RESILIAGE
Revolutionising community resilience

D3.1

RESOURCES ECOSYSTEM for Community Resilience. First Release

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Table of Abbreviations and Acronyms

Abbreviation	Meaning
API	Application Programming Interface
AWS	Amazon Web Services
CC	Climate Change
CCA	Climate Change Adaptation
CH	Cultural Heritage
CORE labs	Community Resilience laboratories
CTA	Call to Action
DDP	Data-Driven Platform
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
DSS	Decision Support System
FAIR	Findable, Accessible, Interoperable, and Reusable
FR	First Responder
IAM	Identity and Access Management
ICT	Information Communication Technologies
JWT	JSON Web Token
LL	Lesson Learned
MFA	Multi-factor Authentication
MoRe Dashboard	Monitoring Dynamic Resilience Dashboard
MultiAtlas	Multidimensional Atlas for Community Resilience
MultiMode	Multi Agent Social Network Modeling for resilient Behaviour
MultiWarn	Multi-hazard early Warning detection system

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NAT	Network Address Translation
PP	Preparedness Planning / Preparedness Plan
RAISE	Resilience Assessment Interactive Self-Enabler
RECORE	Resource Ecosystem for Community Resilience
SAML	Security Assertion Markup Language
SD	Sustainable Development
SDK	Software Development Kit
SSH	Social Sciences and Humanities
SSO	Single Sign-On
SyRI	Systemic Resilience Innovation frameworks
URL	Uniform Resource Locator
UI	User Interface
UX	User Experience
VPN	Virtual Private Cloud
VR	Virtual Reality
WP	Work Package

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1. Executive Summary

The deliverable "*D3.1 Resource Ecosystem for Community Resilience. First Release"*, serves as a compendium report within WP3 of the RESILIAGE project, and more specifically is delivered in the framework of the activity of "*Task 3.1 Resource Ecosystem for Community Resilience and Tools Integration"*. This documentation accompanies the initial rollout of the RESILIAGE Resource Ecosystem for Community Resilience (RECORE) that is the digital platform and the core engine of the RESILIAGE project. The first version of the RECORE is accessible at https://resiliage-ecosystem.eu.

The RECORE is an **open digital platform** that integrates digital tools and addresses the preliminary needs and tool requirements identified in the COmmunity REsilience laboratories (CORE labs), that are the five pilots representing a wide range of cultural geographical regions in Europe affected by natural disasters and climatic crisis. Tools are **co-created with community-based methodologies** with/within the CORE labs that are data and information providers. They will be validated in two steps (initial validation and final validation) within the CORE labs and their multiple stakeholders' networks (WP5). Moreover CORE Associated labs (T7.2) will be enabled to use and test the RECORE with its integrated tools.

This report documents the initial version of the integrated RECORE platform, which serves as a foundational base featuring a variety of digital tools aimed at enhancing community resilience to disasters. The platform is designed to support and address the needs of four main target groups, ensuring that diverse stakeholders are equipped to improve disaster preparedness and response. The platform acts as a dynamic hub for data integration, information exchange, and collaborative efforts, facilitating ongoing use and reuse, and facilitating the development and implementation of effective Disaster Risk Management (DRM) strategies. It has been conceived as **a tool of integrated tools** for

- analysing and monitoring community resilience;
- supporting communities and multiple stakeholders' exchanges;
- replicating RESILIAGE approach and methodologies.

The first-version of the RECORE address the current platform's core functionalities, showcasing its potential to enhance Disaster Risk Reduction (DRR) and transform the implementation of DRM practices by integrating innovative digital tools with community-based specific insights, data and methods. It also expands the knowledge and information produced till now by other WPs (WP1, WP2), and that will be produced, (WP2, WP4, WP5, WP6, WP7).

The final release of the Resource Ecosystem for Community Resilience "*D3.5 Resource Ecosystem for Community Resilience. Final Release"* is scheduled (M36) will incorporate updates and enhancements based on feedback from the initial release, further refining the platform's capabilities to support resilient communities across Europe. The final release will also address additional requirements and integrate further tools' releases to expand the platform's scope and functionality.

This report is structured as follows:

- *Section 2* introduces the report and provides an overview of the RESILIAGE project's key aspects related to the scope of Deliverable D3.1.

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- *Section 3* highlights the project's data-driven and evidence-based approach to enhancing community resilience, emphasizing the role of data integration and analysis in DRM as well as the overall user-friendliness and User Experience (UX) approach.

- *Section 4* details the software architecture underlying the RECORE platform, explaining its technical framework, design principles, and components that ensure functionality, scalability, and accessibility.

- *Section 5* overviews the Analytical Monitoring RESILIAGE Toolkit, which assesses and monitors community resilience, focusing on reducing misinformation and improving disaster communication. The developments of this toolkit will be detailed and covered in D3.2.

- *Section 6* discusses the Supporting Systemic Community Resilience Set, designed to support long-term community resilience strategies through knowledge exchange and stakeholder engagement. The developments will be detailed in D3.3.

- *Section 7* introduces the RESILIAGE Replication Toolbox, which helps communities replicate the project's methodologies for risk analysis and preparedness planning. Developments and details will be provided in D3.4.

- *Section 8* concludes the report by summarizing key findings, reflecting on progress, and outlining future directions of RECORE for the RESILIAGE project.

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2. Introduction

In the face of escalating climate crises and a variety of natural induced disasters that often trigger cascading effects, the RESILIAGE project emerges as a pivotal initiative aiming at enhancing societal awareness and fostering inclusive resilience. These global challenges necessitate a shift towards a sustainable society characterized by improved access to information, digital innovation, and innovative, community-driven strategies for disaster preparedness and response. Central to this vision is the RESILIAGE's innovative approach of leveraging Cultural Heritage (CH) as a valuable resource for community resilience. CH, with its deep-rooted traditions and collective wisdom, serves as a crucial asset in building stronger, more cohesive communities capable of withstanding the challenges posed by modern-day disasters.

Within this framework, the RESILIAGE project conceives, builds, co-designs, and validates the **open** digital *Resource Ecosystem for Community Resilience* accessible at https://resiliage-ecosystem.eu.

This platform is conceived as a "tool of tools" to reflect the project's holistic and systemic approach. It integrates a comprehensive suite of digital resources designed to analyse, support, and foster resilience within communities. Moreover, data integration (both non- and real-time) are managed through the centralized RESILIAGE Data Lake, which aggregates data from various sources across the WPs activities by reinforcing the concept of "integrated tools" and making all the data Findable, Accessible, Interoperable, and Reusable (FAIR),.

By engaging directly with local communities in the development process, RESILIAGE ensures that the platform is tailored to meet the needs and challenges faced by different endangered regions.

The RECORE is not only a technological solution but also aims to facilitate multi-stakeholder collaboration, bringing together diverse groups to work collectively towards DRR and Sustainable Development (SD). It serves as a central hub for multiple stakeholders in communities to access critical information, share best practices, and coordinate efforts in disaster preparedness and response. It addresses RESILIAGE identified main target groups that are decision-makers, First Responders (FRs), knowledge organisations, civil societies associations. According to RESILIAGE approach diversities and variations in society are taken into account including vulnerable groups.

Privacy policies are included, and data storage take into account RESILIAGE Ethical guidance (D8.3).

The platform, shown in Figure 1, is open and accessible to all for reading and testing. However, some direct interactions require registering and logging.

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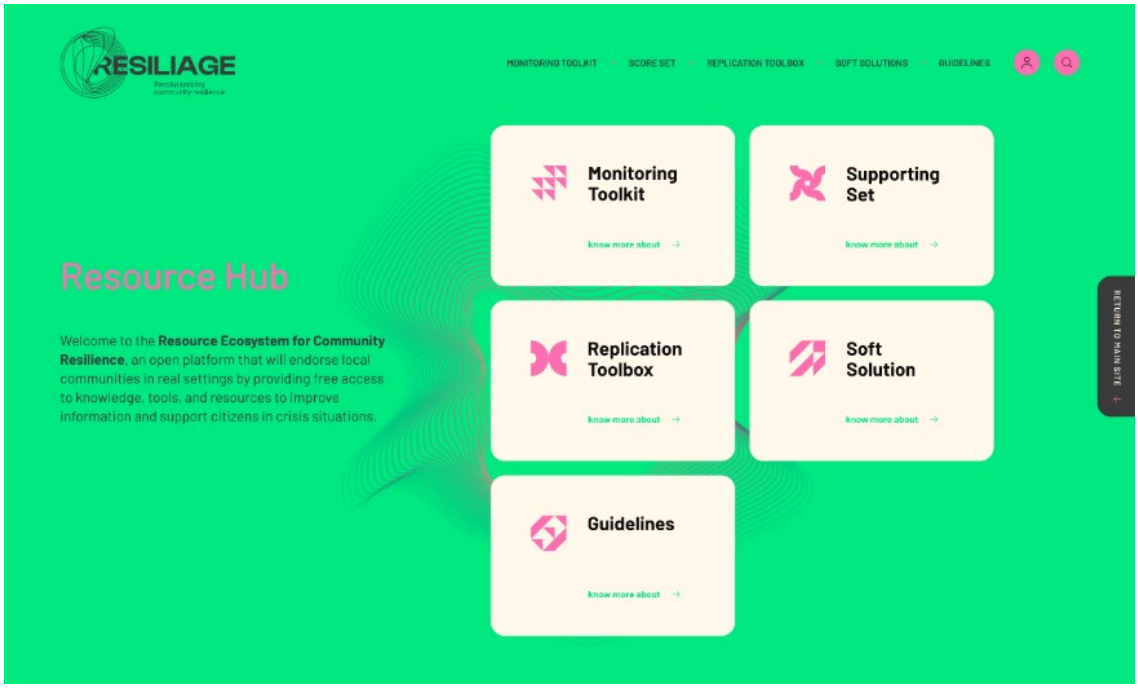

Figure 1 - Resource Ecosystem for Community Resilience (RECORE) interface of the Welcome page (Mock-up)

Moreover, as a comprehensive project's hub, it also incorporates and makes available the RESILIAGE Soft Solutions and the *RESILIAGE Guidelines and Recommendations* for leveraging heritage as a resource of community resilience.

2.1. Project Overview

RESILIAGE, aligned with the Sendai Framework and the 2030 Agenda, considers the need of enhancing societal resilience. In this aim, the project frames community resilience with the objective of advancing our understanding of human behaviours and exploring cultural natural heritage drivers. Its goal is building new knowledge on community resilience by accessing heritage drivers for DRR and contribute to Climate Change Adaptation (CCA) strategies by implementing the SENDAI framework.

To this scope, the research project shapes a holistic and systemic approach, to deal with interlinked psychological, social, cultural, historical, economic, and environmental factors that characterise human behaviours in order to consider them for the enhancement of societal preparedness into the overall DRM.

RESILIAGE relies on community-based methodologies by considering the need of improving collaboration and communication among multiple stakeholders of DRM and co-creating together resilient communities for SD. It facilitates critical thinking using novel data and tools, both digital and non-digital, activating CH as a powerful resource of local communities.

All the developments of the project are co-shaped and validated in five CORE labs, representative of main climatic and environmental challenges in Europe and different heritage's typologies, as detailed in Figure 2.

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		CORE labs large-scale scenarios				
		Karşıyaka CORE lab	Trondheim CORE lab	Naturtejo CORE lab	Crete CORE lab	Famenne-Ardenne CORE lab
Affected population		340.000	180.000	86.729	630.000	67.000 ca.
SyRI		Adaptive Governance	Health and Wellbeing	Social interaction and inclusiveness	Active Memory	Socio-economic resilience
Main Hazards	Heatwaves					
	Landslides					
	Earthquakes					
	Wild-fires					
Other Hazards	Floods					
	Rainstorms					
	Urban fires					
Governance scale		City District	Municipality	Municipality network	Regional	Cross-regional
CORE lab network (e.g., citizens associations, first responders, policy makers, vulnerable groups)		✓	✓	✓	✓	✓
Existing tools		IZUM (Izmir Disaster and Transportation Communication Tool)	CIM for alerting volunteers and staff	App for real time information on national wildfires; GIS information App on national Forest wildfires, and fire risk provider	Permanent exhibition hall of NHMC which informs and trains on natural hazards, the Earthquake simulator, the Evande distant learning platform	Geoportal for real data collection for floods hazard, Flood Management Risk plan, Emergency alarm system app, Citizen preparedness website

Figure 2 - Overview of CORE labs

It should be noted that a Call for CORE Associated labs has been launched to activate (five at least) more communities within the RESILIAGE activities from January 2025 (T7.2). The CORE Associated labs will be enabled to use and test the RECORE with its integrated tools.

Due to the information complexity and the diverse data sources, the RESILIAGE framework is implemented in a multiscale and multisource Data-Driven Platform (DDP) as delivered in D1.3, able to provide the necessary information for shaping a holistic rich analytical framework, collecting new data and information, integrating existing data and information, and developing Preparedness Plans (PPs) and adaptive governance.

2.2. Aim of the Report

The aim of this report is to provide a documentation to accompanies the RECORE demonstrator available at https://resiliage-ecosystem.eu, as the development and initial implementation. Indeed, this report serves as a comprehensive guide to the project's progress in creating an integrated DDP that empowers community resilience through the use of integrated digital tools and community-based methodologies. By documenting the design, functionality, and preliminary outcomes of the RECORE, this deliverable provides valuable insights into the project's approach to DRR and SD.

As the engine of the RESILIAGE project, the platform (therefore D3.1), represents some synthesis of the work done (and still in progress) across all project's WPs also delivered by other reports. As an integral component of the RESILIAGE project, the RECORE integrates the outcomes and knowledge developed in other WPs, providing tools that not only assist communities in building resilience but also generate additional shared knowledge. This interconnection ensures that the platform reflects the comprehensive expertise and innovations arising from the collaborative efforts within the project, as shown in Figure 3.

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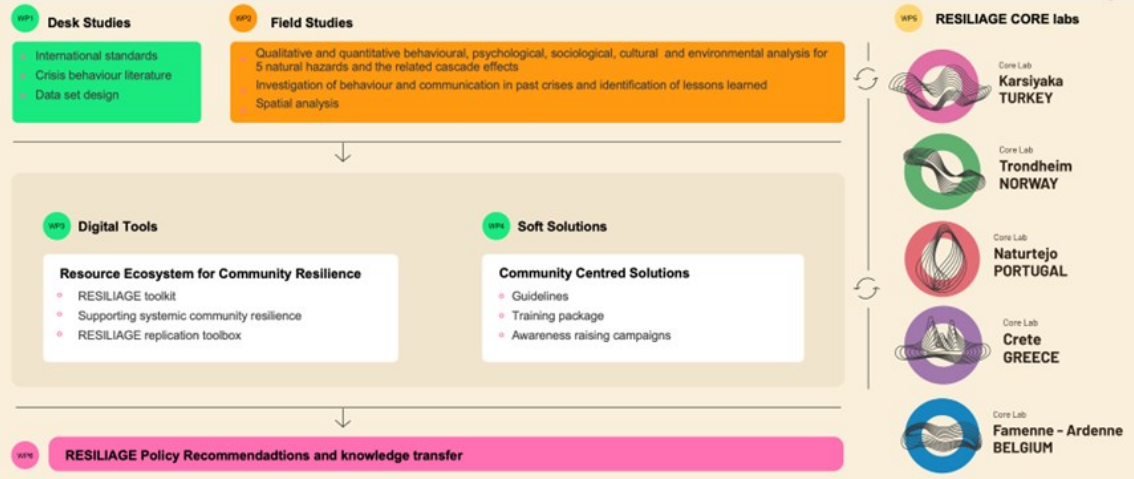

Figure 3 - Digital tools within the RESILIAGE workflow

Due to the evolving nature of this deliverable, the manuscript will be updated to reflect the development of the tools and incorporate feedback from the CORE labs into the final version (D3.5).

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3. Data-driven and evidence-based approach via RECORE

This section introduces and discusses the various technologies and paradigms that form the backbone of the design and implementation of the RECORE. Its implementation is grounded in a comprehensive understanding of the complex interactions between environmental, social, and cultural factors that influence community resilience. By integrating diverse data sources, such as social media, meteorological data, and local community inputs, the platform wishes to offer a holistic approach to risk and resilience dynamics. The section also provides insights into the user-centred design and the user-friendliness approach that encompasses the platform and the tools

3.1. The Tool of Tools: Resource ecosystem holistic integrated approach design

The RECORE is conceived for local communities to implement effective DRM and resilience-building strategies in real-world settings. It focuses on three main objectives: i) analyzing and monitoring community resilience, ii) supporting multistakeholder exchanges and long-term resilience strategies, and iii) replicating the RESILIAGE community-based approach and methodologies.

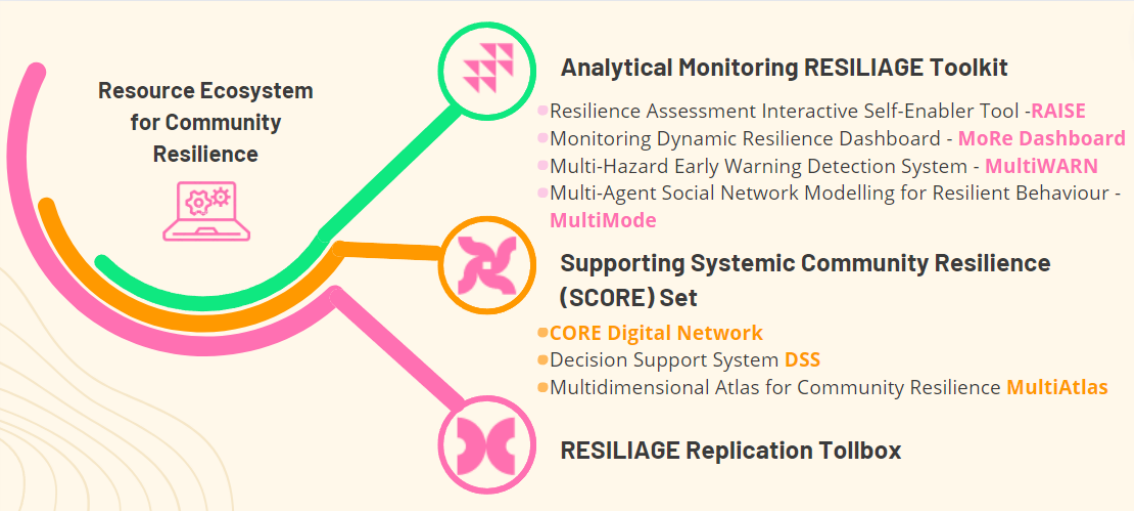

Figure 4 - The tools clusters of the RESILIAGE RECORE

The RECORE provides several tools that have been clustered accordingly as shown by Figure 4.

3.1.1. Methodology for RECORE Building

The overall RESILIAGE approach identifies methodologies that are reflected in the RECORE building to ensure effective long-term strategies. They are:

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1) Holistic and systemic approach

Target Groups		
	First Responders	• Firefighters • Law enforcement officers • Paramedics • Emergency medical technicians
	Policymakers and heritage managers	• Local, regional and national authorities • Governing bodies and institutions • International organisations • EU agencies • Administrators • Heritage managers
	Citizens and civil society organisations	• Citizens including vulnerable categories • Volunteers • Communities • Civil society organisations • Associations • NGO
	Knowledge organisations	• Academia • Research organisations • Educational centres • Training centres

Table 1 - RESILIAGES's Target Groups

The Resource Ecosystem is designed to support a holistic and systemic approach to DRM by facilitating the implementation of the Sendai Framework. It enables the analysis and monitoring of community resilience while supporting the enhancement of PPs. According to RESILIAGE the approach has been shaped to consider **4 main target groups** (D7.1 has provided a general overview, as shown in Table 1 that have been identified as the main leading actors for DRR. They encompass and take into account a range of various stakeholders with their different needs, behaviours, and requirements.

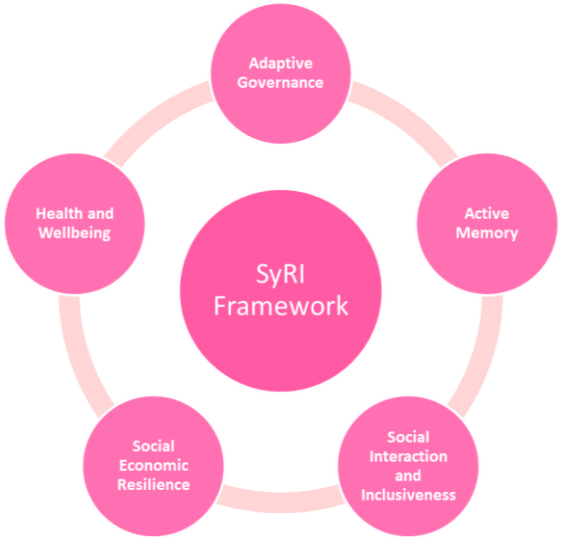

Figure 5 - The Systemic Innovation Resilience framework (SyRI)

For achieving its long-term strategy, RESILIAGE identifies a **Systemic Resilience Innovation framework** (SyRI) to identify main community resilience drivers.

As shown by Figure 5 the SyRI focuses on the following gaps and opportunities:

- Adaptive Governance
- Active Memory
- Social interaction and inclusiveness
- Social economic resilience
- Health and wellbeing

Within the RECORE they are understood as crosscuttings community resilience's issues to address and valorise as specific requirements. **Although the main finalisation of RESILIAGE is preparedness enhancement, the systemic approach** is reflected in RECORE by tools also addressing different stages of DRM, as detailed in Table 2.

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RECORE Resource Ecosystem for Community Resilience		Digital Tool	Prioritisation of DRM stage	Prioritisation of target groups
	Analytical Monitoring RESILIAGE Toolkit	Resilience Assessment Interactive Self-Enabler - **RAISE**	**PREPAREDNESS** Enhances public awareness and fosters community commitment for a culture of resilience	Citizens and civil society organisations
		Monitoring Dynamic Resilience Dashboard - **MoRe Dashboard**	**PREPAREDNESS** Provides real-time, actionable information for monitoring the implementation of PPs	Policymakers, First responders
		Multi-hazard early warning detection system - **MultiWarn**	**PREVENTION/PREPAREDNESS** Provides timely alerts and insights, enabling proactive disaster management	Policymakers, First responders, citizens and civil society organisations
		Multi-agent social network modelling for Resilient Behaviour **MultiMode**	**PREPAREDNESS** Analyses and simulates stressed social networks for disaster resilience and communication strategies	Policymakers, First Responders
	Supporting Systemic Community Resilience Set (Score Set)	**CORE Digital Network**	**Overall DRM** Enhances and facilitates the interaction and engagement among multiple stakeholders	First responders, Knowledge organisations, Policymakers, Citizens and civil society organisations
		Decision Support System - **DSS**	**Overall DRM** Shares Lessons Learned (LLs) and best practices, to support CORE labs in shaping strategic actions for enhancing DRM and PPs	First responders, Policymakers, Knowledge organisations
		Multidimensional Atlas for Community Resilience - **MultiAtlas**	**Overall DRM** Supports decision-making and strategic planning that structurally integrates heritage as a resource for DRR	Knowledge organisations, Policymakers, Citizens and civil society organisations
	RESILIAGE Replication Toolbox	**RESILIAGE Replication Toolbox**	**Overall DRM** Collects LLs and Key Indicators, with their prioritisation for SyRI strategies, providing new knowledge to advance community resilience	First responders, Knowledge organisations, Policymakers, Citizens and civil society organisations

Table 2 – RECORE multi-stakeholders' engagement for DRM

2) Community-based methodologies

CORE labs	Specific Vulnerable Groups
Crete	Children
Naturtejo	Elderly migrants
Famenne-Ardenne	Elderly citizens and tourist
Trondheim	Youth
Karsiyaka	Women and citizens with low income

Table 3 - Specific Vulnerable Groups of CORE labs

The RECORE is conceived to shape bottom-up solutions with collaborative target groups engagement at local level via CORE labs. Each CORE lab especially addresses one of the five main issues as shown Table 3, and they also frame specific

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3) Multiple stakeholder engagement

It should be noted that the RESILIAGE consortium, as well as the CORE labs networks, have been shaped to encompass the four identified main target groups.

The RECORE creates various kinds of engagement across stakeholder types within the CORE lab, across the CORE labs, and beyond. It will be also available for the use of the CORE Associated labs (Task 7.2).

4) Co-creation

RESILIAGE tools are co-created with/within the CORE labs with their diverse specification of main natural hazard type and Climate Change (CC) related issues and cascading effects via SyRI. Research strategy pre-requirements enable RESILIAGE digital tools co-creation across various collaborative activities developed throughout the RESILIAGE WPs. They therefore include a plurality of multiple stakeholders' needs, issues and point of views. Tools are shaped to analyse and monitor gaps and opportunities to foster community resilience by leveraging diversities.

Specific attention is provided to supporting and leveraging local heritage drivers of community resilience.

5) Validation

Tools validation in two steps includes an Initial validation (T5.2), and a Final validation (T5.3) with/in CORE labs across the project life cycle. Modalities and timing have been organised and presented in the Validation Plan delivered in D5.1.

Accordingly, the RECORE building methodology includes a gradual and progressive design that encompasses co-creation with CORE labs throughout various kind of RESILIAGE activities to incorporate new knowledge and customise tools for innovative solutions.

3.1.2. User Requirements

User requirements have been analysed and information gathered through **collaborative workshops**. They have been organised since the Kick-off meeting(September 2023) in order to collect information and immediately start to address specific requirements of multiple stakeholders. Other workshops have been organised at the occasion of the General Assemblies.

More specific focus groups and heritage collaborative workshops and experiments focusing on the intersection of psychological, social, cultural, historical, environmental factors of human behaviours have been organised and are ongoing (WP2) to develop specific information on DRR stakeholders' behaviours **into CORE labs** as well as other collaborative activities for the enhancement of communication and public awareness and commitment via heritage drivers (WP4). RECORE tools are providing support for gathering information, storing and analysing data, and customising tools as innovative solutions. In some cases, tool developments are conceived to be shaped in two steps, by collecting information first, and customised to the requirements (e.g. RAISE tool) later. Moreover, some parallel inquiries have been developed in the context of other project activities for developing critical thinking across the research project. The T2.1 (lead by

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POLITO) has created multiple stakeholders' engagement for shaping some common basic understanding of community resilience and heritage drivers within the research consortium as well as inclusive community resilience through Summer School activities (2 editions in September 2023 and June 2024 organised by POLITO and UNESCO in the framework of T6.3). These activities have also more specifically framed **gender requirements** as a specific need to be considered among user requirements.

According to the RESILIAGE approach and SyRI methodology vulnerable groups requirements are also included among users and their requirements. Further specifications of user needs are also expected by WP4 focusing on developing information on training needs.

3.1.3. Accessing RECORE

The RECORE is designed with user requirements in mind to ensure a user-friendly and convenient experience for all stakeholders, including community members and FRs. To achieve this, the platform will undergo testing, validation, and continuous improvement, culminating in a final validation phase. RECORE offers two primary methods of access, each tailored to provide seamless entry and interaction with the digital tools and data available within the platform:

1. The first method of access is through the official project website, www.resiliage.eu. This integration allows users of all types to explore the broader context of the RESILIAGE initiative, providing a clear understanding of how the RECORE aligns with the overall framework of DRM and community resilience.

2. The second method is direct access through a specific URL https://resiliage-ecosystem.eu. This approach is particularly useful for user already engaged who require quick and direct entry to the platform without navigating through additional pages or content.

Both access methods are designed for intuitive and effortless engagement with the RECORE. Whether users enter through the official project website or a direct URL, the platform ensures easy access for all individuals and organizations involved in DRM and disaster preparedness. These entry points create an open, inclusive digital environment that fosters collaboration and supports the shared goal of building a safer and more resilient society.

The two access modes are described in detail in the following.

1. Access via the official project website

Users can easily access the RECORE through the official project website, which is located at https://resiliage.eu/. The website serves as a central hub for the RESILIAGE project, providing comprehensive information about its goals, activities, and achievements (D7.1). Within the website, users will find a dedicated section that links directly to the Resource Ecosystem, as shown in Figure 6 (i.e., red arrow). This

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integration ensures that users can easily navigate from project-related content to the interactive tools and data services offered by the ecosystem.

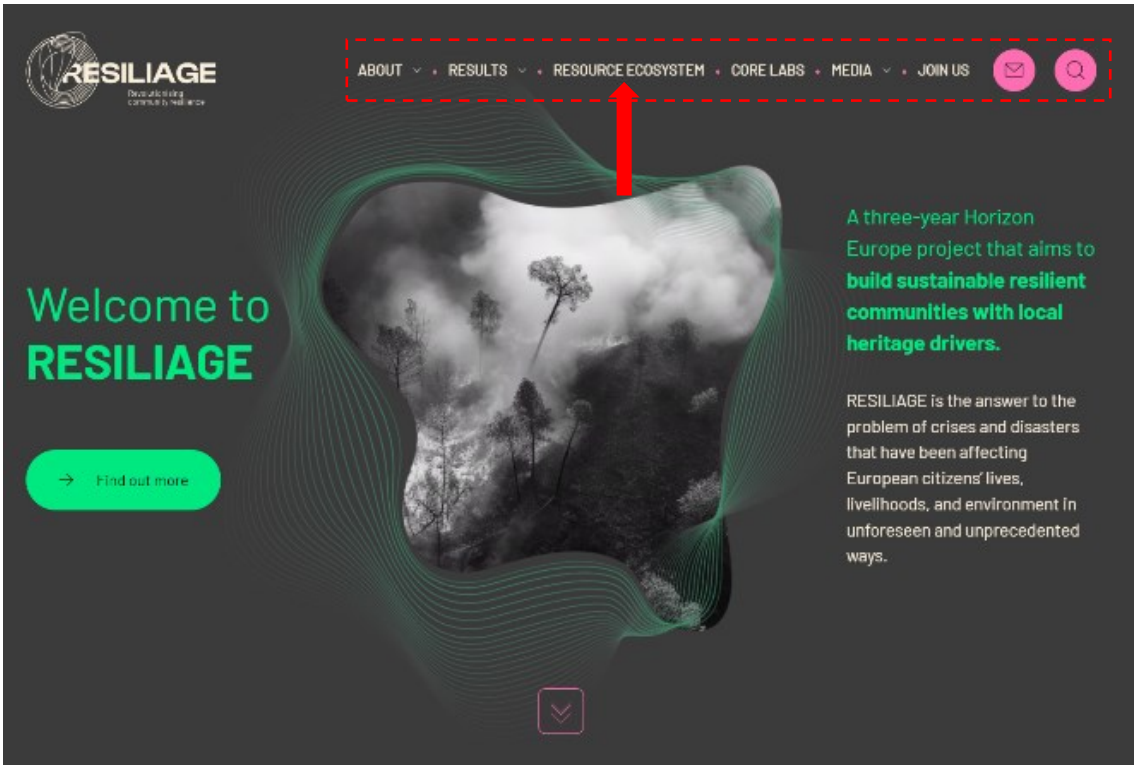

Figure 6 - RESILIAGE Project Website – Home page

Once on the homepage, locate the "Resource Ecosystem" section. This can typically be found through the main navigation menu (see red dotted square in Figure 6) or in a dedicated section highlighted on the landing page. After locating the "Resource Ecosystem" page, accessible directly at https://resiliage.eu/resource-ecosystem/, simply click on the "Resource Ecosystem" button. This action will redirect you to the dedicated webpage where the ecosystem is hosted.

2. Direct Access via a Specific URL

For quick and direct access to the RESILIAGE RECORE, users can utilize a specific URL (Figure 1). Specific URLs are direct links that takes users straight to the platform's interface, enabling them to immediately begin accessing tools and interact with functionalities, data, and resources tailored to their needs. This method is ideal for stakeholders who frequently use the ecosystem, such as the RESILIAGE target groups of FRs, researchers, decision-makers, and community leaders, who need efficient and immediate access to the platform's capabilities.

Upon entering the URL, users will be taken directly to the intended page, eliminating the need to manually navigate through the website. By providing multiple access points—whether through the main website or direct URLs—RESILIAGE ensures that users can efficiently and effectively access the resources they need. Whether navigating through

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the site or jumping directly to a resource, the platform is designed for ease of use and accessibility, accommodating a wide range of user preferences and requirements.

3. Selective access to tools via Log in

Some tools of the RECORE provide the possibility to include new contents (e.g. CORE Digital Network). They are designed to be moderated and contents checked to avoid misinformation. In this case, access requires to identify and authorize the user (see Section 4.3).

3.2. The RECORE for all

One of the primary objectives of the RECORE is to support crisis managers and stakeholders from CORE labs in developing robust PPs. These plans incorporate insights from human performance studies and the SyRI frameworks, ensuring that they are not only scientifically grounded but also practically applicable. RECORE facilitates the creation of tailored strategies that address the unique needs and vulnerabilities of each community.

The RECORE is designed to be user-friendly and accessible to all, regardless of diverse backgrounds or technical expertise. It aims to empower a wide range of users, from local leaders to community members, with a simple and intuitive User Interface (UI). This UI prioritizes clear navigation, understandable icons, and consistent layout structures, all of which will be validated through user testing to ensure ease of use. Additionally, the platform is built to be replicable and adaptable, allowing the RESILIAGE approach to extend beyond the initial project scope. RECORE is designed for scalability, enabling it to be easily adapted to different contexts. This scalability will also be validated to confirm its effectiveness in promoting knowledge transfer and enhancing community resilience worldwide.

3.2.1. User centered design

When designing the RESILIAGE platform, it is crucial to follow some design principles (Beaird, 2020) for enhancing User Experience (UX). These principles — accessibility and usability — are the fundamentals of inclusiveness and intuitiveness (Sauer, 2020).

Prioritizing accessibility is a critical requirement to ensure that the platform is usable by all individuals, including those with disabilities, thus fostering inclusivity. Usability is another key requirement, focusing on the creation of an interface that users can navigate effortlessly, helping them achieve their goals with minimal effort. To meet these requirements, specific technical choices have been made, such as implementing responsive design, ensuring compatibility with assistive technologies, and streamlining navigation with clear, consistent layouts. The expected advantage of these choices is to create a platform that not only accommodates a wide range of user needs but also encourages active engagement. User satisfaction will be validated through testing and feedback collection, both from the project consortium and Associated CORE labs users ensuring that the platform effectively meets the diverse needs of its users.

Accessibility

Ensuring that the design of the RECORE is accessible to a wide range of users, including those with disabilities such as visual impairments, is a fundamental priority for creating

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an inclusive and equitable platform (Abuaddous, 2016). To address accessibility needs, the design includes features aimed at improving usability for users with disabilities, aligning with the latest guidelines and standards (W3C, 2024). The platform uses high contrast color schemes to ensure that text and key elements are easily distinguishable, benefiting users with visual impairments, including those with color vision deficiencies. Additionally, adjustable text and button sizes improve readability and usability across different devices, particularly aiding users with motor impairments. Moreover, the design also includes keyboard navigability and screen reader compatibility, enabling users who rely on assistive technologies to efficiently navigate and access content through keyboard shortcuts and auditory descriptions.

Table 4 summarizes these key design decisions, the requirements they address, and their associated advantages for improving accessibility.

Requirements	Technical choice	Advantages
Improve readability for users with visual impairments	High-contrast color schemes	Ensures text and important elements stand out clearly, aiding users with visual impairments, including those with colour vision deficiencies.
Improve accessibility for users with motor impairments and visual disabilities	Adjustable text and button sizes, keyboard navigability, and screen reader compatibility	Enhances usability across devices, allows efficient navigation without a mouse, and provides auditory descriptions for users relying on assistive technologies.

Table 4 - Key design decisions on Accessibility of RECORE

Usability

Creating a user-friendly interface is essential for enabling users to navigate the platform effortlessly and achieve their goals efficiently. The platform's design is conceived to enhance UX by implementing a clear and organized navigation system that aligns with common user expectations. This navigation system utilizes familiar design patterns to minimize confusion and help users quickly adapt to the interface. By avoiding complex menus and convoluted pathways, the design allows users to efficiently locate the information and tools they need.

Consistency is a key element of the platform's interface, with a uniform layout and design language maintained across all pages. This consistency is conceived to help users develop a mental model of the interface, making it easier to find features and interact with different elements. By using familiar patterns and visual cues, the platform reduces the learning curve and improves overall usability. Furthermore, the interface is designed to be responsive and adaptive, ensuring a consistent experience across desktops, tablets, and mobile devices. The responsive design optimizes layout and functionality for various screen sizes, providing a seamless user experience on any device.

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The platform also hosts the Soft Solutions (WP4) and RESILIAGE Guidelines and Recommendations for leveraging heritage as a resource of community resilience (WP6), and the sitemap is organised as depicted in Figure 7.

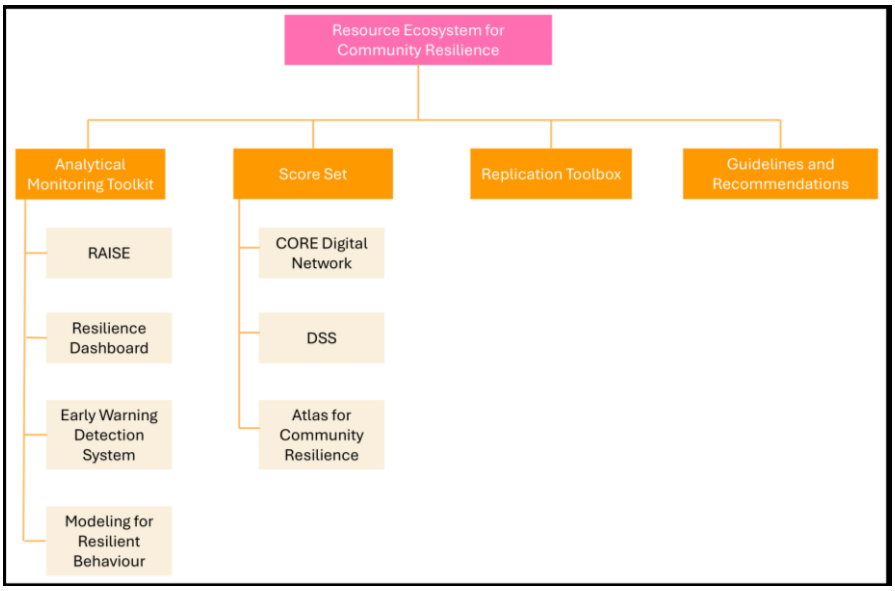

Figure 7 - RECORE sitemap

Clear and descriptive calls to action (CTAs) guide users towards their next steps, with prominent buttons and links that are easily identifiable. A minimalist design approach is adopted to avoid clutter, focusing on essential elements and reducing distractions, as depicted in Figure 8. In the homepage, all clusters of tools are easily accessible, providing a CTA to the user to access them.

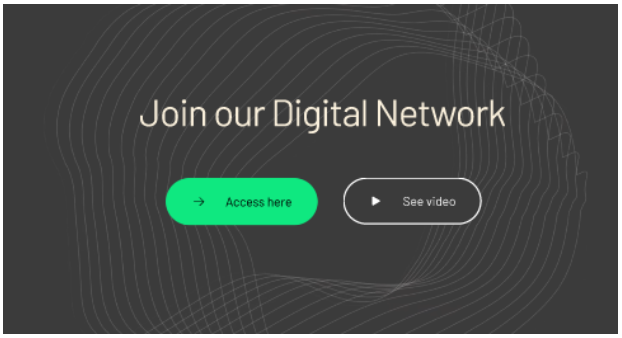

Figure 8 - Print screen of the design of the CTA in the RECORE's homepage

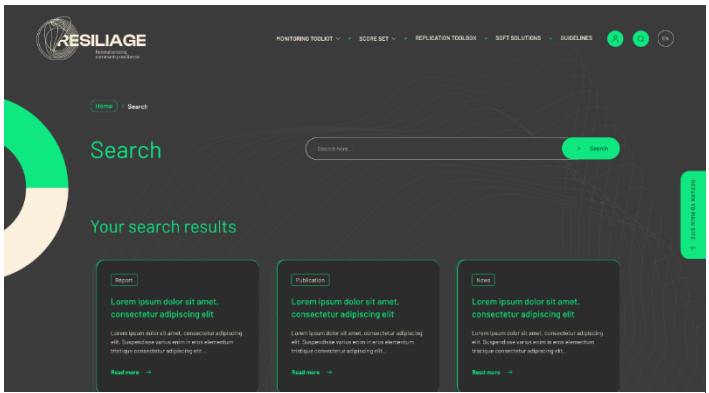

Figure 9 - Print screen of the design of the search menu

The search functionality is included to help users find the information they need, as depicted in Figure 9. It is planned to develop a video tutorial to assist the users in the onboarding process, to get familiar with the platform's features and functionalities.

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Table 5 summarizes the key design decisions, the requirements they address, and their associated advantages:

Requirements	Technical choice	Advantages
Enable users to navigate the platform effortlessly	Clear and organized navigation system with familiar design patterns	Minimizes confusion, helps users adapt quickly, and allows efficient location of tools and information
Ensure consistency across the platform	Uniform layout and design language across all pages	Helps users develop a mental model of the interface, making it easier to find features and interact
Provide a seamless experience across devices	Responsive and adaptive design	Ensures a consistent experience across desktops, tablets, and mobile devices, optimizing for all screen sizes
Guide users effectively through the platform	Clear and descriptive calls to action (CTAs) with prominent buttons and links	Directs users towards the next steps, making navigation intuitive.
Reduce visual clutter and focus on essentials	Minimalist design approach	Reduces distractions, allowing users to focus on essential elements
Assist users in finding information quickly	Search functionality	Helps users efficiently locate the information they need
Facilitate user onboarding and familiarization	Planned development of a video tutorial	Will assist users in understanding the platform's features and functionalities

Table 5 - Key design decisions on Usability

3.2.2. Style and Layout

By implementing a cohesive design language and adhering to best practices in visual communication, the platform aims to create a seamless and engaging user experience (McIntire, 2007) enhancing both readability and the intuitive navigation of content. The main approaches include the following topics presented in the Table 6:

Topic	Requirements	Technical choice	Advantages
Visual Design	Ensure readability and accessibility across the platform	High contrast color schemes, clear layout, and responsive design	Enhances usability for all users, including those with visual impairments, and ensures a consistent experience across devices.
	Create an intuitive and	Cohesive design language with consistent	Enhances usability for all users, including those with visual impairments, and ensures a

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	consistent user interface	fonts, spacing, and alignment	consistent experience across devices.
Color Scheme	Reflect project's visual identity while enhancing user experience	Primary color: deep grey (HEX #3B3B3B); Accent colors: green (HEX #0FE880), pink (HEX #FF9900), orange (HEX #FF70B2)	Provides a sleek, modern aesthetic that is visually engaging and supports the project's core values
	Ensure elements are easily distinguishable and accessible	High contrast between primary and accent colors	Improves readability and navigation without overwhelming the user.
Typography	Optimize readability and user engagement	Sans-serif font Barlow for body text; adequate line spacing and font size; distinctive headings	Ensures text is clear and easy to read, guiding users through content with well-spaced, readable text.
	Highlight key information and facilitate navigation	Bold type applied selectively to key points	Draws attention to important details without cluttering the interface.
Iconography	Enhance navigation and user comprehension	Consistent, minimalistic icon style	Avoids visual clutter, and aids in the identification of features and actions.
	Distinguish between different tool clusters	Strategically placed icons	Facilitates intuitive navigation and improves user understanding of various platform components.
Layout	Provide an intuitive, user-centric experience	Multi-column grid system with consistent margins and gutters	Maintains alignment, reduces visual clutter, and ensures content is easy to digest and well-organized. Also optimizes screen space and ensures a smooth experience across all devices, from desktops to smartphones.
Navigation	Ensure clear and intuitive access to key platform areas	Main navigation bar with prominently labeled links; dropdown menus; footer navigation	Allows users to efficiently find and access resources, reduces time spent navigating, and organizes content into manageable segments.

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	Facilitate quick access to specific information	Integrated search function in the top menu	Streamlines user experience by enabling quick location of specific content.

Table 6 - Main approaches on the Style and Layout

3.2.3. Mock-up

The design and development process of the RESILIAGE platform provided the mock-up, namely a visualization or design that illustrates how the final outcome might look like. The main approaches we adopted include:

1. wireframes;
2. low-fidelity wireframes;
3. high-fidelity wireframes;
4. feedback and testing;

1. Wireframes

Wireframes serve as the blueprint for the UI and UX. Wireframes are simplified representations of the platform's layout and structure. They focus on the placement of key elements, including navigation menus, content areas, buttons, and interactive features, without delving into detailed design aspects such as colours, fonts, or images. The primary purpose of wireframes is to establish a clear and functional framework for the platform, allowing designers, developers, and stakeholders to visualize and evaluate the arrangement of components and the flow of user interactions.

The RESILIAGE platform's wireframes are crafted to reflect the core functionality and navigation pathways of the site. They are used to outline the organization of content and user interface elements, ensuring that the platform's structure supports intuitive navigation and effective user engagement. Each wireframe corresponds to different pages and sections of the platform, including the homepage, main navigation areas, content pages, and interactive tools.

Key aspects addressed in the wireframes are described in Table 7.

Key Aspect	Description
Layout and Structure	Wireframes define the layout of each page, including headers, footers, navigation bars, and content sections. This layout creates a consistent and logical user experience across the platform.
Navigation	Wireframes illustrate primary and secondary navigation elements, such as menus, dropdowns, and links, ensuring easy access to platform features and resources.
Interactive Elements	Wireframes identify the placement of buttons, forms, search fields, and other interactive components, facilitating user interactions and ensuring key functionalities are easily accessible.

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Content Organisation	Wireframes provide a visual representation of how text, images, and other media will be organized and displayed, ensuring content is clear and engaging.

Table 7 - Key aspects addressed in the wireframes

The wireframes for the RESILIAGE RECORE are developed iteratively, with feedback from stakeholders and user testing guiding refinements and enhancements. This iterative approach ensures that the wireframes effectively address user needs and project goals before moving on to higher-fidelity design phases.

2. Low-Fidelity Wireframes

Low-fidelity wireframes, developed on FIGMA, are essential in defining the foundational structure and layout of the RECORE platform. These simple, black-and-white sketches focus on the placement of key elements like the main navigation bar, content areas, sidebars, and footers, without including detailed design features like color or typography.

By providing a simplified visual representation, these wireframes help team members quickly understand the platform's architecture, enabling early evaluation of the layout and content flow. They also serve as a communication tool, allowing stakeholders to provide feedback on the organization and user interface before moving to more detailed design phases. These wireframes help identify and resolve structural issues early in the process, facilitating rapid iterations and adjustments based on feedback, leading to a more refined final product.

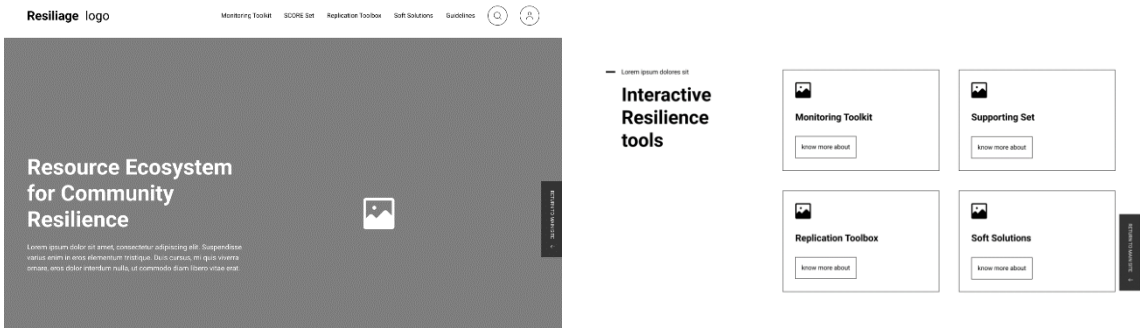

Figure 10 - Print screens of some pages of the low-fidelity wireframes

3. High-Fidelity Wireframes

High-fidelity wireframes, or prototypes, represent an advancement from their low-fidelity counterparts, incorporating intricate design elements that bring the platform's vision to life. Unlike the basic black-and-white sketches of low-fidelity wireframes, high-fidelity wireframes integrate detailed design components, including colour schemes, typography, and iconography. These wireframes offer pixel-perfect representations of the final design, presenting a comprehensive and realistic depiction of the platform's visual and interactive features.

High-fidelity wireframes provide a detailed, realistic view of how the platform will look and function, including actual content and interactive elements like buttons, menus, and

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forms. This level of detail allows for thorough evaluation of the visual design and user experience. These wireframes are crucial for refining the interface and functionality, gathering targeted feedback on usability and overall interaction, and identifying any design issues or areas for improvement before finalizing the platform.

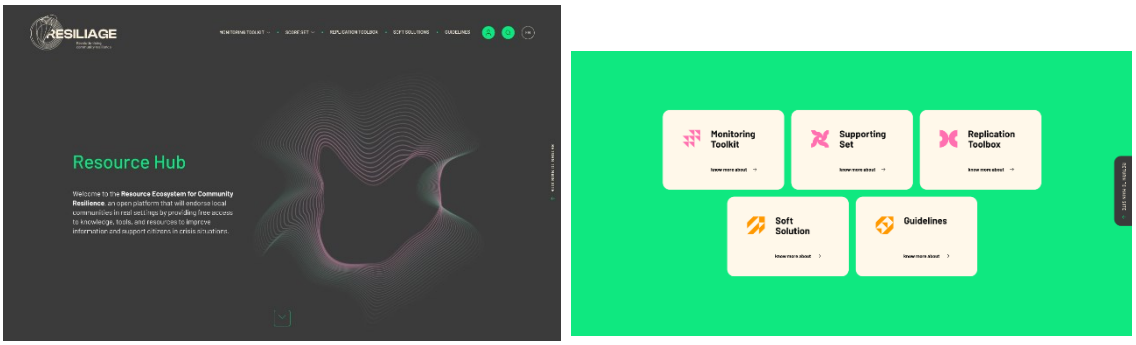

Figure 11 - Print screens of some pages of the low-fidelity wireframes

4. Feedback and Testing

Testing was conducted on the initial version of the high-fidelity wireframes to gather valuable insights into user interaction with the platform. This evaluation took place during a structured collaborative workshop, where consortium partners engaged in hands-on testing of the platform's navigation and overall user journey from an end-user perspective. Table 8 condenses the testing process, feedback collected, and the corresponding actions taken to improve the platform:

Kind of test	Feedback Collected	Countermeasures to improve
Hands-on testing in a structured collaborative workshop	Users experienced difficulties or confusion in navigation and user journey	Revise and simplify navigation structure and user flow to enhance clarity and ease of use
Assessment of general usability and interface design	Some aspects of the interface design were found to be unclear or not intuitive	Refine interface elements and improve design consistency for better usability
Evaluation of accessibility	Accessibility issues were noted, potentially hindering some users	Implement necessary adjustments to ensure accessibility compliance

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Interactive co-creation feedback process using design thinking (poster and post-it notes)	Participants provided real-time feedback and suggestions for improvements	Integrate participant suggestions into design refinements to address identified issues: - **Color Scheme**: Transition from green and pink to neutral colors (grey and beige) and add a toggle for light and dark modes saved to user profiles. - **Text and Button Size**: Increase sizes for better readability and easier interaction on touchscreens. - **Logo Placement**: Adjust logo placement to top left and make it a link to the homepage. - **Top Menu Design**: Redesign top menu to include a dropdown feature for easier access to tools and sections. - **Search Functionality**: Improve search functionality by adding keyword suggestions. - **Icon Clarity**: Use clearer and more descriptive icons. - **Language Selection**: Add a language selection option. - **Tutorial Video**: Create a tutorial video to guide new users through the platform's features and functionality.

Table 8 - User Testing Feedback and Improvement Actions

Addressing these issues will help refine the platform to better align with user needs and expectations, ultimately creating a more intuitive and effective user experience. By evolving from low-fidelity wireframes to high-fidelity prototypes and incorporating feedback from partners, the development process has embraced a user-centered approach. This iterative refinement ensures that the platform not only meets but exceeds user expectations, resulting in a more functional, engaging, and accessible design.

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4. Software architecture

This section delves into the technical underpinnings of the RECORE, outlining its software architecture and the underlying infrastructure that supports its functionality.

The discussion centers on the RECORE platform's architectural framework, which is designed with a modular, microservices-based approach to ensure flexibility and scalability. This architecture allows for the independent development, deployment, and scaling of components, making it adaptable to evolving user needs and new functionalities. Key areas of focus include data management, which covers the design of storage solutions, processing workflows, and strategies for ensuring data integrity and security. Additionally, the discussion examines interaction protocols, highlighting the methods used for seamless communication between the platform's components, users, and tools.

A detailed overview of the RECORE software architecture is essential for demonstrating how the platform operates, supports its tools, and adapts to user needs. At this development stage, the architecture's key features, technical specifications, and design rationale are outlined, highlighting the platform's role in enhancing community resilience through innovative digital solutions.

4.1. Technical background

To provide a clearer understanding of the RECORE's software architecture, the following insights into the technologies and methodologies used in the development and implementation of the platform defining the fundamental technical concepts and components that underpin the system

The AWS-based architecture is designed to support scalability, security, and high performance, incorporating the AWS services adopted in the project.

4.1.1. Data-driven platform

RESILIAGE data-driven platform is designed to base its operations, functionalities, and UX around the collection, analysis, and application of data. Unlike traditional systems that may rely on static or predefined information, a data-driven platform dynamically utilizes both real-time and historical data to adapt and enhance its capabilities (Song, 2019). In a data-driven platform, the architecture and features are fundamentally built around data, the main features and related benefits are summarized in Table 9.

Key Feature	Benefits
Design	design ensures that every aspect of the platform, from its core functions to user interactions, is influenced by data inputs.
Real-time data processing	allowing the platform to deliver up-to-date information and insights based on the latest available data. This enables the system to provide relevant and timely responses, enhancing its overall effectiveness.
Dynamic adaptation	by analysing current data, the system can customize UX, adjust its behaviour, and modify its content in real-time. This dynamic adaptability

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	allows the platform to cater to individual user preferences, historical interactions, and emerging trends, thereby improving user engagement and satisfaction.
Integration	it combines multiple data sources, which may include internal datasets, external databases, and real-time inputs, to offer a comprehensive and unified view. This integration supports more accurate and informed decision-making by providing a broader context and deeper insights.
Advanced analytics	these systems utilize sophisticated tools and algorithms to perform detailed data analysis, such as statistical analysis, machine learning, and predictive analytics. These analytical capabilities help identify patterns, trends, and opportunities, which are crucial for making data-informed decisions.
Personalization	a data-driven platform can tailor UX by analysing individual behaviours, preferences, and interactions. This personalization can manifest in various ways, such as customized content recommendations or targeted notifications, enhancing the relevance of the platform for each user.
Feedback	data-driven platforms incorporate feedback loops, allowing them to continuously improve. User feedback and performance data are collected and analysed to refine platform features, ensuring that the system evolves in response to user needs and preferences.

Table 9 - Characteristic features of modern data-driven platforms

In conclusion, a data-driven platform is defined by its reliance on data to drive its operations and decisions. By harnessing data, such platforms provide timely, relevant, and personalized experiences, fostering innovation and effectiveness across different applications.

4.1.2. Microservices-based architecture

A microservices-based architecture is a modern design approach for developing software systems where the application is structured as a collection of loosely coupled, small, and independent services. Each of these services, known as microservices, focuses on a specific business function or domain and communicates with other services through well-defined interfaces (De Lauretis, 2019).

In a microservices-based architecture, each service is independently developed, deployed, and scaled, with each performing a specific function, such as user authentication or inventory management. This modular approach contrasts with traditional monolithic architectures, where all functionalities are integrated into a single, unified application, as depicted in Figure 12.

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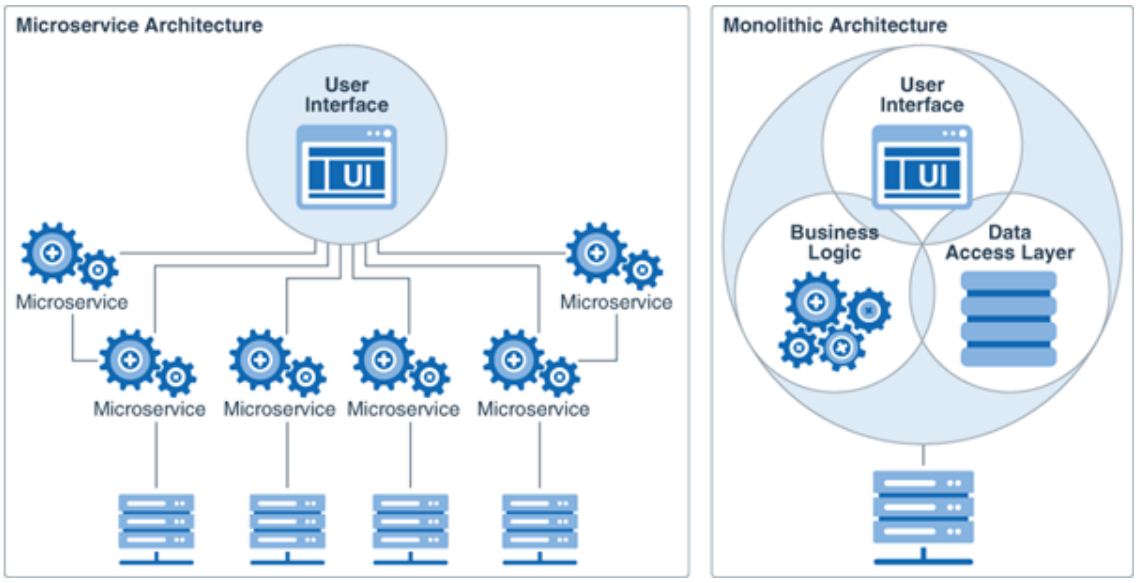

Figure 12 - Differences between a microservices-based approach and a monolithic one

A key feature of microservices is their independence. Each operates as a standalone unit with its own codebase, database, and runtime, enabling teams to develop, update, and maintain services simultaneously. This autonomy accelerates development cycles, simplifies maintenance, and allows for updates without impacting the entire system, thereby enhancing reliability and minimizing downtime.

Microservices communicate with each other through APIs (Application Programming Interfaces) or messaging protocols. These interfaces define how services interact, exchange data, and perform operations. Figure 13 shows how APIs work.

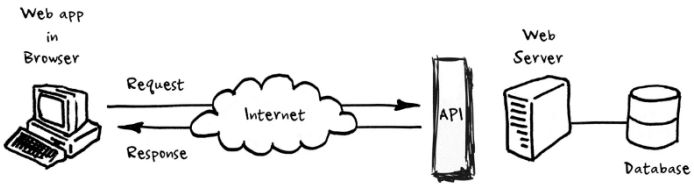

Figure 13 - How APIs work

The decoupling of services in a microservices architecture provides significant flexibility, allowing new features or technologies to be integrated or existing ones replaced with minimal disruption to the overall system.

Microservices offer significant advantages in scalability and flexibility, allowing each service to be scaled independently and optimized for performance and cost. This architecture supports diverse technology stacks, enabling teams to use the best tools for each task, leading to more effective solutions. However, the approach introduces complexities in service coordination and management, requiring tools like service discovery, API gateways, and centralized monitoring to maintain system consistency and performance. Despite these challenges,

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microservices enhance agility, support independent development, and create a more responsive and adaptive software system.

4.1.3. Big Data

The term "Big Data" is a fundamental concept in data management and analysis, referring to the massive volumes of structured and unstructured data generated at high speeds from diverse sources like social media, sensors, and transactional systems (Wang, 2020). This data is characterized by the *3Vs* model: **Volume** (large amounts of data), **Variety** (diverse types of data, including text, images, and videos), and **Velocity** (the fast pace of data generation and processing). Additionally, other aspects like **Veracity** (data accuracy) and **Value** (insights gained) highlight Big Data's complexity and potential.

Managing Big Data requires specialized tools and techniques, such as distributed processing systems, which distribute tasks across multiple nodes to enhance processing power and ensure scalability. Advanced analytics techniques, like machine learning and artificial intelligence, are used to extract meaningful insights from Big Data. Efficient data integration from various sources and effective storage solutions, such as NoSQL databases and cloud storage, are crucial for handling Big Data's volume and variety. While Big Data offers numerous benefits, such as improved customer insights and optimized operations, ethical considerations about data privacy and security remain essential as this field evolves.

Big Data is managed and utilized within the RESILIAGE project as part of the data infrastructure and methodologies employed to handle and analyze the vast datasets generated within the project's scope. Please refer to D1.3 for complete documentation.

4.1.4. Data Lake

RESILIAGE Data Lake is a centralized repository designed to store and manage large volumes of raw, unstructured, and structured data. Unlike traditional databases or data warehouses that require data to be processed and structured before storage, a Data Lake can ingest data in its native format, allowing for more flexibility and scalability in handling diverse datasets (Giebler, 2019).

Key characteristics of a Data Lake have been analysed for building the RESILIAGE Data Lake in D1.3 and are not duplicated in this document. Only relevant aspects for accompanying the demonstration of the RESILIAGE RECORE are included in this document. Please refer to D1.3 for complete documentation.

4.2. Infrastructure of Resource Ecosystem

The RESILIAGE infrastructure is built on Amazon Web Services (AWS), leveraging a range of AWS resources to ensure robust performance, scalability, and security (Amazon Web Services I. , About AWS, 2024).

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Feature	AWS	On-Premises/Custom-Built Solutions
Scalability	Highly scalable with on-demand resource adjustments, handling varying workloads easily.	Limited scalability requiring significant investment in additional hardware and infrastructure.
Cost Efficiency	Pay-as-you-go model with no upfront capital expenditures, and various pricing models to optimize costs.	High initial investments in physical infrastructure and ongoing maintenance costs, leading to higher total cost of ownership over time.
Operational Ease	Managed services, automated updates, and built-in security, reducing the need for in-house expertise.	Requires extensive in-house resources to manage hardware, software updates, and security patches.
Flexibility	High flexibility, easily adapting to fluctuating traffic and computing needs.	Less agile, requiring careful forecasting and slower adaptation to changing demands.
Maintenance	No hardware management needed, reducing operational complexities.	Full responsibility for hardware and infrastructure maintenance.

Table 10 - AWS versus on-premises/custom-built solutions comparison

In summary, thanks to these advantages in scalability, cost efficiency, operational ease, and flexibility, we have chosen to adopt the AWS strategy for designing and implementing our solution. This approach ensures that our platform is robust, adaptable, and capable of meeting the dynamic needs of the RESILIAGE project. The core components of this infrastructure, described in the following, include AWS EC2 instances, Amazon S3, AWS Lambda, and other essential AWS services, all orchestrated to create a cohesive and efficient environment.

1. AWS EC2 instances

The infrastructure harnesses the computing capabilities of AWS EC2 instances (Amazon Web Services I. , Amazon EC2, 2024), each of which is deployed within a dedicated Virtual Private Cloud (VPC). This VPC configuration guarantees that each instance operates within a highly secure and isolated network environment, significantly minimizing the risk of unauthorized access and potential security breaches. By placing these instances in private subnets, the infrastructure effectively restricts direct access from external networks, thereby bolstering the overall security posture of the platform. This isolation not only enhances data protection but also ensures that internal communications and processes remain secure and private.

2. VPC and subnet configurations

The Virtual Private Clouds (VPCs) are configured to facilitate secure communication between resources within each VPC, while effectively blocking unsolicited external traffic

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(Amazon Web Servicesc, 2024). Each VPC is segmented into private subnets designated specifically for EC2 instances. This strategic segmentation ensures that these instances are shielded from direct internet exposure, thereby mitigating potential vulnerabilities. By isolating these instances from external access, the infrastructure minimizes potential attack vectors and reinforces the overall security of the system, providing a robust defence against unauthorized intrusions and enhancing data integrity and confidentiality.

3. Public subnet and traffic management

External access to the platform's services is managed through a dedicated public subnet, which is equipped with an internet gateway integrated with a reverse proxy and load balancer. This configuration serves as the singular gateway for all incoming traffic, ensuring that requests are efficiently routed and distributed to the appropriate backend services. The reverse proxy and load balancer play a pivotal role in optimizing traffic management by intelligently directing requests and balancing the load across multiple instances and services. This not only enhances the platform's ability to scale dynamically with demand but also fortifies its resilience by ensuring high availability and reliability, even during periods of high traffic or service disruptions.

4. Secure access and data management

To ensure secure and efficient connectivity between the VPC and Amazon S3 bucket (Amazon Web Services I. , Amazon S3, 2024), AWS VPC endpoints are employed. These endpoints facilitate a private and secure connection directly to the S3 bucket, eliminating the need for internet-facing traffic and thus preserving the integrity and confidentiality of the data. By leveraging AWS VPC endpoints, the platform maintains a closed network environment, similar to the function of a NAT gateway, but with enhanced security and efficiency. This setup ensures that data transfers are protected from external threats while optimizing performance, as all traffic remains within the secure confines of the AWS network infrastructure.

5. AWS Lambda Integration

AWS Lambda is utilized for serverless computing, allowing code execution in response to events without the need for server management (Amazon Web Services I. , AWS Lambda, 2024). By integrating Lambda functions into the infrastructure, the platform gains significant advantages in flexibility and scalability. This approach enables the execution of specific tasks and workflows dynamically, as Lambda functions automatically scale to handle varying workloads and only incur costs when in use. This not only simplifies operations by removing the overhead of server maintenance but also ensures that the platform can efficiently adapt to fluctuating demands while optimizing resource utilization and cost-efficiency.

Future enhancements and improvements will be integrated into the architecture to adapt to emerging needs, incorporate feedback, and leverage new technological advancements. This flexible approach ensures that the Ecosystem platform remains robust and capable of supporting resilient community solutions as developments unfold.

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In conclusion, the AWS-based architecture is designed to deliver a high-performance, secure, and scalable infrastructure for the RESILIAGE RECORE. This approach ensures the platform can efficiently manage varying workloads while maintaining resilience. By utilizing AWS's advanced services, the architecture upholds strong security measures, optimizes resource management, and supports the platform's growth and adaptability to changing user needs and data volumes.

4.3. Authentication and authorization system

The authentication system for the RESILIAGE RECORE is powered by AWS Cognito (Amazon Web Services I. , Implement secure, frictionless customer identity and access management that scales, 2024), a comprehensive and secure identity management service offered by AWS.

AWS Cognito is designed to provide robust authentication and authorization capabilities for both web and mobile applications, ensuring a seamless and secure UX. AWS Cognito supports a variety of authentication methods, catering to diverse user needs and preferences. It facilitates integration with social identity providers such as Google and Facebook, enabling users to sign in using their existing social media accounts.

The system supports identity providers through Security Assertion Markup Language (SAML) for single sign-on (SSO) and integrates with corporate directory services. It also accommodates traditional username and password authentication, offering flexibility for various user needs. Advanced security features include multi-factor authentication (MFA) for enhanced protection, data encryption both at rest and in transit, and a user directory managed by AWS Cognito, which provides comprehensive control over user profiles and access rights.

Figure 14 illustrates the logical flow for user access within the Ecosystem. Users can access RECORE through either the main project website or the dedicated RECORE site. For certain tools that require user interaction with CORE labs, such as the CORE Digital Network, users are redirected to a login page. This selective access is necessary for tools that allow content contributions, where a moderator manages stakeholder identification and authorization to prevent misinformation. The restriction is needed to avoid any misinformation (see Section 3.1.3).

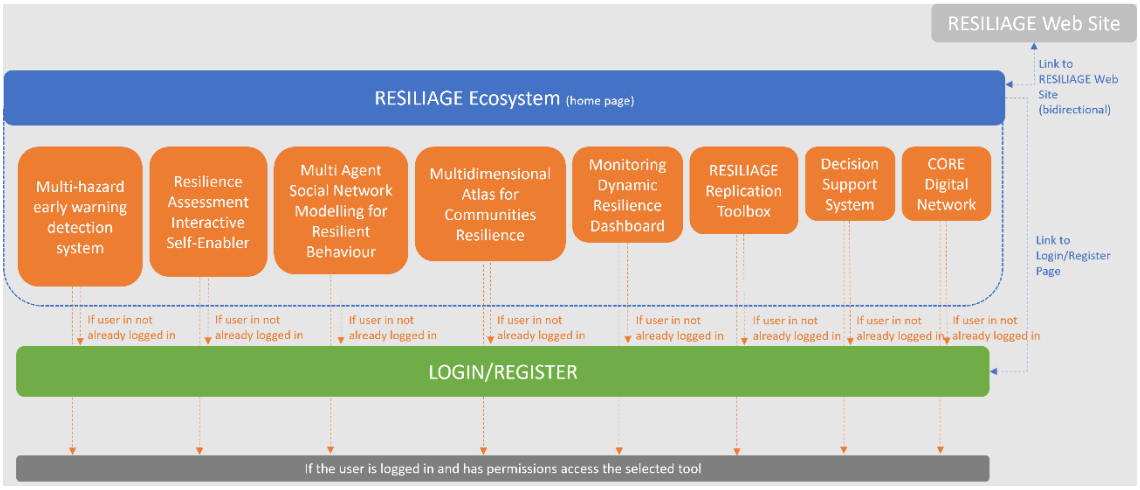

Figure 14 - Access Management Schema

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For users who are already authenticated, the process is streamlined, allowing them to log in directly without needing to re-authenticate. Upon successful login, users are granted the necessary authorizations required to operate the different tools within the RECORE. These authorizations play a critical role as they cascade through the system, empowering users to access tool functionalities, interact with data, and utilize integrated features seamlessly.

From a technical perspective, AWS Cognito enables authentication logic as described in the diagram (see Figure 15). In detail, the API authentication flow is determined as follows (Amazon Web Services I. , 2024):

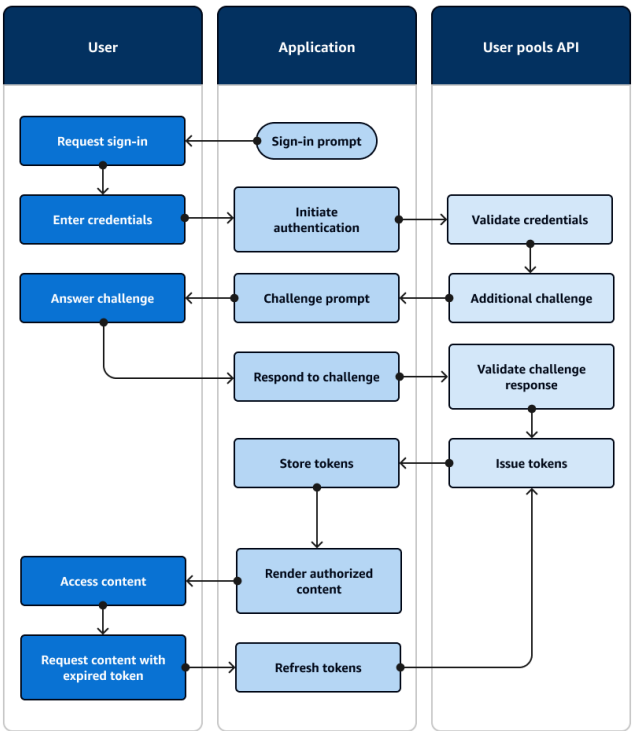

Figure 15 - Typical sign-in session for API authentication

1. A user accesses the application;
2. select a "Sign in" link;
3. enter their username and password;
4. the application invokes the method that makes an InitiateAuth API request. The request passes the user's credentials to a user pool,
5. the user pool validates the user's credentials and determines that the user has activated MFA);
6. the user pool responds with a challenge that requests an MFA code;
7. the application generates a prompt that collects the MFA code from the user;
8. the application invokes the method that makes a RespondToAuthChallenge API request. The request passes the user's MFA code;
9. the user pool validates the user's MFA code;
10. the user pool responds with the user's JWTs;
11. the application decodes, validates, and stores or caches the user's JWTs;
12. the application displays the requested access-controlled component;
13. the user views their content;
14. later, the user's access token has expired, and they request to view an access-controlled component;
15. the application determines that the user's session should persist. It invokes the InitiateAuth method again with the refresh token and retrieves new tokens.

The structured process ensures that only authorized users can access specific tools, maintaining a secure and efficient environment. The diagram illustrates this user access

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and authorization flow, emphasizing how RECORE effectively manages user interactions and tool accessibility. This approach enhances security through proper authentication while optimizing the user experience with streamlined access. Additionally, the architecture's flexibility allows for future enhancements and expansions as RECORE adapts to evolving needs and technological advancements.

4.4. RESILIAGE's Data Lake

The RESILIAGE data lake is designed as a centralized repository to store both general and geospatial data generated throughout the project. It acts as a comprehensive storage solution that facilitates seamless data management and accessibility. Users can contribute data to the platform through exposed APIs or a user-friendly web-based interface. This interface offers robust functionalities for uploading, retrieving, and filtering data and metadata, ensuring that users can efficiently manage large datasets with ease. By providing these capabilities, the data lake enables enhanced collaboration and data sharing across the project, supporting various analytical and research initiatives. Additionally, the system's architecture ensures scalability and flexibility, accommodating future growth and evolving data requirements.

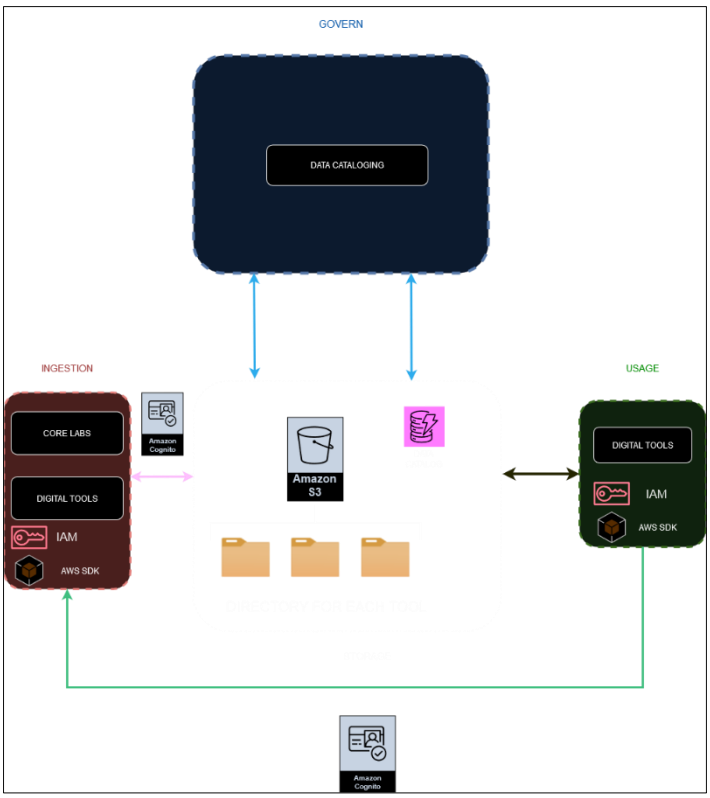

Figure 16 - RESILIAGE data lake general overview

The architectural details of the RESILIAGE Data Lake are illustrated in Figure 16. This advanced system is composed of four primary components: Ingestion, Storage, Governance, and Usage, each playing a vital role in the data lake's functionality. As mentioned at the beginnings of this Section, for more detailed information please refer to D1.3 - Data Lake model.

The RESILIAGE data lake serves as a centralized hub for managing and organizing both general and geospatial data generated by the project. Users can efficiently upload and access data through APIs or a user-friendly web interface, with advanced capabilities for data retrieval and filtering. The data is stored in an AWS S3 bucket, chosen for its scalability and durability, and is systematically organized into directories by tool type for quick access. Security is a key focus, with AWS Cognito providing robust user

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authentication and authorization to ensure that only verified users can access the data. AWS IAM (Identity and Access Management) further refines access control, specifying permissions for viewing, updating, or deleting datasets. The AWS SDK (Software Development Kit) supports seamless interaction with these AWS services, enabling developers to create dynamic applications that fully utilize the data lake's resources. This setup ensures that the data lake remains a versatile and secure asset for data-driven decision-making throughout the project.

5. Analytical Monitoring RESILIAGE Toolkit

This Section provides an overview of the Analytical Monitoring RESILIAGE Toolkit by illustrating its tools, their state of development, and mock-up for the scope of their integration in the RECORE. More detailed user requirements are also included for each tool. User requirements have been identified through multiple stakeholders' workshops organised at different stages of the RESILIAGE activities focusing on RECORE (see Section 3.2.1).

Detailed insights and final developments of the Analytical Monitoring RESILIAGE Toolkit with its tools in the framework of T3.2 will be delivered in D3.2.

The Analytical Monitoring RESILIAGE Toolkit is a comprehensive set of novel digital tools integrated within the RECORE and especially conceived and designed **to enhance the preparedness** of individuals and communities to improve disaster societal resilience. It also serves as a resource for improving communication and reducing the spread of false information during emergencies.

This toolkit is integral to the RESILIAGE project, offering an evidence-based and data-driven approach to DRM and community resilience. The Toolkit includes the following tools:

1. The Resilience Assessment Interactive Self Enabler Tool (**RAISE**) is a versatile crowdsourcing mobile platform. This tool self-enables individuals and communities **to assess** their levels of preparedness interactively. It also serves as a data collection instrument, gathering insights from disaster witnesses across all CORE labs, thereby helping to identify areas for improvement in resilience.
2. The Monitoring Dynamic Resilience Dashboard (**MoRe Dashboard**) provides a dynamic representation of resilience-related data for the local community. It displays relevant information collected through surveys and other tasks of the project, offering a configurable space for viewing and analysing data. Users can prioritize and check updated information, while also viewing a flexible summary of periodic activities. The dashboard categorizes information by disaster type and/or geographic location, providing a comprehensive overview **to monitor** the community resilience landscape.
3. The Multi-Hazard Early Warning Detection System (**MultiWARN**) serves as an early warning mechanism, by providing timely alerts and facilitating coordinated responses. This system characterizes and clusters weather patterns related to various disasters, such as fires, heatwaves, and floods, within the CORE labs. It is essential **to mitigate** the impacts of disasters.

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4. The Multi-Agent Social Network Modelling for Resilient Behaviour (**MultiMode**) is a simulation tool that models complex social interactions and responses to disasters, focusing on the flow of **information** through different channels, including word of mouth and social media, especially relevant in the **response** during a crisis. This tool also aims to investigate the impact of both in-person and online interactions, using anonymized or pseudonymized data to ensure privacy.

5.1. The Resilience Assessment Interactive Self-Enabler tool (RAISE)

The RAISE tool is designed *to raise* the individuals' resilience. It provides self-enabler exercises in a survey form to assess individual **preparedness**. Its objective is to enhance public awareness and foster community commitment for educating to a culture of resilience. By answering the survey, RAISE gives feedback and facilitates the understanding of what actions to take, who to contact, and how to access essential resources during emergencies. Additionally, it also provides experiential simulations (from WP2 experiments) in Virtual Reality (VR) environment that creates immersive, interactive learning experiences to reinforce the educational impact of the tool.

Furthermore, in RESILIAGE investigations, RAISE serves as a valuable data collection instrument, gathering insights from disaster witnesses across CORE labs, thereby helping to identify fragile areas for improvement in resilience.

The tool's conceptualisation and prototype are currently at second stage of development, an improvement of its UI is ongoing.

5.1.1. User requirements

RAISE is thought to aim citizens in general. Multiple stakeholders' user needs that were detected are:

- Enable all society awareness for DRR.
- Activate societal disaster resilience against extreme events and climatic crisis.
- Enable multiple stakeholder collaboration for DRM.
- Provide basic information in emergency.
- Educate youth on existing resources and safety measures.
- Inform citizens.
- Receive clear, actionable instructions.
- Use simple and understandable language for instructions.
- Collect data on human behaviour and perception for insights and research.

5.1.2. Solution design and implementation details

RAISE is implemented as a web-based survey platform using ArcGIS technology. The survey is structured into several stages, each focusing on different aspects of disaster preparedness and community resilience.

RAISE enables multiple-choice questionaries to:

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- Identify the stakeholder type.
- Collect data about past events.
- Assess individual preparedness and response capabilities.
- Explore effects on cultural and natural heritage.
- Provide personalized preparedness scores and improvement suggestions.
- Gather user feedback for continuous tool enhancement.

Implementation:

- **Stage 1: Who are you?**
  - Identifies user demographics and roles within the community.
  - Multiple-choice questions to classify users into RESILIAGE target groups.

- **Stage 2: Disaster Experience and Impact**
  - Collect information on users' past experiences with natural disasters.
  - Include questions on individual perception of local disasters, impacts, and vulnerabilities.
  - Feature interactive maps and crowdsourcing.

- **Stage 3: Response Capability**
  - Assess users' knowledge and preparedness in past experiences.
  - Assess individual emergency kits and local know-how.
  - Identify assembly points and safe zones.

- **Stage 4: Memories**
  - Explore the impact of disasters on cultural and natural heritage sites.
  - Identify cultural assets and interrupted community traditions or events.
  - Build and share memories

- **Feedback and Conclusion**
  - Provide users with a preparedness score and tailored feedback based on their responses.
  - Offer suggestions and resources for improving awareness and preparedness.
  - Incorporate users' feedback on the survey.

The RAISE tool conceptualisation and development (by Vexiza and Polito) is currently undergoing a redesign of its UI (by LOBA) with the design team make the tool more engaging and accessible. Feedback collected from tests conducted in the CORE labs are used to refine the tool.

5.1.3. Mock-up

Figure 17 shows screenshots of the current version of the RAISE tool. These images offer a visual representation of the tool's interface and functionality, showcasing the initial design. The tool guides users through four main stages: *Who are you?*, *Disaster Experience and Impact*, *Response Capability*, and *Memories*. Each stage is designed to collect specific information that contributes to a comprehensive assessment of individual and community resilience.

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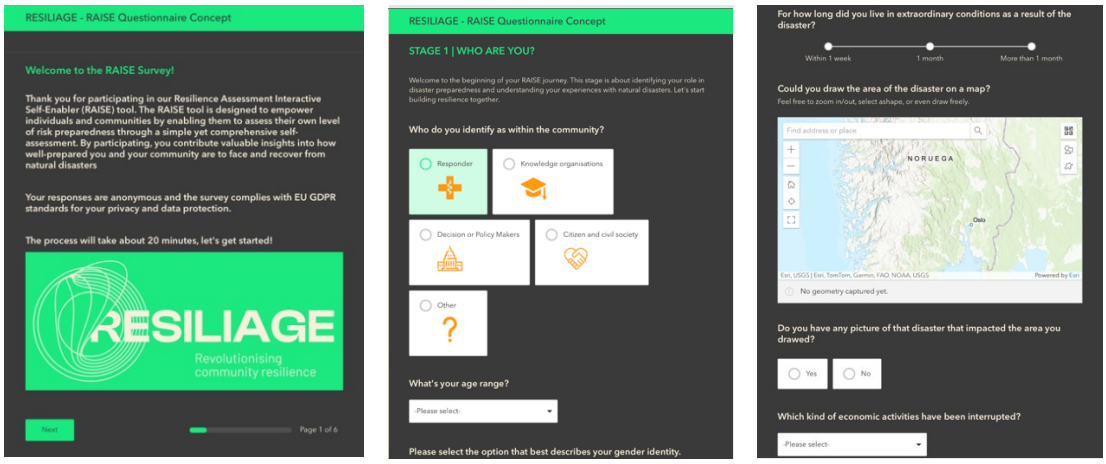

Figure 17 - RAISE Welcome page. Example of wizard for user onboarding. Example of functionality

This mock-up serves as a baseline for further enhancements and user feedback integration, ensuring that the final version of RAISE meets the needs and expectations of its diverse user base.

5.2. Monitoring Dynamic Resilience Dashboard (MoRe Dashboard)

The MoRe Dashboard tool is designed to provide real-time, actionable information to various stakeholders of RESILIAGE target groups for monitoring the implementation of PPs and other initiatives enhancing community resilience. This dashboard will integrate and display data on/for PPs (T6.1) according to indicators generated by T2.5, classified according to CORE labs strategies (WP5), to visualize prioritizations and ensure regular updates. The tool aims to enhance situational awareness, support decision-making, and facilitate effective communication among all parties involved.

The MoRe Dashboard is designed to include:

- an updated mapping of refuge centers in the different CORE labs;
- real-time relevant weather conditions related with natural disasters;
- a user-friendly interface with non-technical language;
- stability to handle a high number of simultaneous users and enable location services for response actors.

The information about preparedness plans will also be incorporated into the dashboard, providing a comprehensive tool for enhancing the response to crises and their mitigation. Although the tool is still pending inputs from other tasks, this section outlines the current state and expected functionalities.

The MoRe Dashboard tool conceptualisation and prototype is currently at its first stage of development.

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5.2.1. User requirements

An initial survey conducted among potential users of the MoRe Dashboard revealed several key requirements:

1. **Information display:**
    a. Up-to-date mapping of refuge centers.
    b. Current weather conditions relevant to natural disasters.

2. **User interface:**
    a. Non-technical language for broad accessibility.
    b. Simple warning signs with contrasting colors and clear explanations.
    c. Actionable instructions for crisis response.

3. **Technical performance:**
    a. Stable operation under high user load.
    b. Integrated location services.

The MoRe Dashboard's identified requirements will be implemented as feasibly as possible, balancing user needs with technical limitations. Currently in its initial development stage, the dashboard's concept and prototype are evolving. As the RESILIAGE project advances, ongoing research and stakeholder engagement will refine these requirements, ensuring the dashboard meets the needs of local authorities, FRs, and citizens, thereby enhancing community resilience.

5.2.2. Indexes and Key Indicators

As a general overview at this stage of the project and tool development, we can consider to be integrated into MoRe dashboard key indicators to monitor and enhance dynamic resilience including:

Refuge Center Availability / Event Updates / Public Awareness / Meteorological Data/ Characterization of hazards / Cultural, environmental, and historical dimensions of community resilience / Psycho-social dimensions of risk representation and community adaptation / Social and societal dimensions of resilience.

5.2.3. Solution design and implementation details

The design and implementation of the MoRe Dashboard is executed using ArcGIS Dashboards (ArcGIS, 2024), a platform known for its robust mapping and real-time data visualization capabilities. Key design and implementation details include:

- **UI:** A clean, intuitive design with easy navigation, non-technical language, and simple visual elements. ArcGIS Dashboards will provide customizable widgets and data-driven elements to enhance UX/UI.
- **Data Integration:** Real-time data integration will be managed through the centralized RESILIAGE Data Lake, which aggregates data from various sources across the WPs activities, meteorological data, and geospatial information.

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ArcGIS will facilitate seamless integration of heterogeneous data sources for accurate and up-to-date visualizations.

- **Scalability:** The ArcGIS platform offers scalable infrastructure to support a high number of simultaneous users, ensuring stability and performance.
- **Location Services:** Integration of geolocation to provide real-time tracking and updates. ArcGIS's advanced mapping capabilities will enable precise location services.

Following the co-creation spirit of RECORE, the development of the tool will integrate the recently launched Task T2.5 inputs, together with the corresponding inputs from T6.1 and the CORE labs (WP5). The implementation will follow agile development practices, with continuous feedback loops and iterations to refine the functionalities. Given that the tool is still pending inputs from other tasks, the initial phase will focus on setting up the core infrastructure and basic functionalities.

5.2.4. Mock-up

Since the MoRe Dashboard has not yet been fully implemented, a conceptual framework can be only included in this document. Attached mock-ups illustrate potential functionalities and design elements envisioned for the dashboard.

These mock-ups were developed for the RESILIAGE Summer School held in September 2023 (WP6).

The conceptual framework includes the following components:

1. **Heritage Value Assessment:** This element focuses on evaluating the cultural and historical significance of assets at risk, helping users prioritize protection measures during a disaster.
2. **Personal Insights & Background:** This feature allows users to input personal data and experiences, providing a tailored dashboard experience that takes individual perspectives into account.
3. **Hazard Perception & Preparedness:** The dashboard aims to gauge users' awareness and readiness concerning various hazards, offering personalized advice to enhance preparedness.
4. **CC Insights:** This component provides users with information and data related to CC impacts, helping them understand long-term environmental shifts and potential risks.

These mock-ups are conceptual and not final designs, they illustrate key aspects of data representation and user interaction that the dashboard aims to incorporate:

1. **Heritage Value Assessment:** Shows the location of cultural and physical heritage sites, along with their perceived disaster impact. This helps prioritize protection efforts during emergencies.
2. **Personal Insights & Background:** Displays demographics of respondents, offering insights into the diversity of community members engaged in resilience efforts.

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3. **Hazard Perception & Preparedness:** Illustrates the most common hazard types that have affected respondents, as well as their perceived risk levels for various threats.
4. **Climate Change Insights:** Presents data on climate change impacts and trends, helping users understand long-term environmental risks.

As the project progresses, the dashboard designs will be refined and expanded to meet the evolving needs of the involved stakeholder. By incorporating user feedback and real-world testing, the dashboard aims to become a reliable tool for dynamic resilience monitoring. This iterative process supports the final product to address both technical specifications and the practical challenges stakeholders face in DRM and resilience building.

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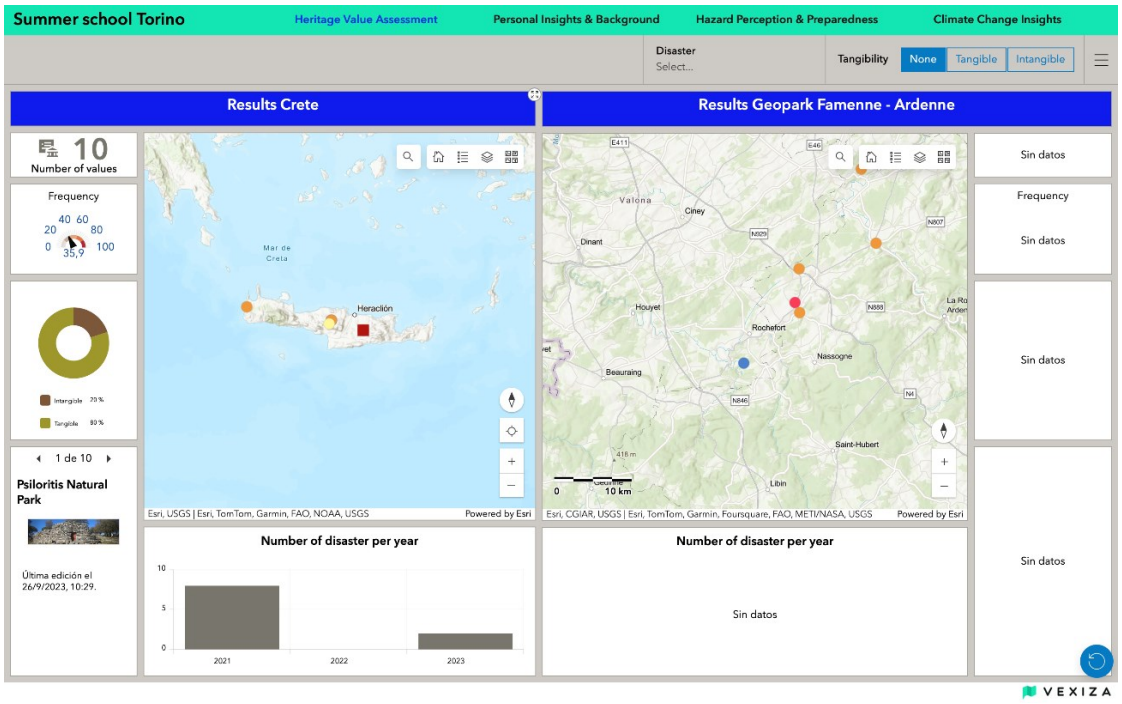

Figure 18 - Demo for the Summer School 2023. Heritage Value Assessment Dashboard.

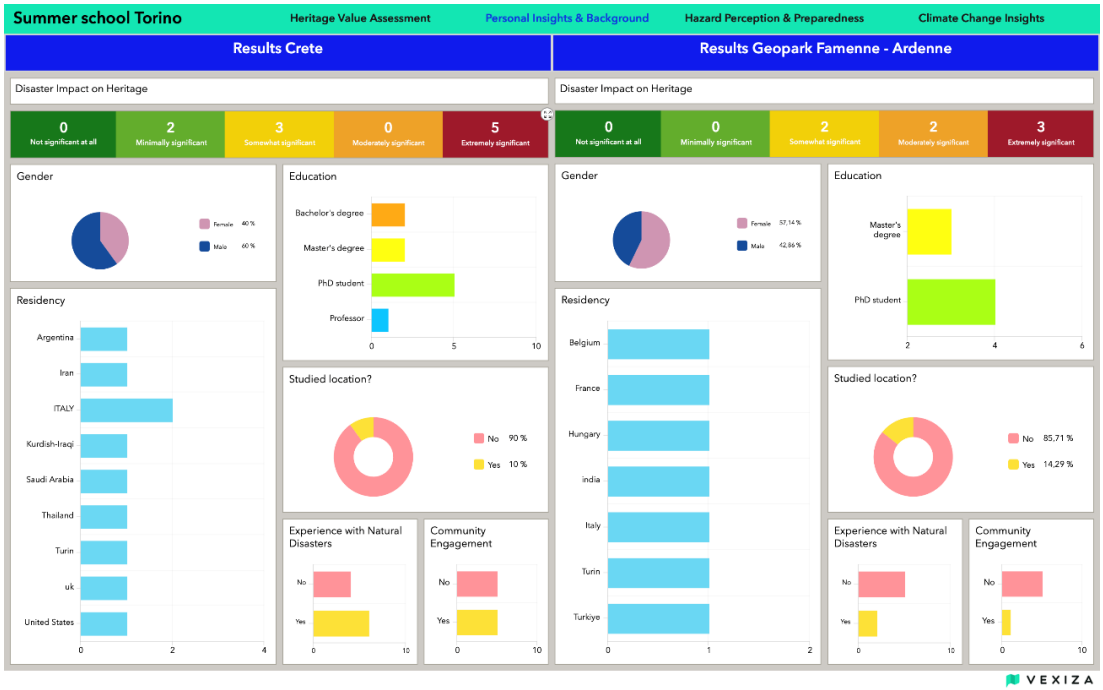

Figure 19 - Demo for the Summer School 2023. Personal Insights & Background.

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Figure 20 - Demo for the Summer School 2023. Hazard Perception & Preparedness

Figure 21 - Demo for the Summer School 2023. Climate Change Insights.

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5.3. Multi-hazard early warning detection system (MultiWarn)

The MultiWarn tool aims to simulate, analyze, characterize, and cluster weather patterns that may result in meteorological disasters like fires, heatwaves, and floods. This advanced system leverages both historical and real-time data from all CORE labs to anticipate and mitigate the impacts of these events. By integrating data analytics and predictive modelling, the system provides timely alerts and insights, enabling proactive disaster management and enhancing community resilience against severe weather conditions. The tool developed by VEXIZA is at an initial stage of development.

5.3.1. User requirements

Initial requirements for the MultiWarn tool, based on preliminary studies, include:

- **Timely Information**: Provide relevant, real-time data about ongoing events.
- **System Stability**: Ensure reliable performance under various conditions.
- **Location Services**: Integrate location-based functionality for improved coordination.
- **Alert System**: Disseminate clear, understandable information to all users.
- **Actionable Instructions**: Offer specific guidance for emergency responses.
- **Visual Indicators**: Use simple, recognizable warning signs to communicate risks.

These requirements will be refined through co-creation with CORE labs and end users, ensuring MultiWarn meets the needs of local authorities, FRs, and citizens.

5.3.2. Solution design and implementation, and Mock-up

The design and implementation of the MultiWarn tool will be carried out in close collaboration with CORE labs and end-users. The development process will include the following key steps:

- **Data Collection and Analysis**
  - Collect historical data on past disasters from all CORE labs.
  - Analyze this data to identify key patterns and trends that can inform the development of predictive models.
  - Conduct a preliminary study on user needs to ensure that the system aligns with the requirements of local authorities, FRs, and citizens.
- **Model Development**
  - Develop hazard-specific models for each CORE lab based on the analyzed data.
  - Implement the multiscale data model to integrate and analyze data from multiple sources.
  - Use machine learning algorithms to enhance the predictive capabilities of the system.

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- **User Interface and Experience**
  - Design a user-friendly interface for all user groups, ensuring accessibility and clarity.
  - The interface will deliver real-time alerts, warnings, and actionable instructions.
- **Testing and Iteration**
  - The system will be tested in simulated environments to ensure accuracy and reliability.
  - Feedback from CORE labs and workshops will be incorporated to refine and improve the system.
  - The system will undergo continuous updates and improvements based on user feedback and emerging data.
- **Deployment and Maintenance**
  - The system will be deployed across all CORE labs, with ongoing support and maintenance to ensure its effectiveness.
  - Regular updates will be provided to adapt to changing weather patterns and emerging hazards.

The development of mock-ups for the MultiWarn is currently in progress.

5.4. Multi-agent social network modelling for Resilient Behaviour (Multi-Mode)

The primary goal of the Multi-Mode tool is to perform qualitative mathematical analysis of the behaviour of stressed social networks. To better reflect real-world variations, this analysis is also supported by multi-agent-based simulations.

Agent-based modelling can particularly be useful for studying sociological systems, enabling the analysis of phenomena such as:

- **How** information is **shared** over social networks in various contexts.
- **How** word-of-mouth **transfers** information between unrelated individuals.
- **How** social roles **influence** the spread of (mis)information.

The Multi-Mode tool aims to help stakeholders, and especially local authorities and FRs, of DRM to analyse disaster scenarios and understand dynamic communication patterns that emerge during crises, and strategize **for preparedness planning**.

In RESILIAGE analysis (WP2) the tool support how to examine the role of societal and cultural factors in shaping resilience behaviours and exploring how various social roles influence the spread and reception of messages.

The tool is currently under development (by ALMENDE).

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5.4.1. User requirements

The development of the Multi-Mode tool has taken into account several key user requirements, primarily focusing on

Local Authorities and FRs:

- **User Authentication**: The system will feature secure login accounts.
- **Multi-Language Support**: The tool will support multiple languages to cater to a diverse user base.
- **Intuitive and User-Friendly Interface**: The interface will be designed to be user-friendly, allowing easy access to data and viewing of results.
- **Report Exporting**: Users will be able to export reports.
- **Data Sharing**: The system will enable users to share data, models, and reports with stakeholders, facilitating collaboration and informed decision-making.

5.4.2. Multiscale data model

TheMulti-Mode tool requires detailed information about starting parameters for software agents (i.e., computer programs that have intelligence regarding a specific domain and a local view of the problem, which are used to reason and evaluate the impact of their actions on the environment. In addition, an agent is able to take action autonomously, including citizens, FRs, volunteers, and others, to accurately set up the simulation environment. This data is essential for creating simulations that reflect real-world scenarios and social dynamics.

To ensure the simulations are realistic and comprehensive, the system will incorporate parameters of social behaviour. These parameters are extracted from relevant literature and refined through discussions with social experts and project partners. This approach allows the tool to integrate nuanced social dynamics and behaviours, enhancing the accuracy and relevance of the simulations.

5.4.3. Solution design and implementation, and Mock-up

Currently, work is underway to create mock-ups based on brainstorming and activities developed with project partners. The design process also considers input and findings from T2.2, particularly taking into account the restrictions imposed by social media platforms over the past years on accessing social media data (Bruns, 2021).

The following figures illustrate the current mock-ups and conceptualisation for the Multi-Mode tool.

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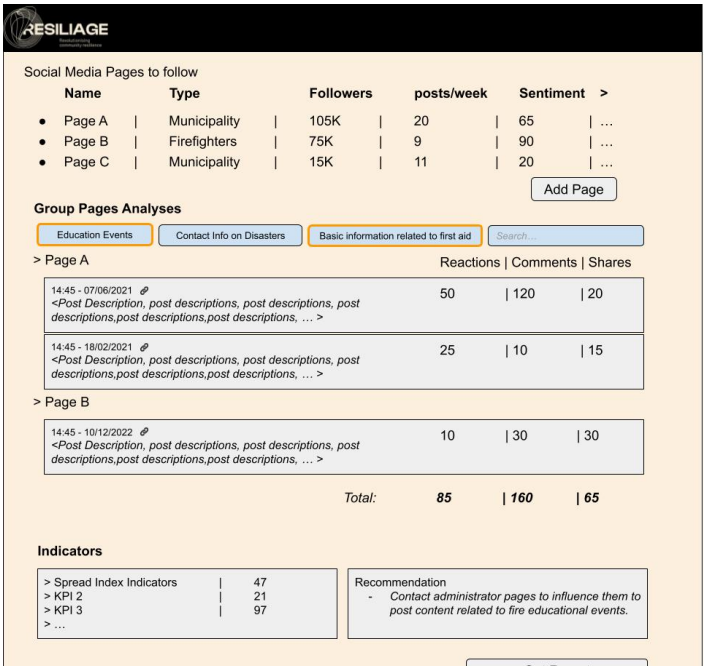

Figure 22 - Multi-Mode- Social Media Home Page

In detail, Figure 22 presents the social media analysis on the main social pages that might influence the citizens of the area. Developments consider: **(i)** Provide an overview of social media communication with the most influence in the territory. **(ii)** Help analyse content being shared to create effective communication strategies for citizens. **(iii)** Generate Social Media Communication reports.

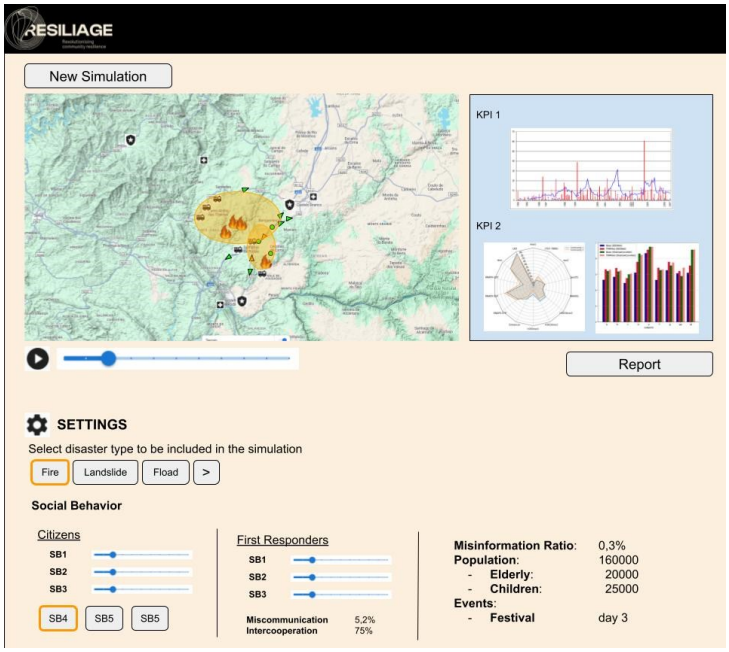

Figure 23 - Multi-Mode Example of Simulation

Figure 23 represents the simulation page for communication analysis. Developments consider to: (**i**) Simulate different scenarios for when disasters might occur to understand the communication between multiple actors. (**ii**) Integrate social behaviour as parameters in the simulations, based on literature and social experts feedback. (iii) Use data from open datasets (e.g., Copernicus or Eurostat) to support the simulation modules.

These mock-ups are iterative and will be refined based on ongoing feedback and testing to ensure the tool meets the needs of its users effectively.

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6. Supporting Systemic Community Resilience Set (SCORE)

The Supporting Systemic Community Resilience Set is an initiative integrated into the RECORE platform and designed to bolster long-term systemic strategies for enhancing community resilience. This set comprises several key components aimed at fostering knowledge exchange and peer learning, training, guiding decision-making, and providing detailed insights into the cultural and historical dimensions of resilience.

The SCORE Set includes:

- The **CORE Digital Network** tool is an open blog platform that facilitates knowledge exchange, peer learning, online training and promotes best practices within/among the CORE lab and the CORE Associated labs. It enhances **multiple stakeholders' engagement** providing a direct channel for local and global collaboration throughout the overall DRM. It enables a network, with a dedicated communication channel, making available updates and announcements relevant to the communities involved, thereby fostering a sense of connectedness and shared purpose.

- The Decision Support System (**DSS**) tool is a system designed to assist decision-makers by filtering information and offering guidance to **systemic approach to DRM** based on best practices derived from the RESILIAGE project. By integrating data from various sources, including geographic, cultural, health, economic, and human capitals, the DSS especially **target FRs, planners, and policymakers** in supporting them how to better implement strategic actions and preparedness plans.

- The **Multidimensional Atlas for Community Resilience** (MultiAtlas) tool works via WebGIS with both spatial and non-spatial data by identifying and visualising in CORE labs drivers to leverage heritage as a resource of community resilience. It provides a dynamic repository of information by integrating RESILIAGE investigations of the interactions between communities and their historic landscapes and in-depth co-mapping. It captures community perspectives and sense of place and enables grasping knowledge on regions' gaps and opportunities by **systemic** enhancing all **society approach to DRM**.

Detailed insights and final developments of the SCORE Set with its tools in the framework of T3.3 will be delivered in D3.3.

6.1. CORE Digital Network

The CORE Digital Network tool is a customised online platform designed to provide a shared virtual space for exchange of knowledge, experiences, best practices and peer learning as well as providing training and information among communities facing natural hazards and CC-related challenges. It is conceived to **enhance and facilitate the interaction and engagement among different stakeholders** within the CORE labs to foster their networking. By enabling cross-fertilisation through cross-cutting challenges, clusters and actors, the platform supports systemic multi-stakeholder collaboration within all phases of DRM and DRR at local and global levels.

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The CORE Digital Network plays a role in capability building, shaping a multi-actors training package (T4.4), supporting interaction with project partners acting as moderators and mentoring for CORE Associated labs (T7.2), and enabling peer exchanges among analogous stakeholder types. Through this tool, the CORE labs and Associated CORE labs can explore synergies and differences in hazard types, cascade effects, and proposed solutions, contributing to a deeper understanding and more effective strategies across the network (T6.4). By its flexibility to various uses and users this tool aims to ensure a strong cohesion within the consortium and among the DRM stakeholders creating collaborative environments.

The CORE Digital Network tool (developed by POLITO with UI developed by LOBA) is at an advanced stage of development to be ready to enhance exchanges with CORE Associated labs and available at link https://forum.resiliage-ecosystem.eu/.

6.1.1. User requirements

The tool is implementing the following features accordingly to user requirements that were preliminary identified (see Section 3.1.2):

- **User authentication**: Privacy policy is provided, and modalities for integrating new content. Only users invited by moderators can directly interact with the network; people external to the network are only enabled to read through posts.
- **Moderation**: The CORE labs representatives and identified RESILIAGE partners will have the role of facilitators
- **Organised information structure**: Easy search for content. The tool is organized into sections, allowing users to easily find and access information by browsing categories relevant to DRR.
- **User-friendly interface**: The users have a button to toggle dark or light mode depending on their preferences.
- **Portability**: The software has different desktop and mobile versions.
- **User Role Classification:** A system to classify users based on their roles, improve organisation and interaction within the community.
- **Multi-Language Exchange:** Communication and content exchange are enabled in CORE lab languages.
- **Expandable and Customizable Structure**: The system includes a flexible architecture that supports the expansion of the structure by allowing moderators or administrators to add new clusters and sections for discussions. This adaptability ensures the platform remains responsive to the evolving needs of the community.

6.1.2. Solution design and implementation details

The CORE Digital Network is developed using *Discourse* open-source software, extensively customized to meet the project's specific requirements. *Discourse* is an open-source software designed to foster community platforms. It provides a modern and intuitive interface, making it easy for users to participate effectively. It supports a wide

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range of customization options, including topics, plugins, and integration with other tools, allowing to adapt the platform to specific needs.

The RESILIAGE customizations includes a tailored colour scheme and appearance to align with the project's branding. Functional enhancements were also implemented, such as restricting user registration to those invited by CORE lab's representatives (thereby ensuring a secure and controlled user base), light and dark mode toggle to accommodate each user preference, and a system for classifying users based on their roles, enhancing organization and interaction within the community. These modifications ensure that the CORE Digital Network is not only visually cohesive but also functionally robust, catering to the needs of the project.

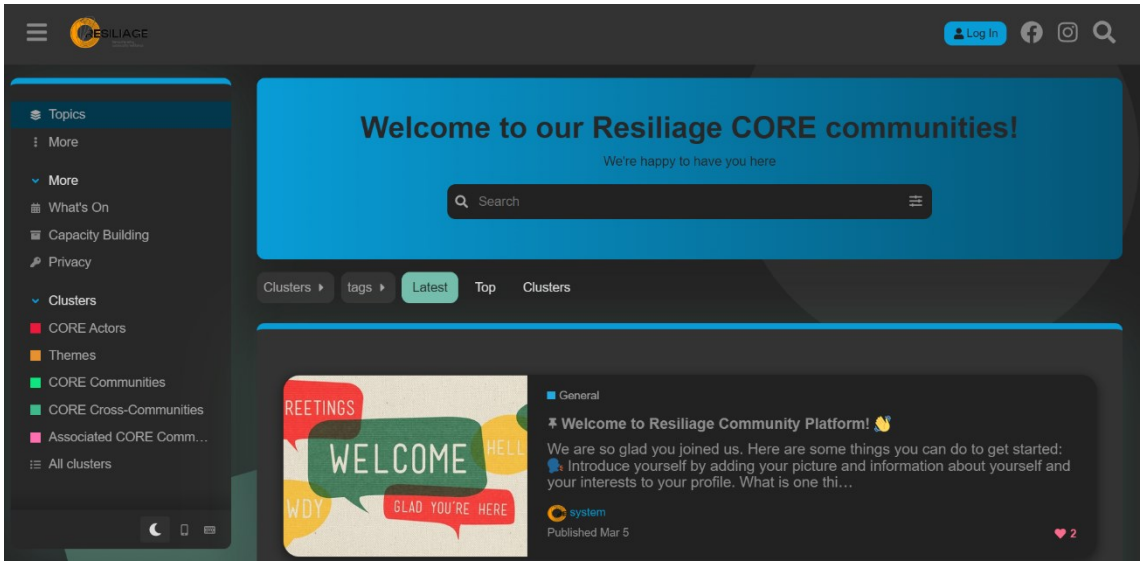

Figure 24 - CORE Digital Network - Welcome Page

The sections, referred to as "clusters", to facilitate focused interaction and engagement, at this stage of development, are:

- **CORE Communities:** a dedicated page for local multi-stakeholder interaction and communication in each CORE lab.
- **CORE Cross-Communities:** enabling cross-community exchanges and knowledge sharing among the five CORE labs
- **Associated CORE Communities:** promoting integration of Associated CORE labs within the RESILIAGE community
- **CORE Actors:** ensuring each group of target users (FRs, knowledge organisations, policymakers, and civil society associations) with a tailored space for direct interaction and collaboration
- **Themes:** encompassing various cross-cutting categories relevant to specific themes and challenges

The tool will undergo a second phase of implementation, for further refining and customizing in co-creation with the CORE labs. The co-shaping process is to ensure that

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the tool is aligned with the objectives and requirements of the different stakeholders' groups.

6.1.3. Mock-up

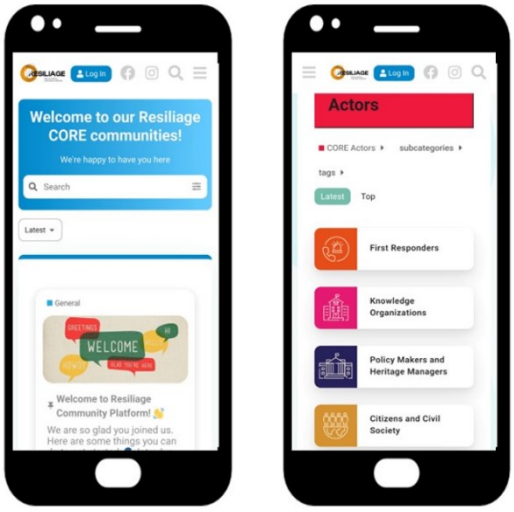

Figure 25 - CORE Digital Network Mobile version

Presented below are screenshots of the latest iteration of the CORE Digital Network tool, accessible via the link https://forum.resiliage-ecosystem.eu/. Figures depict the foundational layout, user experience, interface, and functionality of the platform.

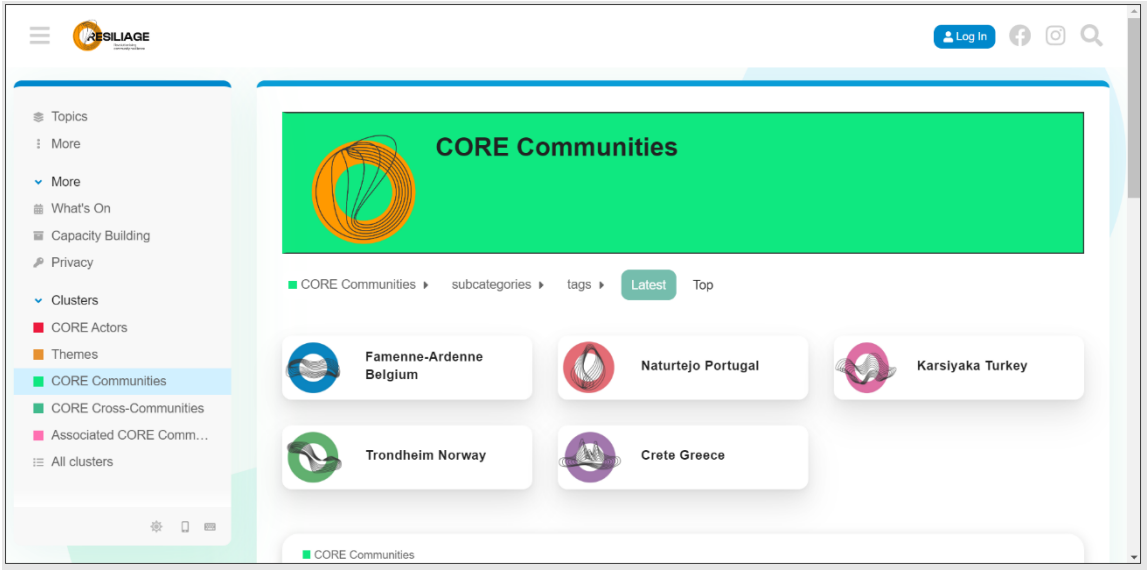

Figure 26 - CORE Digital Network – CORE Communities cluster

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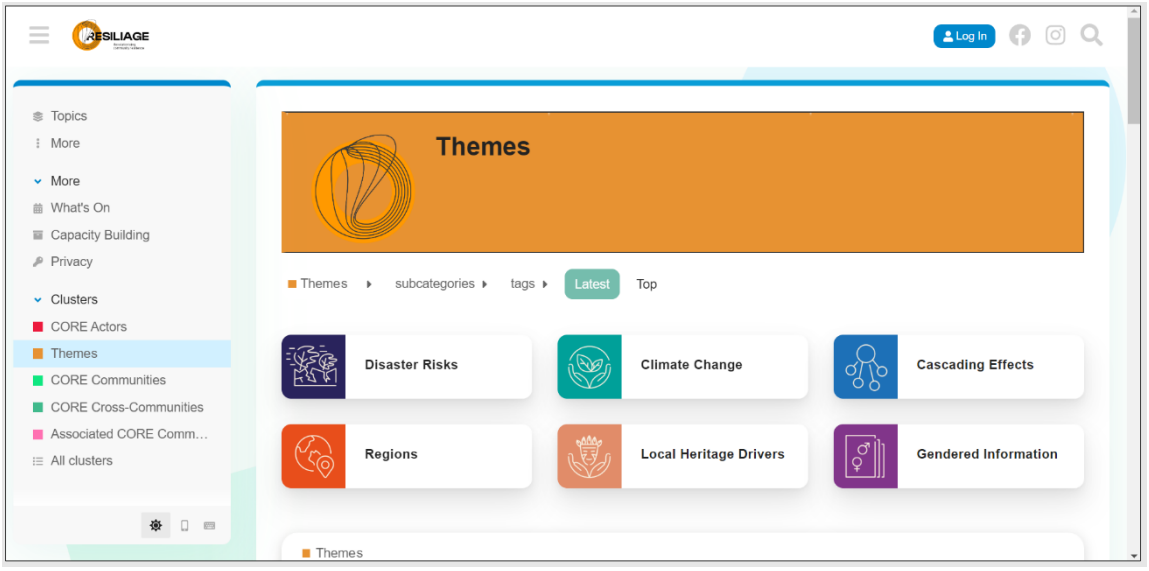

Figure 27 - CORE Digital Network – "Themes" cluster

6.2. Decision Support System (DSS)

The primary goal of the DSS is to distil the extensive knowledge accumulated through the RESILIAGE project and make it accessible to diverse users, including local authorities, FRs, and citizens. The DSS serves as a crucial tool for sharing Lessons Learned (LLs) and best practices, supporting CORE labs in shaping strategic actions **for enhancing DRM, response, and PPs**. By allowing users to tailor RESILIAGE achievements to their local needs, the DSS fosters a deeper understanding and implementation of effective long-term structural disaster resilience strategies.

Designed to facilitate seamless Knowledge Transference among multiple users, the DSS centralizes a wealth of information collected through the RESILIAGE project. This includes LLs, Best Practices, and Policies, all organized for easy access, understanding, and analysis. To enhance the data availability and richness, the system might also be designed to potentially connect to external public databases or APIs. This capability allows for the integration of additional data sources, ensuring that the DSS remains a robust and versatile tool for DRM. The system ensures that valuable insights are readily available to support informed decision-making in DRM.

The tool (developed by ALMENDE) is at its first stage of development to be integrated by more RESILIAGE activities across WPs.

6.2.1. User requirements

To ensure the DSS meets the needs of its primary users (see Section 3.1.2), we have carefully considered several key requirements:

- **User Authentication**: The system will feature secure login accounts. Authenticated users might benefit from features like saving favourite reports, receiving customized recommendations, saving preference system settings, and more, potentially enhancing their overall experience and efficiency.

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- **Multi-Language Support**: Recognizing the diverse users' bases, the DSS will support multiple languages, making it accessible to a wider audience.

- **Intuitive and User-Friendly Interface**: The interface is designed to be intuitive and user-friendly, allowing users to easily access data and view results.

- **Report Exporting**: Users, when possible, will have the ability to export reports in various formats, including PDF and CSV, facilitating the sharing of information.

- **Data Sharing**: The system will enable users to share data, models, and reports with stakeholders, promoting collaboration and transparency.

6.2.2. Solution design and implementation details, and Mock-up

The DSS will incorporate advanced features to ensure that users can efficiently find and utilize the most relevant data:

- **Search, Filter, and Sorting Mechanisms**: The DSS will include search, filter, and sorting mechanisms that enable users to quickly locate the most suitable data for their needs. These features are designed to streamline the user experience and enhance the accessibility of information.

- **Analyses and AI Features**: The system will leverage analytical and AI capabilities to provide deeper insights and support more informed decision-making. These features are integral to the DSS, offering users tools for data analysis and interpretation.

Figure 28 shows the screenshot of the current system.

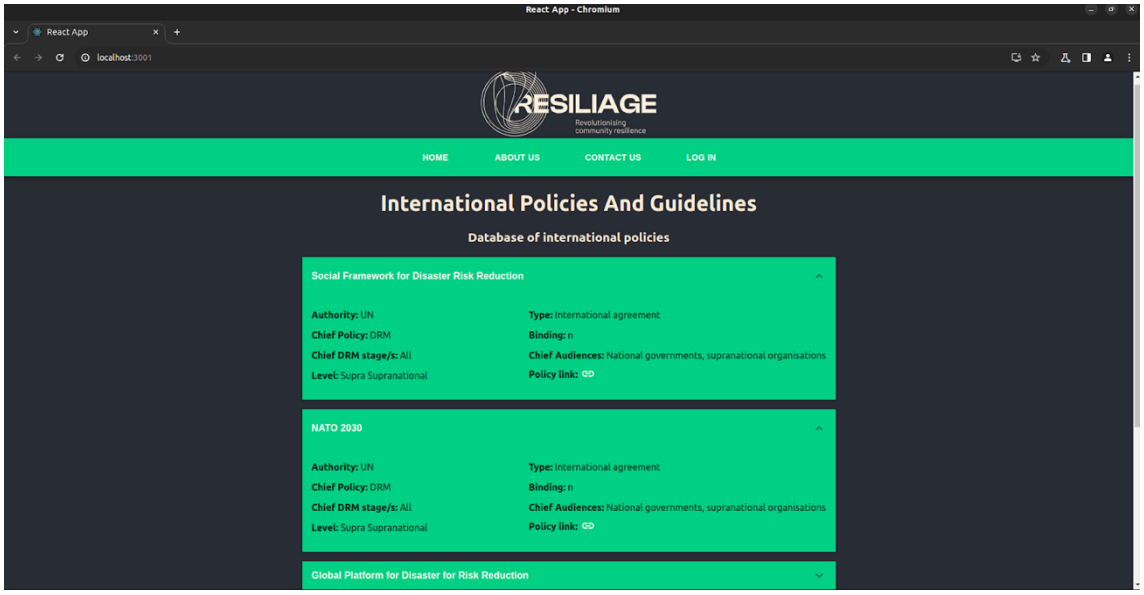

Figure 28 - DSS - Home Page

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6.3. Multidimensional Atlas for Community Resilience (MultiAtlas)

The MultiAtlas tool plays a pivotal role in integrating heritage-led knowledge for community resilience generated in the RESILIAGE project. It is designed to integrate webGIS-based information enabling multiple readings and understandings. It creates insights across the plural dimension of cultural natural heritage and cultural practices and its diversity in representing communities' historical and cultural backgrounds and current values. By doing so, the MultiAtlas enables visualizing and analyzing rich insights into RESILIAGE project.

Navigating and/or searching for crosscutting strategic aspects of SyRI across various and complex datasets, users are facilitated for a more awared decision-making and strategic planning that **structurally integrate heritage as a resource for DRR**.

MultiAtlas incorporates collaboratively collected data and information to create a comprehensive picture of features and ways of leveraging heritage for empowering community resilience, also considering **diversity in society** and including gendered information.

By combining data sources and creating narratives, the MultiAtlas aims to enable CORE labs to grasp knowledge on regions' gaps and opportunities and systemically enhancing the **all-society approach to DRM.**

This rich repository of information not only aims to document past experiences but also to serve as a vital resource for understanding community resilience' drivers and enhancing societal awareness. It includes creative collaborative mapping (T2.6) and outputs from sustainable CH workshops (T4.2), and other heritage focused workshops and activities developed across WPs (WP1, WP6, WP7). It also connects more data, maps, images, models, and information collected across the project (such as from past disaster simulations, crowdsourcing efforts), ensuring they are all fully interconnected and accessible. It features hazard risk perception maps and a digital archive containing heterogeneous data.

Key functionalities of the tool are its ability: to visualize geospatial data, integrate and filter multidisciplinary information. For each CORE lab, MultiAtlas helps in both capturing and identifying community perspectives, the sense of place shaped by historical stratification and support inclusive **gendered vision** of community resilience. State-of-the-art web-based GIS technology provides an interactive platform where users can explore and search for spatial and non-spatial data.

The MultiAtlas (developed by POLITO) is at the first stage of development. It will be fed by forthcoming inputs (e.g. T2.6 and T4.2 and more activities across WPs).

6.3.1. Concept Design

The custom-made MultiAtlas software is designed to provide tailored geographical information and visualizations that address the specific needs of users, particularly those identified in the CORE labs. The MultiAtlas is designed to be highly adaptable, allowing for the incorporation of diverse data sources to meet various operational needs. Its advanced visualization capabilities enable users to overlay multiple data layers, facilitating in-depth spatial analysis and linking intangible values to specific locations.

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The interactive map and platform are conceived to provide an intuitive experience, making it easier to identify patterns and trends in geographical information.

The MultiAtlas conceptualisation encompasses some specific aims and approaches that are:

- **Sustainable approach**: The UX and narratives include sustainable development goals and climatic crisis information
- **Multi-scalarity**: The UX and narratives consider endangered sites at different scales and their interactions
- **Multidimensional:** The design and UX integrate both spatial and non-spatial information, tangible and intangible heritage
- **Dynamic:** The design includes past events, memories, and living heritage with current practices.
- **From local to global:** Information on existing PPs and good practices in CORE labs are linked to implementation of international Recommendations

6.3.2. User requirements

By considering identified user requirements (Section 3.1.2), the MultiAtlas will especially answer to needs of:

- *User Friendliness*: The UI and UX is under development to be intuitive and user-friendly
- *Inclusive User Friendliness***:** The UI and narratives include inclusive signs and contents by taking into account gendered aspects
- *Cultural Accessibility***:** The UX and narratives include historical, cultural and scientific information by providing also basic explanations
- *Grasping Dissemination*: The UX is under development to be fully visual.

6.3.3. Solution design and implementation details, and Mock-up

In the solution design and implementation of the custom-made Multi-Atlas software, data storage and management play crucial roles. The geographical and heritage data will be stored in the RESILIAGE data lake, which provides a centralized repository for all raw and processed data. Metadata, including information about data provenance, schema, and other contextual details, will be stored in a DocumentDB instance on AWS. DocumentDB, a fully managed NoSQL document database service, is chosen for its scalability, low-latency performance, and ease of integration with other AWS services. The Multi-Atlas supports flexible, JSON-like document structures, making it ideal for managing metadata associated with various data types stored in the data lake. Each data will be georeferenced with coordinates, so that they will be displayed on an interactive map.

At this stage of the project, mock-up for the custom Multi-Atlas software are not yet available.

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7. RESILIAGE Replication Toolbox

The RESILIAGE Replication Toolbox is a crucial component of the project designed to facilitate the replication of the RESILIAGE paradigm across different contexts and communities. This toolbox will serve as a comprehensive, step-by-step guide to assist users in replicating the project's approach and community-based methodologies and strategies for DRR, risk perception analysis, disaster and cascading effects' mitigation, and enhancement of PPs by using RECORE with RESILIAGE digital tools and soft solutions. By providing a structured framework, the Toolbox aims to empower users to develop their own tailored solutions for enhancing community resilience throughout DRM for the implementation of Sendai framework, CCA policies and SD.

Set to start in month 24 (M24), the development of the RESILIAGE Replication Toolbox is currently in the preliminary preparatory phase. During this time, foundational activities are being undertaken to ensure a robust and effective implementation. This includes integrating external data sources, such as Copernicus data and results from other H2020/HE projects. The Toolbox will also feature a repository of overall RESILIAGE LLs and identified Key Indicators of community resilience, with their prioritisation for SyRI strategies across the stage of DRM, providing valuable insights, best practices and new knowledge to advance understanding of community resilience for future applications.

The RESILIAGE Replication Toolbox (developed by POLITO) is at the early preliminary stage of development. Detailed information and final developments of the Toolbox with its tools will be delivered in D3.4.

7.1. User requirements

Preliminary analyses (Section 3.1.2) will be further developed (in collaboration with WP4) on refining the user requirements. By thoroughly understanding these requirements, the Toolbox will be designed to be both functional and adaptable, ensuring it meets the diverse needs of its users and effectively supports the replication of the RESILIAGE paradigm. The insights gained from these analyses will directly inform the design process, and as the project progresses, more details about the Toolbox's specific features and functionalities will be developed.

7.2. Solution design and implementation details, and Mock-up

No implementation detail or solution design are available at this stage of the project development. Mock-ups of the Toolbox are not yet available.

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8. Conclusion

This document as a companion of the RECORE platform demonstrator has provided a comprehensive overview of the initial rollout of the platform, its conceptualisation, design and aims. It has also illustrated the different stages of development of its tools with current challenges and opportunities.

The prototype, accessible at https://resiliage-ecosystem.eu, makes available the core functionalities of the platform with its integrated tools at this stage of development to demonstrate its potential.

The platform reflects RESILIAGE approach to embed local societal resilience empowerment into a global vision of a digital society. As an initial release, it showcases a prototype that integrates digital tools with insights and data tailored to specific local community needs, reflecting the iterative consultation process with stakeholders as a co-creation approach across the CORE labs via community-based methodologies.

This report has introduced functionalities, modalities and collaborations among the tools' developers in WP3. It has also provided some disclosures about how RECORE incorporates knowledge and information developed through various activities of the project (mainly WP1, WP2, WP4 and WP6) setting the stage for further enhancements and expansions.

It also intended to highlight how RESILIAGE approach to digital tools co-creation materialises. This approach - within a research innovation project – builds and feed the platform and its tools with data and information that are modeled by the analyses and activities of the ongoing project for future end users. However, it also generates some difficulties that gradually arise in designing the tools to be appropriate for each CORE lab but at the same time useful for producing exploitable solutions are addressed.

The collaborative workshops with the CORE labs have provided important feedback for improving the design and usability of the RECORE. The important outputs (e.g. changing colors, denominations, understandings) encourage further collaborative processes to refine and progress toward the next developments of the tools.

The cross-fertlisation among various experts as well as the various objectives of the project are fostering strong SSH and ICTs collaborations. The workflow is complex by linking various Tasks and WPS. However the activities undertaken are promising in creating novel customisations for addressing DRM according to RESILIAGE holistic systemic approach.

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