maintainer will be required for **3 person-months per year**. Furthermore, we will require Neo4j cloud support and Neo4J licences for the database management system.

Alongside the technical development and maintenance, a data manager will be essential throughout all phases of the project, with a commitment of **3 person-months per year**. Besides, to ensure effective use and understanding of the catalogue system, we foresee a need for comprehensive training, necessitating an allocation of **3 person-months per year** throughout all project phases.

- **Governance, System Management and Application Platform**

The components that we will require are already available through Blue Cloud, eliminating the need for the development of new components. The primary requirement will be IT support to facilitate effective communication and collaboration between our development and operation teams and the technical teams at Blue Cloud. To this end, we estimate the need for an IT support role, dedicating **2 person-months per year** throughout all phases of the project. This plan is based on the assumption that the Memorandum of Understanding (MoU) with Blue Cloud provides access to its infrastructure and tools at no cost.

4.2.2. Summary of e-JERICO Resources

Table 6 summarises the estimated resource allocation needs for the components of the e-JERICO project as described above.

Catalogue of Services	Design & Development (Prep & Impl phases)	Operations (Op. phase)	Infrastructure, External Software & Tools	Data Management	Training & Support
JWP - e-JERICO Web Portals	3	3			
VRE – Virtual Research Environment	6	3			2
TTC – Thematic & Technical Center	11 (per TTC)	11 (per TTC)		3	1
RPS – Resources Providers HRV – HarVesting	14 (per provider)	2 (per provider)			
TNA – Transnational Access	2			3	3
JCA – e-JERICO API	1.5	1.5			
SCN – SoCial Networking	1	1			3
HYD – HYDra	14 2 (per platform)	3 (per platform)			
EVT - EvenT Engine	6	2			
AMS – Assessment Metric System	4	2			3
DAA - DAta Analysis	3 (per TTC)	2 (per TTC)		1 (per TTC)	

Catalogue of Services	Design & Development (Prep & Impl phases)	Operations (Op. phase)	Infrastructure, External Software & Tools	Data Management	Training & Support
JWP - e-JERICO Web Portals	3	3			
VRE – Virtual Research Environment	6	3			2
TTC – Thematic & Technical Center	11 (per TTC)	11 (per TTC)		3	1
RPS – Resources Providers HRV – HarVesting	14 (per provider)	2 (per provider)			
TNA – Transnational Access	2			3	3
DAP - DAta Process	3 (per TTC)	2 (per TTC)		1 (per TTC)	
CTR - CaTalog of Resources	3	3	Neo4j licence & support	3	3
GOV - Governance SYS - System Management AP - Application Platform	2	2	Should be covered by MoU		

Table 6: Costs of e-JERICO components described in D3.2 in person-months per year

4.2.3. Budget of e-JERICO for various scenarios

We provide in this section the budget for three different scenarios as explained in section 4.1 (Cost Overview). We consider the following scenarios:

- **Worst case scenario (see table 7):**
  In this scenario we would integrate 2 TTC to e-JERICO and collect information from 4 resource providers into the catalogue in order to demonstrate basic integration to validate the e-JERICO capabilities and obtain more funding. We would not integrate any platform through the HYDra layer since this functionality is not critical.

Catalogue of Services	Design & Dev. (Prep & Impl phases)	Operations (Op. phase)	Data Management (All phases)	Training & Support (All phases)
JWP	3	3		
VRE	6	3		2
TTC	22	22	3	1
RPS & HRV	56	8		
TNA	2		3	3
JCA	1.5	1.5		
SCN	1	1		3
HYD	0	0		
EVT	6	2		
AMS	4	2		3

Catalogue of Services	Design & Dev. (Prep & Impl phases)	Operations (Op. phase)	Data Management (All phases)	Training & Support (All phases)
JWP	3	3		
VRE	6	3		2
TTC	22	22	3	1
RPS & HRV	56	8		
TNA	2		3	3
DAA	6	4	2	
DAP	6	4	2	
CTR	3	3	3	3
GOV & SYS & AP	2	2	0 (MoU)	
TOTAL	**118.5**	**55.5**	**13**	**15**

Table 7: Costs of e-JERICO components described in D3.2 in person-months per year for the **worst case scenario**.

- **Medium/realistic case scenario (see table 8):**
  In this scenario we would develop 10 TTC, collect information from 10 resource providers and integrate 5 platforms through the HYDra layer. We estimate that this scenario would allow the use of e-JERICO to support the JERICO-RI activities in a realistic way. In fact, it would allow the integration of major information providers such as data aggregators, software and document repositories and other international information systems.

Catalogue of Services	Design & Dev. (Prep & Impl phases)	Operations (Op. phase)	Data Management (All phases)	Training & Support (All phases)
JWP	3	3		
VRE	6	3		2
TTC	110	110	3	1
RPS & HRV	140	20		
TNA	2		3	3
JCA	1.5	1.5		
SCN	1	1		3
HYD	24	15		
EVT	6	2		
AMS	4	2		3
DAA	30	20	10	
DAP	30	20	10	

Catalogue of Services	Design & Dev. (Prep & Impl phases)	Operations (Op. phase)	Data Management (All phases)	Training & Support (All phases)
JWP	3	3		
VRE	6	3		2
TTC	110	110	3	1
RPS & HRV	140	20		
TNA	2		3	3
CTR	3	3	3	3
GOV & SYS & AP	2	2	0 (MoU)	
TOTAL	**362.5**	**202.5**	**29**	**15**

Table 8: Costs of e-JERICO components described in D3.2 in person-months per year for the **medium/realistic case scenario**.

- **Maximum/optimal case scenario (see table 9):**
  In this scenario we would develop 16 TTC, collect information from 30 providers (inc. JERICO RIs) and integrate 50 platforms through the HYDra layer. We estimate that this scenario would allow the use of e-JERICO to support the full JERICO-RI activities. In fact, it would allow to incorporate to the infrastructure all the federated RIs that are part of the consortium.

Catalogue of Services	Design & Dev. (Prep & Impl phases)	Operations (Op. phase)	Data Management (All phases)	Training & Support (All phases)
JWP	3	3		
VRE	6	3		2
TTC	176	176	3	1
RPS & HRV	420	28		
TNA	2		3	3
JCA	1.5	1.5		
SCN	1	1		3
HYD	114	150		
EVT	6	2		
AMS	4	2		3
DAA	48	32	16	
DAP	48	32	16	
CTR	3	3	3	3
GOV & SYS & AP	2	2	0 (MoU)	
TOTAL	**834.5**	**435.5**	**41**	**15**

Catalogue of Services	Design & Dev. (Prep & Impl phases)	Operations (Op. phase)	Data Management (All phases)	Training & Support (All phases)
JWP	3	3		
VRE	6	3		2
TTC	176	176	3	1
RPS & HRV	420	28		
TNA	2		3	3

Table 9: Costs of e-JERICO components described in D3.2 in person-months per year for the **maximum/optimal case scenario**.

The summary of the costs for these three scenarios are presented in Table 10.

Scenario	Design & Dev. (Prep & Impl phases)	Operations (Op. phase)	Data Management (All phases)	Training & Support (All phases)
minimum/worst	118.5	55.5	13	15
medium/realistic	362.5	202.5	29	15
maximum/optimal	834.5	435.5	41	15

Table 10: Summary of the total costs of e-JERICO in person-months per year for each of the budget scenarios.

4.3. Current Source of Funding

Source	Description	Amount
JERICO-S3	Design and development of JERICO-CORE pilot	11.4 PM
	Operation of JERICO-CORE pilot during 2 years	71250€
Blue Cloud	MoU to use JERICO-CORE Virtual Lab	In-kind
Blue Cloud 2026	Partners of the project to develop JERICO Virtual Lab with three TSs (WP4). Improvement of harvesting processes and assessment tools (WP2&5).	318,812.5€
OSTrails	Pilot to integrate catalogue, assessment tools and data management plans. The pilot will work toward interoperability of JERICO-CORE catalogue with EOSC.	155,000€
All partners contributing to JERICO-CORE pilot	Co-design, co-development and hosting of JERICO-CORE.	In-kind

Table 11: Sources of support for e-JERICO through the contributions to the JERICO-CORE pilot, detailing contributions from various partners and programs.

5. Risk Management

5.1. Risk Assessment and Analysis

Risk	Likelihood	Impact
Discontinuity of Blue Cloud or lack of agreement between JERICO and Blue Cloud	Low	High (high impact in project baseline)
Federated partners	Low to Moderated (difficult agreements and engagement, affiliations of Nations)	High (delay the project, increase costs)
Federated and well established infrastructures	Moderate (diverse interfaces, difficult adaptation)	High (difficult operations and integration)
Insufficient Funding	Moderate (uncertain funding sources)	High (project delays, reduced functionality, stakeholders not satisfied)
Schedule uncertainties	Moderate	Moderate
Design uncertainties	Moderate	High
Lack of service definition	Low to Moderate	High
Poor service integration		
Lack of User Adoption	Moderate (insufficient outreach activities)	Moderate (underutilised resources)
Inadequate Technical Expertise	Low to Moderate (skilled team members)	Moderate (development delays or poor operations, maintenance or services)
Poor stakeholder engagement	Low to Moderate (previous project efforts)	Moderate
Data Breach or Security Breach	Low to Moderate (robust security measures in design)	High (compromised user data, reputational damage)
Technical Glitches and Downtime	Moderate (software bugs, server issues)	Moderate (temporary service interruptions)
Information Loss or Corruption	Low (redundant data backups)	Moderate (loss of research data)

Table 12: Potential risks in e-JERICO development, categorising them by their likelihood of occurrence and potential impact on the project.

Throughout its maturation phases, e-JERICO will encounter both internal and external risks at different levels. These risks can have varying impacts on the success of the project. They encompass financial, operational, external, and reputational factors. To evaluate the potential impact of each identified risk, we utilised a risk matrix, ranking risks based on their likelihood and potential consequences (Table 12). By prioritising risks that are more likely to

occur and could significantly affect the project, section Risk Mitigation Plan will proactively address them and enhance the project's overall resilience.

5.2. Risk Mitigation Plan

Risk	Mitigation	Phase
Discontinuity of Blue Cloud or lack of agreement between JERICO and Blue Cloud	Alternative partnership development	Design, implementation
Federated partners	Iterative co-design process involving stakeholders and partners.	Implementation, operation
Federated and well established infrastructures	Work package to work on interfaces and metadata definition at the consortium level.	Implementation
Insufficient Funding	Diversify funding sources, seek additional grants, establish cost-saving measures without compromising quality.	Implementation, operation
Schedule uncertainties	Cyclic development, maintenance and operational process	Implementation
Design uncertainties	Cyclic development, maintenance and operational process	Design, implementation
Lack of service definition	Work package to work on interfaces and metadata definition at the consortium level.	Design, implementation, operation
Lack of User Adoption	Workshop and regular training.	Operation
Inadequate Technical Expertise	Recruit and retain qualified team members, invest in continuous skill development.	Design, implementation, operation
Poor stakeholder engagement	Cyclic development, maintenance and operational process	Design, implementation, operation
Data Breach or Security Breach	Implement strong data encryption, regular security audits, and strict access controls.	Operation
Technical Glitches and Downtime	Regular system maintenance, continuous monitoring, and rapid response protocols.	Operation
Information Loss or Corruption	Regular automated data backups, periodic data integrity checks.	Operation

Table 13: Key risks and their respective mitigation strategies during the e-JERICO development phases.

In the planning phase, once the project scope is well-defined and a comprehensive understanding of the risks is established, it is essential to develop effective strategies to mitigate or manage the identified risks. This involves a multi-faceted approach, including risk avoidance, where the cause of the risk is entirely eliminated; risk reduction, where steps are

taken to lessen the likelihood or impact of the risk; risk transfer, wherein responsibility for managing the risk is shifted to a third party through insurance or outsourcing arrangements; and contingency planning, with the development of backup plans to address potential consequences if the risk materialises.

To ensure ongoing risk management success, continuous monitoring and review are necessary. Regularly assessing the identified risks and the effectiveness of the implemented mitigation strategies will enable timely adjustments to the plan as needed, ensuring the project's overall resilience and success. In this section, we explain the mitigation plans for the risks identified in section Risk Assessment and Analysis.

6. Conclusion and Next Steps

In summary, this document represents a significance in the JERICO-DS project, presenting an all-encompassing, strategic blueprint for the evolution of e-JERICO. The inception of an e-infrastructure specific to JERICO, a concept first recognized during the JERICO-NEXT phase, is elaborately addressed here. Drawing from the experience harvested from the JERICO-DS project, we have elaborated a strategic plan for e-JERICO's future. Significantly, the knowledge garnered from the JERICO Coastal Ocean Resource Environment (JERICO-CORE) pilot have been pivotal in sculpting the core concepts and design of e-JERICO. This pilot e-infrastructure, in conjunction with other progressive strides made within the JERICO initiatives, has been critical in shaping the strategic direction, operational structure, and technical framework of e-JERICO.

The document aligns with the broader strategy of JERICO-RI, mirroring the aspirations and objectives of key national and international stakeholders. This strategic plan delineates the various stages of the project, tracing the path set out by the ESFRI roadmap from its genesis through to its active phases. It springs from an in-depth analysis of requirements, technical solutions, governance models, and operational methodologies conducted in WP3. This strategic plan encompasses economic analyses, risk evaluations, scheduling, resource allocation, and strategies for engaging stakeholders, all aimed at steering e-JERICO towards a successful implementation and operational life.

The detailed project plan for e-JERICO spans across the preparatory, implementation, operational, and concluding phases as per the ESFRI Roadmap. For each of these phrases section 3 includes milestones, initial planning, expected outcomes, and an informative visual summary.

Section 4 delves into the economic analysis, breaking down the costs associated with each component of the architecture. This facilitates the formulation of a budget under various scenarios, including different budget constraints, thus providing a clear framework for decision-making and prioritisation. This section also highlights the benefits and synergistic value of collaborations between EU Research Infrastructures.

The risk assessment and mitigation strategy, encapsulated in Section 5, is based on the project planning and the choices that underpin the cost structures. It underscores the project's proactive stance in navigating potential challenges and uncertainties.

In conclusion, this document charts a path forward, ensuring that e-JERICO supports the activities of JERICO-RI and significantly contributes to the progress of European research infrastructures.

7. References

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[6] Data Management Plan for e-JERICO added value products (JERICO-S3 D6.1)

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[11] JERICO-CORE Conceptual Design

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