



Grant Agreement 101079792, RESILIENCE PPP

IT Services Catalogue

Title of Deliverable:	IT Services Catalogue	
Deliverable Number:	D2.3 - BETA	
Type of Data:	Report	
Lead Beneficiary:	FSCIRE	
Publishing Status	Public	
Last Revision Date:	19/11/2024	by: R. DEMO
Verification Date:	21/11/2024	by: Francesca Cadeddu
Approval Date:	21/11/2024	by: Francesca Cadeddu
Document Name:	RESILIENCE_WP2_D2.3_ITServicesCatalogue_01.00_FINAL	



Funded by
the European Union

Change History

Version Nr	Date	Status	Name	Summary of Main Changes
00.01	25/10/2024	DRAFT	Initial Draft	
00.02	04/11/2024	Final Draft	First Review	Comments from KULeuven
00.03	11/11/2024	Final Draft	First Review	Comments from KULeuven
01.00	21/11/2024	BETA Final	-	Release of the Beta version

Author(s)

Name	Beneficiary	Role
Rudy DEMO	FSCIRE	WP Leader

Distribution List

Name	Beneficiary	Role
WP2	Various	Various
All	Various	Various

Table of Contents

1	Introduction	6
1.1	Objectives of this document	6
1.1.1	Long-term objectives	6
1.1.2	Recommendations for Developers	7
2	IT Services	8
2.1	Access to Physical & e-Infrastructures.....	8
2.2	Service Onboarding and Evolution.....	10
2.2.1	Aggregators & Integrators	11
3	Conclusion	13
4	Document Information.....	15
4.1	Reference Documents	15

Glossary

Term	Definition
API (Application Programming Interface)	A set of protocols that allow different software systems to communicate with each other, essential for integrating services in RESILIENCE with external platforms.
Authentication & Authorization Infrastructure (AAI)	Systems that manage user identities and control access to resources, using secure login mechanisms like SSO and MFA.
CESSDA	The Consortium of European Social Science Data Archives, which offers tools, data, and training specifically for social sciences research.
Compliance with Open Science and Research Policies	Ensures alignment with Open Science, FAIR data principles, and GDPR to support transparency, reproducibility, and accessibility of research outputs.
CI/CD	Continuous Integration/Continuous Deployment: Automated software development processes that include regular testing and deployment, ensuring reliable and consistent software updates.
DARIAH	A European Research Infrastructure Consortium for the arts and humanities that provides digital tools and resources for research in these fields.
Data Interoperability Standards	Standards that ensure data from different sources can be combined and used together, supporting seamless data exchange and integration.
Disaster Recovery & Business Continuity	Systems and protocols that ensure service and data recovery in the event of a system failure or disaster, ensuring research continuity.
European Open Science Cloud (EOSC)	A European initiative providing a cloud-based environment that enables researchers to store, share, and analyse data, supporting Open Science practices across disciplines.
FAIR Principles	Guidelines to ensure that data is Findable, Accessible, Interoperable, and Reusable, supporting open data standards and interoperability in research.
GDPR	The General Data Protection Regulation, an EU regulation that mandates data protection and privacy for all individuals within the European Union.
Green ICT Objectives	EU goals to minimize the environmental impact of digital infrastructure by promoting energy efficiency, sustainable data management, and eco-friendly practices.
High-Performance Computing (HPC)	Computing resources that enable data-intensive tasks and complex calculations, often necessary for large-scale research.
Metadata Harvesting	The collection of metadata across different platforms to ensure data discoverability and FAIR compliance, enhancing research data management.
Middleware Solutions	Software that connects different applications, data, or services, enabling interoperability and seamless data exchanges between platforms.
Service Aggregation	The process of collecting and organizing research tools, data, and services into a unified platform for easier access and discovery.
Service Registries	Tools for cataloguing and discovering available services within an ecosystem, helping users identify and access the resources they need.



Document Title:
Status:
Version:

IT Services Catalogue, D2.3
FINAL
01.00

Technology Readiness Level (TRL)

A scale used to assess the maturity of a technology, ranging from TRL 1 (basic principles observed) to TRL 9 (fully operational). IT Services in RESILIENCE are expected to meet TRL 9 for robustness.

Virtual Machines (VMs)

Virtualized computing environments that allow users to create isolated systems for research without requiring physical hardware.

1 Introduction

1.1 Objectives of this document

Deliverable 2.3 is described in the RESILIENCE PPP Grant Agreement as follows: «IT Services Catalogue: organised, curated and documented collection of any and all IT services supporting the user services operated on the RESILIENCE platform». This beta-version of the deliverable aims to provide a first overview of the IT Services Catalogue, the core technical services that form the backbone of the RESILIENCE Research Infrastructure (RI). These IT services are essential for enabling the delivery of user services to the scientific community, ensuring the performance, scalability, and robustness required to support large-scale, data-intensive research. They are critical for facilitating collaboration, data sharing, and computational activities among researchers in the field.

Aligned with the European Open Science Cloud (EOSC) initiative, these services offer researchers advanced tools while ensuring compliance with key principles such as Open Science, FAIR data principles, and GDPR. The catalogue details each service's functionality and its role in supporting the research lifecycle, meeting the technological needs of modern interdisciplinary research within religious studies.

This document presents services that are proven in real-world research environments, providing scalable solutions that align with the maturity and robustness required by research infrastructures like RESILIENCE. This catalogue is pivotal for documenting, analysing, and planning the IT services that will support the RESILIENCE User Services.

1.1.1 Long-term objectives

The IT services in this catalogue are designed around the following principles:

User-Centric Design: Services are tailored to meet the specific needs of researchers in religious studies, ensuring ease of use, high performance, and flexibility.

Sustainability, Scalability, and Security: Services are built to grow with increasing research needs, ensuring long-term sustainability through secure and scalable access and functionality.

Compliance with Open Science and Research Policies: Services comply with **Open Science, FAIR data principles**, and **GDPR**, supporting transparency, reproducibility, and long-term accessibility of research outputs.

Maturity and Robustness: The IT services demonstrate high **Technology Readiness Levels (TRL 9)** to ensure reliability. They integrate with the broader research ecosystem, enabling seamless collaboration and access to computational, storage, and network resources.

Alignment with EU Green ICT Objectives: In line with the EU's commitment to green digital transformation, the IT services prioritize energy efficiency, sustainable data management, and eco-friendly practices. This includes promoting energy-efficient digital infrastructures, exploring low-power computing solutions, and supporting sustainable practices across data centers and cloud services.

1.1.2 Recommendations for Developers

In alignment with D2.7 section 7.1 (Secure Software Development Lifecycle + DevSecOps) and/or the D2.8 Software Development Plan, RESILIENCE adopts the following guidelines to ensure systems deployed on RESILIENCE RI are interoperable and secure:

1. **Adopt Open Standards:** Utilize open standards (e.g., RESTful APIs, **OAuth2**) for seamless integration.
2. **Security by Design:** Implement encryption, secure authentication, and comply with **GDPR**.
3. **Modular Architecture with Containerization:** Use containerization technologies like **Docker** and **Kubernetes** for easy deployment and scalability.
4. **Compliance with FAIR and Open Science:** Align systems with FAIR principles and support Open Science initiatives.

Testing and Documentation: Provide extensive testing and documentation to ensure service integration and maintenance.

2 IT Services

2.1 Access to Physical & e-Infrastructures

This section covers already existing services enabling access to physical and electronic infrastructures that are relevant for the RESILIENCE RI. RESILIENCE leverages existing resources like **CINECA**, **EGI**, **EURO HPC** and **EOSC EU Node** to avoid the need for purchasing physical hardware. This approach ensures scalability and flexibility while aligning with modern scientific standards such as Open Science and FAIR data.

- Instruments & Equipment Access

Services providing access to digital tools and equipment essential for research on religion and digital humanities such as **DARIAH Integration**, **CLARIN**, **CESSDA**, **OPERAS**, facilitating access to digital humanities research tools, enhancing data analysis and research methodologies.

- Computing Resources

Services offering computational resources for processing large datasets and complex computations required in research projects, such as **Access to HPC and Cloud Resources**: through partnerships with **CINECA**, **EGI**, **EURO HPC** and **EOSC EU Node**, researchers gain access to high-performance computing (HPC) and cloud-based computing resources.

- Data Storage Solutions

Services providing scalable and secure storage for large datasets and research outputs, like the following:

RESILIENCE Community: all deliverables respecting our D2.4 Data Management Plan, in which the metadata requirements are included, are published as part of our community.

Zenodo Integration: Enables the storage and publication of research outputs on **Zenodo**, ensuring compliance with FAIR principles and enhancing visibility.

EUDAT B2SHARE and B2DROP: Offer data sharing and synchronization services among research teams.

EOSC EU Node - File sync and share: Offer secure file synchronization and sharing through the EOSC platform.

D4Science StorageHub: Provides a platform for data storage and management tailored to research needs.

- Virtualization

Virtualization services provide flexible, isolated environments for conducting research experiments, developing software, and managing computational workflows. By using virtual machines (VMs) or containerized applications, researchers can create customizable, reproducible setups for their projects without needing dedicated physical hardware. This approach enables efficient use of resources, scalability, and easy deployment across various platforms.

Virtual Machines (VMs): Through partnerships with providers like EOSC EU Node, CINECA, D4Science and EGI, RESILIENCE offers access to virtual machine resources, allowing researchers to configure isolated computing environments tailored to their specific needs.

The Interactive Notebooks service on EOSC EU Node is a managed JupyterHub environment that allows researchers to create and share documents with live code, equations, and visualizations.

Containerized Environments: Utilizing container platforms (e.g., Kubernetes on EOSC), researchers can deploy and manage applications with increased portability, ensuring consistent performance and reproducibility across different infrastructures.

- Security & Operations

The Security & Operations services are foundational to maintaining the integrity, reliability, and resilience of the research infrastructure. This section covers critical IT services dedicated to safeguarding data, managing secure access, and ensuring the smooth, uninterrupted operation of IT resources. By implementing robust security measures and comprehensive infrastructure management practices, these services support the trustworthiness and sustainability of the research ecosystem.

The Security & Identity Management services focus on protecting sensitive information and controlling access through reliable authentication and encryption methods. Meanwhile, Operations & Infrastructure Management services are responsible for monitoring and maintaining system performance, automating key functions, and preparing for disaster recovery to support ongoing research activities.

Together, these services provide a secure, stable, and efficient operational environment that aligns with compliance standards and best practices, ensuring researchers can rely on an infrastructure that meets high standards of security and reliability.

To these objectives, RESILIENCE has published D2.7 - Security Management Plan, which is a comprehensive document that encompasses all the aspects of the entire RI's security landscape.

- Security & Identity Management

Services dedicated to protecting the infrastructure, securing user access, and managing user identities, such as:

Authentication & Authorization Infrastructure (AAI): Implements secure login mechanisms such as Single Sign-On (SSO) and Multi-Factor Authentication (MFA) using platforms like **My Access ID**, **eduGAIN** and **EGI Check-in**.

Data Encryption: Ensures data is encrypted both in transit and at rest to protect sensitive information.

Security Monitoring & Incident Response: Provides continuous monitoring for security threats and a defined response plan for incidents.

- Operations & Infrastructure Management

Services ensuring reliable infrastructure performance and maintenance, such as:

Monitoring & Alerting Systems: Implements real-time system performance and uptime monitoring using tools like **Nagios** or **Zabbix**.

Automation & Orchestration: Utilizes automation tools for backups, load balancing, and service scaling with technologies like **Ansible** and **Kubernetes**.

Disaster Recovery & Business Continuity: Establishes backup services to ensure minimal downtime and data loss, maintaining continuity of research activities.

- Service Integration and Interoperability

This section addresses the technical frameworks and best practices needed to connect and align RESILIENCE infrastructure with other research platforms. Ensuring seamless integration and data interoperability is essential for fostering collaboration, expanding resource access, and aligning with the broader European Open Science ecosystem, including platforms like EOSC and SSHOC.

Service integration focuses on establishing standard APIs, data formats, and middleware solutions that enable RESILIENCE to interact smoothly with other research infrastructures. These efforts support the flexible exchange of data and applications, adhering to Open Science and FAIR principles. In addition, Recommendations for Developers provide essential guidelines for researchers and developers to design systems that are interoperable, secure, and compliant with key standards. By adopting open standards, prioritizing security, using modular architecture, and maintaining rigorous testing and documentation, developers can ensure that their systems can integrate seamlessly with the RESILIENCE infrastructure, enhancing both the robustness and accessibility of research services.

To facilitate seamless integration with other platforms and ensuring system and data interoperability, RESILIENCE considers the following:

API Integration: Develops standardized APIs for integration with **EOSC**, **SSHOC**, and other platforms.

Data Interoperability Standards: Adopts standardized data formats and compliance with Open Science recommendation as mentioned in D2.4 Data Management Plan.

Middleware Solutions: Implements middleware services to enable cross-platform data exchanges and service integration.

2.2 Service Onboarding and Evolution

This section outlines the preliminary framework for incorporating new IT services into the RESILIENCE infrastructure while ensuring they remain relevant and aligned with evolving research needs. The detailed processes, standards, and tools for onboarding and service evolution will be defined in upcoming phases of the RI's development, particularly during the implementation phase. This approach is crucial for maintaining a flexible and scalable research environment that can adapt to emerging technologies and user requirements.

The Onboarding Procedures will be developed as part of the RI's future deliverables. These procedures will provide a structured approach for evaluating and integrating new services, emphasizing compliance with RESILIENCE's strategic objectives and technical standards, as defined in documents like D2.4 Data

Management Plan and D2.7 Security Management Plan. Each service is expected to meet a Technology Readiness Level (TRL) of 9, ensuring that all onboarded services are fully operational, reliable, and robust for use by the research community.

Continuous Improvement and Roadmap planning will be conducted during the implementation phase. This process will involve regular assessments and updates based on user feedback and technological advancements. By planning these activities for the implementation phase, RESILIENCE ensures that it can offer state-of-the-art tools and platforms that meet the highest standards for performance and interoperability.

The following subsections outline services that facilitate integration at multiple levels: Aggregators & Integrators for combining various research platforms, Data Aggregation to ensure interoperability of research data, Application and Software Integration to support flexible deployment and collaboration, and Additional Support Services that provide training and technical support for seamless use and adoption.

Some of these services are planned for future development, while others involve leveraging existing tools from RESILIENCE or other providers. These efforts collectively aim to enhance the research capabilities within RESILIENCE, creating a cohesive ecosystem where services, data, and applications work in concert to support the academic community.

2.2.1 Aggregators & Integrators

This section introduces services and tools that integrate various platforms, tools, and data sources, enhancing research capabilities within the RESILIENCE infrastructure. These are guidelines and principles that will inform the development and integration of services in later RI's development phases. The focus is on ensuring that the RESILIENCE infrastructure can effectively interoperate with other research platforms and resources.

- Service Aggregation

Services that aggregate research tools and services into a unified platform:

Service Registries: Tools for cataloguing and discovering available services within the RESILIENCE ecosystem.

Interoperability Layers: Middleware facilitating integration between different research platforms.

Service Monitoring Dashboards: Tools for tracking service health and availability across infrastructures.

- Data Aggregation

Support for data integration and interoperability:

Data Mapping and Transformation Tools: Allow researchers to integrate and align data from different sources using common standards and ontologies.

Metadata Harvesting Services: Tools for collecting metadata across platforms to ensure FAIR compliance and enhance discoverability.

- Application Integration

Integration of research applications with existing services:

API Management Platforms: Tools to securely expose and manage APIs for research services.

Containerization and Virtualization: Use of containerized environments for easy deployment and scaling of research applications across infrastructures. See also section 7.

- Software Integration

Support for software development and integration:

Version Control Systems: Encourages the use of platforms like **GitHub** or **GitLab** for managing software projects and collaborations.

Continuous Integration/Continuous Deployment (CI/CD): Integrates automated testing and deployment pipelines to ensure software reliability.

- Additional Support Services

Other integrative services for researchers:

Training & Documentation: Provides comprehensive documentation and training materials for researchers to effectively use and integrate services.

Technical Support & Consultancy: Offers expert assistance to help research teams integrate their services and data with the RESILIENCE platform.

3 Conclusion

The development of the IT Services Catalogue marks a pivotal advancement in the establishment of the RESILIENCE Research Infrastructure (RI), setting a comprehensive technological foundation that is meticulously aligned with the specialized needs of researchers in religious studies and digital humanities. This catalogue not only enumerates a first list of the core technical services but also embeds them within a framework of principles and guidelines that ensure their sustainability, scalability, and interoperability within the broader European research ecosystem.

By adopting a user-centric design philosophy, the catalogue ensures that all services are tailored to facilitate ease of use, high performance, and flexibility, directly addressing the specific workflows and research methodologies prevalent in religious studies. This focus enhances the researchers' ability to engage with complex data, employ advanced computational resources, and collaborate across interdisciplinary teams, thereby fostering a more dynamic and productive research environment.

The emphasis on sustainability, scalability, and security within the IT services is particularly critical. By leveraging existing infrastructures such as CINECA, EGI, EURO HPC, and the EOSC EU Node, RESILIENCE avoids redundant investments in physical hardware, promoting an efficient use of resources that can adapt to the evolving demands of large-scale, data-intensive research. The incorporation of robust security measures, as outlined in the D2.7 Security Management Plan, ensures that data integrity and user privacy are maintained, aligning with GDPR compliance and fostering trust within the research community.

The recommendations for developers underscore the importance of building interoperable and secure systems. By advocating for the adoption of open standards, security by design, modular architectures with containerization, and thorough testing and documentation, RESILIENCE ensures that new services can be seamlessly integrated into the existing infrastructure. This approach facilitates ongoing innovation while maintaining the integrity and reliability of the research ecosystem.

The detailed delineation of services—including access to physical and e-infrastructures, virtualization, security and operations, and service integration—provides a clear roadmap for both current capabilities and future developments. The planned onboarding procedures and continuous improvement strategies indicate a commitment to adaptability and responsiveness to user feedback and technological advancements. By planning these activities for the implementation phase, RESILIENCE demonstrates foresight in maintaining the relevance and efficacy of its services in a rapidly evolving technological landscape.

Moreover, the catalogue acknowledges the necessity of aggregators and integrators, data aggregation tools, and application and software integration services. These components are essential for fostering interoperability with other research platforms such as EOSC and SSHOC, enhancing collaborative opportunities, and expanding the reach and impact of research conducted within the RESILIENCE framework.

In conclusion, the IT Services Catalogue serves as a foundational element that not only supports the current technological needs of the RESILIENCE RI but also provides a scalable and adaptable framework for future growth. It encapsulates a strategic alignment with key research policies, technological standards, and sustainability goals, ensuring that the infrastructure remains robust, secure, and at the cutting edge of research support. The catalogue is a testament to RESILIENCE's commitment to empowering researchers through advanced technological solutions, fostering innovation, and contributing significantly to the advancement of scholarly knowledge in religious studies and beyond.



Document Title:
Status:
Version:

IT Services Catalogue, D2.3
FINAL
01.00

The forthcoming inclusion of detailed links and references to key documents, standards, and resources will further enhance the utility of the catalogue, providing users and developers with immediate access to essential information that supports the implementation and utilization of the IT services.

4 Document Information

4.1 Reference Documents

Reference documents are intended to provide background and supplementary information.

ID	Date	Title/Reference
R1	18/08/2022	GRANT AGREEMENT Project 101079792 — RESILIENCE PPP
R2	22/02/2023	ITSERR – Stakeholders Analysis



Funded by
the European Union