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

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Article

Engaging Users in Resource Ecosystem Building for Local Heritage-Led Knowledge

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Abstract: The aim of this paper is to form an analytical and critical framework to consider the uses of digital platforms in heritage field and practices and to provide methodologies for user profiling based on the identification of local stakeholders and their needs. Within the context of the EU H2020 research project RURITAGE, a resource ecosystem (RRE) of various integrated tools was created for shaping and addressing heritage-led knowledge and bottom-up strategies of local regeneration. More specifically, the RRE was conceived to provide local stakeholders with new methodologies and user-friendly tools based on bottom-up processes for identifying and actioning heritage and territorial features and turning these cultural natural values—as well as the gaps—into opportunities. This paper undertakes a comparative analysis of the integration of tools in other digital platforms for heritage practices and/or regeneration processes to explore the holistic approach to heritage knowledge and the effectiveness in engaging local stakeholders. In addition, it frames methodologies for local stakeholder and related needs identification. Through this comparative analysis among digital heritage platforms and through user profiling to target the needs of users by using the RRE as a case study, the paper explores the challenge of helping communities to shape a local heritage-led collaborative knowledge supported by integrated and user-friendly digital tools and to activate them in preserving and exploiting their territories and building shared and plural cultural heritage understandings, considering cultural heritage as a social need.

Keywords: holistic heritage knowledge building; holistic heritage digital platform; cultural natural heritage; digital humanities; heritage-led collaborative strategies; cultural heritage user engagement; digital tools integration; Findable Accessible Interoperable Reusable (FAIR) data; local stakeholders; bottom-up rural regeneration



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1. Introduction

The upcoming transition is a multilevel transition, which closely connects several challenges [1]. The role of cultural heritage in this innovation has been widely recognized both for its intrinsic and instrumental values. The Faro Convention has identified the value of cultural heritage for society as a right to participate in cultural life according to the Universal Declaration of Human Rights, which also underlined individual and collective responsibility in this process [2]. Moreover, because of their strong potential, culture and cultural heritage have been included in European policies as active beneficial factors of societal changes. Challenges addressed by strategy 21 of the Council of Europe [3] consider cultural heritage as a social component for “Living in peace”, “Improving quality of life”, “Promoting participatory management” and “Promoting an inclusive approach

to heritage" [4]. For these aims, the strategy particularly specifies the need to encourage the involvement of citizens and local authorities in capitalizing on their everyday heritage, making that heritage more accessible and creating a suitable framework to enable local authorities and communities to take action to promote and manage their heritage. Thanks to recent developments, we can assume, thus, that the challenge of a more cohesive and fair society firstly requires a democratization of culture and heritage. This should be understood not only in terms of accessibility, but also in terms of shaping new approaches and new strategies to innovate the processes of heritage knowledge building. Users also should be better engaged in heritage practices as well as in the creation of a new local heritage-led knowledge and management strategies.

Cultural heritage identification is undergoing further development especially related to digital transition. A definition of heritage as something that is "of the past, in the present, for the future" [5] has been recently discussed, considering the need for a reframed heritage as a processual and discursive notion, to adapt a plural understanding of "heritage futures" [6]. Reflections on change related to a digital approach highlight a new kind of 'enactment' fostered by data visualization, placing "the idea of making active at the center of our attention" enabling us to better think, do, and perform [7]. Recent research has been addressed at enabling inhabitants "to gain access to knowledge, markets, social and cultural services, technologies and infrastructure that are usually only accessible to urban residents" [8]. In the meantime, new complex environmental heritage assets have led to definitions that emphasize the strong interactions between human and nature to consider a 'cultural natural heritage (CNH) framework' [9–11].

Sustainable growth is also a main challenge that applies to CNH. Since 2000, UNESCO has fully recognized the importance of sustainability in CNH practices and aims [12,13]. However, it has also been observed that there are no models, rules or specific definitions for this purpose [14]. Possible indicators for evaluating the sustainability of cultural heritage investments have been surveyed and the crucial importance of local stakeholders and "appropriation of cultural heritage by the community" have been underlined for durable effects on regional developments [15]. Cultural heritage has been explored for its sustainable integration with tourism in regeneration, especially in rural areas [16].

Digital innovation, as a cross-cutting engine, has a vital role in activating CNH for these challenges. It has already brought about extensive change in the humanities field [17] and in heritage studies, as relationships in the use of digital approach in the humanities and heritage studies are under the spotlight [18], and has contributed to transforming the cultural heritage world [19]. However, the effects of the transition in this field are still far from complete. Digital innovation can be better exploited to encourage and support the cultural heritage innovation in terms which especially entail innovation in processes. Digital innovation processes play a fundamental role in allowing citizens and communities to act and to improve, instead of being passive end-users or consumers. It becomes strategic to foster heritage as a key activator of social innovation, especially in specific key frameworks, such as rural areas where digital innovation could make a difference in addressing CNH-led regeneration processes [20]. Digital innovation together with a bottom-up active knowledge of CNH can strongly improve economic performance and quality of life.

In this paper, within this state-of-the-art field, we propose novel heritage knowledge building approaches and tools through community-based methodologies with active participation and collaboration of local stakeholders for innovating regeneration processes in rural areas within the scope of the H2020 RURITAGE research project: rural regeneration through systemic heritage-led strategies. The proposed methodologies make use of integrated tools enabled by a digital resource ecosystem to guide local stakeholders in local knowledge building related to CNH, addressing sustainable strategies that can foster the regeneration of their rural areas based on local heritage-led knowledge building. Local stakeholders are not only the testers of these tools, but they are also the active contributors to the design and implementation. They have directly participated and provided input in

the process, and they have also helped define the customization of each tool allowing for the future use of these tools by other stakeholders/citizens within the research project and also after its completion.

To this end, the RURITAGE Resources Ecosystem (RRE) is conceived as a distributed software platform establishing a data ecosystem and open standards for the management of information, aimed at providing different services and customizable applications to suit the needs of the various end-users identified in the project and also future end-users that will benefit from the ecosystem [21]. Both the integration of tools and the engagement of local stakeholders in the customization of tools have special benefits to better enable end-users to integrate different and concomitant aims by empowering heritage and local stakeholders.

In the heritage field, other digital tools for supporting different purposes of user engagement and sustainable regeneration of historical sites have been developed for various purposes. Barrientos, et al. [22], among others, contributed with a literature review, which specifically enlightens the correlation between the class of computational method and its scope and area of application with regard to rural areas, proposing some different uses of these methods as well. The main novelty of the RRE is that it has conceived community-based methodologies for co-building and operationalizing heritage-led knowledge for innovating both the usability of integrated user-friendly digital platforms by local stakeholders [21] and regeneration processes [23]. In this aim, it provides easy to use digital technologies at the service of rural territories.

2. Research Aim

The RRE fosters digital transition to empower rural territories, by enhancing the bottom-up active knowledge and sustainable conservation of CNH. With this in mind, it aims to provide a flexible and user-friendly holistic digital resource ecosystem including a complete range of useful knowledge and tools to help local stakeholders shape general strategies and move to immediate precise actions based on heritage-led knowledge. To achieve this general purpose, the research needed to achieve a holistic knowledge of local areas centered on CNH, conceived as catalyst of innovation within territories. However, it also required user-focused innovation methods to co-generate knowledge through step-by-step local stakeholder engagement.

Accordingly, one of the main aims of the research has been the creation of the RRE as an integrated ecosystem of tools for holistic collaborative heritage knowledge and different kinds of heritage-related user engagement. This aim also includes the flexibility to adapt to CNH characterizations and to systemic and strategic areas of innovation. A parallel aim thus has been the user-friendliness of the ecosystem to achieve effective local stakeholder engagement.

The aim of this paper is to provide an analytical and critical framework to consider the uses of digital platforms in heritage field and practices. It also aims at providing methodologies for user profiling based on the identification of local stakeholders and their needs. Comparative analysis of the integration of tools in a digital platform for heritage practices and/or regeneration processes can be beneficial to explore the holistic approach to heritage knowledge and the effectiveness in engaging local stakeholders through digital tools. Through this comparative analysis among digital heritage platforms and through user profiling to target the needs of users by using the RRE as a case study, we explore the challenge of helping communities to shape a local heritage-led participatory knowledge supported by integrated and user-friendly digital tools, to be more aware of different values of cultural and natural heritage and to activate them in preserving and exploiting their territories and building shared and plural cultural heritage understandings, considering cultural heritage as a social need.

3. Materials and Methods

3.1. An Identification, Review and Comparison of Cultural Heritage-Related Digital Platforms

The analysis of the existing digital heritage platform was undertaken by identifying, reviewing and comparing the recent tools that are provided mostly in the heritage field. The identification, review and comparison included platforms for enhancing cultural heritage, for public engagement in the heritage field and for fostering rural areas. The analysis provides a general overview with a specific description of the integration of tools and an analysis of utilities.

The identification, review and comparison demonstrated that some actions have been undertaken directly by the European Community and other associations. The ICT Mediterranean platform for UNESCO cultural heritage (iHERITAGE) [24], for example, provides new solutions through an innovation-driven growth process to promote cross-border technological transfer, Living Labs, industry–academia collaboration and the creation of spin-offs and new products, using the latest Information and Communication Technology (ICT)—augmented reality (AR), virtual reality (VR) and mixed reality (MR).

The H2020 research project Social Platform for Holistic Impact Heritage Assessment (SoPHIA) [25] was expressly conceived for the creation of a new type of heritage platform. In this context, researchers and consortium members designed a social platform with the aim of providing a virtual meeting point for a heterogeneous community of stakeholders, from different fields and disciplines, who are interested in interventions in historical environment and cultural heritage that work together towards the definition of an effective impact. The platform, however, is not yet publicly accessible. Currently, it can only be accessed by active members of the project. A fully commercial solution has also been exploited.

The H2020 RE-designing Access to Cultural Heritage (REACH) project [26] aims to expand participation in the preservation, (re-)use and management of European culture. To achieve this, the researchers developed an independent online space open to the contribution of the community of heritage researchers, practitioners, professionals and citizens interested in promoting the value of cultural heritage and supporting its public recognition. Basically, the platform consists of a series of databases to collect and expose data, information and a collection of blogs on the theme of cultural heritage and participatory activity in culture.

The PLUGGY platform, conceived within the scope of the H2020 project Pluggable Social Platform for Heritage Awareness and Participation (PLUGGY) [27], enables citizens to share their local knowledge and everyday experience with others, with the participation of cultural institutions and digital libraries, building extensive networks around a common interest in connecting the past, present and future.

The Network and digital platform for the Cultural Heritage Enhancing and Rebuilding (NETCHER) [28] platform aims to set up an information network and a chart of good practices at European level, by gathering a maximum number of actors engaged in the preservation of cultural heritage. In detail, the social platform aims to systematize and frame best practices to enhance and capitalize on the international experiences of the consortium members to carry out a joint action plan, with shared toolkits and a research and innovation roadmap. Its main tools are the WebGIS platform, which is password-protected, and the Library, which consists of a bibliography collected through Zotero and made public through BiBbase. However, this platform is not publicly accessible. Only members of the consortium can contribute to its growth.

The European Network for Rural Development (ENRD) [29] is a framework aimed at (i) increasing the involvement of stakeholders in rural development, (ii) improving the quality of rural development Programs (RDPs), (iii) better informing people of the benefits of a rural development policy and (iv) supporting the evaluation of the RDPs. ENRD is a hub for exchanging information on how rural development policy, programs, projects and other initiatives are working in practice and how they can be improved to achieve more. This is achieved by sharing information stored in databases among the various end-users.

3.2. Platforms in a Comparative Perspective

Heritage tools often suffer from a lack of public involvement, which represents one of the biggest issues regarding the impact of cultural heritage on society. Civic engagement and active involvement are often severely underestimated. It is necessary to design methodologies and tools to create meeting and discussion points that are accessible, intelligible and easy to use. The scientific community, which is sensitive to these issues, has found a solution in the integration of tools and platforms from the ICT world. However, the use of digital tools, together with the information shared with the public, is often too technical, and those who have no relevant scientific expertise are inevitably left out. Moreover, the integration of tools through a digital ecosystem is limited and not so well developed. Although research projects also provide new kinds of advanced tools, they mostly work independently without an integrated distributed software platform.

Table 1 presents the nine above-mentioned platforms to show how digital transition in the world of cultural heritage includes several tools. Some of them especially face the challenge of engaging users in cultural heritage practices; some others address other issues such as rural development or heritage social accessibility. Moreover, it also includes the RRE. This platform is a component of an overall methodology of RURITAGE research project, which aims to sustainably enhance local heritage for regional and community development. The project frames six systemic innovation areas (SIA)—Pilgrimage, Resilience, Sustainable Local Food Production, Integrated Landscape Management, Migration and Art and Festivals—that help the identification of unique heritage potential within rural communities. Its digital platform, RRE, is to ensure effective knowledge sharing, mutual learning and communication, and provide stakeholders with data, information and support through innovative, integrated tools developed within RURITAGE. For these multiple purposes, the RRE hosts and integrates six key interactive tools accessible to all users interested in promoting rural regeneration. That way, the gathered data and shaped local heritage-led knowledge are finalized by each tool to various interlinked objectives. These objectives range from heritage historic knowledge to territorial issues up to supporting decisions for sustainable development.

Table 1. Analysis of existing heritage-related platforms.

Project Denomination	Project Aim	Platform Aims	Tools
PLUGGY: Pluggable Social Platform for Heritage Awareness and Participation	To enable citizens to share their local knowledge and everyday experience with others.	To create the architecture for the creation of pluggable applications, allowing for beyond the project, not yet imagined ways to utilize the content on the social platform, while focusing on the design of the social interaction.	Open-source solutions that programmers can use to build a range of social applications: PLUGGY3D Suite (for creating augmented reality experiences), PLUGGY Pins (for creating guided tours), Games Hunter (for creating interactive games) and PlugSonic Suite (for creating soundscapes).
NETCHER Social Platform for Cultural Heritage.	To set up an information network and a chart of good practices at European level, gathering a maximum number of actors engaged in the preservation of cultural heritage.	To systemize and frame best practices to enhance and capitalize on the international experiences of the consortium members to carry out a joint action plan, with shared toolkits and a research and innovation roadmap.	Best Practices Repository, WebGIS Library with database. The WebGIS is password protected, whereas the Library provides a bibliography collected through Zotero and made public through BiBbase.
ARCHES: Accessible Resources for Cultural Heritage EcoSystems	To help European museums to become barrier free with 3D art replicas, mobile phone apps, games and sign language video avatars.	To create apps, games and an interactive multimedia guide. Apps are available in App Stores.	Sign language video avatars, tactile artwork reliefs, barrier-free apps for museum visits and games for smartphones and tablets.
CEMEC: Connecting Early Medieval European Collections	To create a collaborative network, and a cost-effective business model, between eight European museum collections and six technical partners.	To create the Mobile Panoramic Project System (MPPS) to enable museum and online visitors to explore the rich cultural history and diversity of Early Medieval Europe.	MPPS will connect to a database of 3D-scanned objects, allowing users to take a closer look at objects in the exhibition and to learn more about the collections and history from their devices at home.

Table 1. Cont.

Project Denomination	Project Aim	Platform Aims	Tools
IMareculture: Advanced VR, iMmersive serious games and Augmented REality as tools to raise awareness and access to European underwater CULTURal heritagE	To raise public awareness of European identity by focusing on maritime cultural heritage, which by default bridges different civilizations.	To release the tools and games free to the public. As each tool has a dedicated platform, there is no single ecosystem that hosts all tools.	Exhibition on Thalassa Museum, 3D Libraries of Ships, 3D Libraries of Amphorae, image enhancement tools and a navigation algorithm.
INCEPTION: Inclusive Cultural Heritage in Europe through 3D semantic modelling	To solve the shortcomings of the state-of-the-art 3D reconstruction by significantly enhancing the functionalities, capabilities and cost-effectiveness of instruments and deployment procedures for 3D laser survey, data acquisition and processing.	To solve the accuracy and efficiency of 3D capturing by integrating Geospatial Information, Global and Indoor Positioning Systems (GIS, GPS, IPS) through both hardware interfaces as well as software algorithms.	3D models, videos and e-learning.
ENRD: The European Network for Rural Development (works alongside the European Innovation Partnership for Agricultural Productivity and Sustainability (EIP-AGRI))	To increase the involvement of stakeholders in rural development, to improve the quality of rural development programs (RDPs), to better inform on the benefits of rural development policy, to support the evaluation of the RDPs.	To serve as a hub for the exchange of information on how rural development policy, programs, projects and other initiatives are working in practice and how they can be improved to achieve more.	Project database, Evaluation knowledge Bank, Share your Rural Story, LAG Database (allows Local Action Groups (LAGs) to get in touch, network and cooperate with each other), CLLD Partner Search, LEADER resources (includes News, Publications, Good Practices, Guides, Videos, LEADER Historical resources), NRN Toolkit and myENRD.
REACH RE-designing Access to Cultural Heritage	To have a wider participation in preservation, (re-)use and management of European culture	To create an independent online space open to the contribution of the community of heritage researchers, practitioners, professionals and citizens interested in promoting the value of cultural heritage and supporting its public recognition.	REACH Good Practice about participatory approaches in culture and social innovation database, MEMOLA Archive about rural heritage, the CINE Gate about culture in Northern environment, the RICHES Showcase and Taxonomy about cultural heritage in a changing world.
SOPHIA: Social Platform for Holistic Impact Heritage Assessment	To promote collective reflection within the cultural and political sector in Europe on the impact assessment and quality of interventions in European historical environment and cultural heritage at urban level.	To create a social platform, a vast and diverse community of stakeholders from different fields and disciplines interested in interventions in historical environment and cultural heritage in Europe, that work together towards the definition of an effective impact.	The impact assessment model, best practices identified and report.
RURITAGE: Rural regeneration through systemic heritage-led strategies	The project aims to sustainably enhance local heritage for regional and community development. The intention is to regenerate rural areas with the help of the systemic innovation areas (SIA) framework, which identifies unique heritage potential within rural communities. The recognized SIAs are Pilgrimage, Resilience, Sustainable Local Food Production, Integrated Landscape Management, Migration and Art and Festivals.	The RURITAGE Resource Ecosystem ensures effective knowledge sharing, mutual learning and communication, and provides stakeholders with data, information and support through innovative, integrated tools developed within RURITAGE. The RURITAGE Resource Ecosystem consists of six key interactive tools accessible to all users interested in promoting rural regeneration.	ATLAS (to navigating the RURITAGE territories and discover their unique cultural and natural heritage), Decision Support System (to support the discovery and composition of possible heritage-led regeneration scenarios), Digital Heritage Hub (to enable exchange between stakeholders), Replication Toolbox (to support future stakeholders in replicating rural regeneration strategies), My Cult-Rural Toolkit (to enable participatory research through three physical tools and two mobile apps), monitoring platform (to examine the evidence of the role of cultural and natural heritage in rural areas as a driver for sustainable growth).

3.3. Engaging Users in the RURITAGE Resource Ecosystem

The proposed RRE platform was developed in continuous interaction with various stakeholders from rural territories involved in the RURITAGE project. As partners of the project, they have been actively involved in creating heritage-led methodologies for developing regeneration plans [23]. Methodologies are based on peer learning and mutual exchanges between “role models” representative of good practices in the six systemic innovation areas (namely pilgrimage, local food, migration, art and festival, resilience and landscape) and “replicators” of these excellent models of CNH exploitation and management. Facilitator partners provided methodologies to extract all kinds of useful information thanks to interactive engagement with the data made available on the RRE, and developed tools to build a holistic heritage knowledge to design and implement regeneration strategies in the systemic innovation areas identified [30]. The platform builds on principles of inclusion, diversity, cultural identity and community empowerment that are essential principles of heritage, strongly integrated in the nature of the RURITAGE project. The RRE, thus, is conceived as an open, inclusive platform.

The identification of relevant user groups followed the stakeholder identification and engagement strategy for creating local heritage hubs in the RURITAGE project rural areas (physical spaces for participatory activities towards co-development and implementation of rural regeneration plans). Key stakeholder groups to mobilize and involve in local activities were identified based on four functional core areas: policy, public/user, research and industry/services/investors. The stakeholder groups identified were adapted to target users of the RRE and include:

- Policy makers: international organizations, governing bodies and institutions;
- Knowledge organizations: universities and research institutions, schools and other educational and training centers;
- Civil society organizations: NGOs, interest groups and associations;
- Practitioners and key service providers in rural areas;
- Businesses and public and private investors;
- Citizens and rural residents.

Based on the definition of relevant user groups, an interest and needs assessment was performed with the RURITAGE community. Inputs were solicited from RURITAGE primary stakeholders i.e., role models and replicators, as user group representatives with regard to their views on the possible needs of RRE users. This had a dual purpose: first, it helped identify possible additional users, and second, it helped identify critical user needs. As part of the assessment, several other local stakeholders were identified as primary users of the RRE. These potential users are not primary RURITAGE stakeholders but cooperated with the project to replicate rural regeneration strategies in their own territories leveraging project outcomes, tools and methodologies (known as additional and digital replicators). To the scope of this analysis, the whole of these local stakeholders engaged in the project methodologies are, thus, considered as the RRE users (more than 100 in total) covering all user categories (with the majority from civil society organizations), numerous countries (more than 25) and regions and exhibiting an overall gender balance (54% male, 46% female).

The results of the user needs’ assessment are summarized in Table 2.

According to these needs, RRE tools and their potential end-users are also identified, as shown in Table 3. A further explanation of these tools and their functionality are explained below in the Results section. For further information, see also the publication referenced in [21].

Table 2. Summary of RRE user needs assessment. Primary users of the RRE are included as local-level stakeholders/user groups.

N	User Groups	Levels	Participants	Needs
1	Policy makers	Global	United Nations, EU, IMF, Global banks	Data of rural communities, best practices, assessment of previous projects
		National	Ministries, national authorities	Data of rural communities, best practices, assessment of previous projects, protocols, national plans, key performance indicators (KPIs)
		Regional	Regional authorities	Maps, data of vulnerable areas and population exposed, active organizations in the area, KPIs
		Local	Municipalities (73% male, 27% female)	Maps, data of vulnerable areas and population exposed, development plans, KPIs, knowledge of local enterprises and initiatives
2	Knowledge Organizations	Global	United Nations University, Think tanks	Methodologies about rural development, publications, statistics of population, comparative studies, KPIs
		National	National research institutes, universities	Material for teaching, contacts with project coordinators, social and economic studies of the territory, KPIs
		National	Institutes, high schools, elementary schools, college	Material for teaching, contact with experts, visits to live labs with learning purposes, methodologies in rural development
		Local	Local research centers, universities (54% male, 46 % female)	Material for teaching, contact with experts, visits to live labs with learning purposes, methodologies in rural development, collaboration with civil society, business and policy makers
3	Civil Society Organizations	Global	International NGO, International cooperation organizations	Data of rural communities, best practices on rural development, assessment of previous projects, maps, data of vulnerable areas and population exposed, KPIs
		National	National NGO, social organizations, grass roots organizations, churches, farmers' organizations, museums	Thematic maps, data of vulnerable areas and population exposed, active organizations in the area, database of local producers, local development plans, identification of tourist sites, KPIs
		Local	Local NGOs, interest groups, associations, social organizations, grass roots organizations, churches, farmers' organizations, museums (50% male, 50% female)	Thematic maps, data of vulnerable areas and population exposed, active organizations in the area, database of local producers, local development plans, identification of tourist sites, KPIs, networking, inspiration on good practices
4	Practitioners and key service providers	National	Clubs, delivery services, emergency services, mobility providers, postal services, social care, retail service	Directory of child and elderly care providers, local and farmers markets, highways and route maps, directory of recreational facilities, directory of accommodation establishments
		National	Design, production, marketing and distribution services	Directory of local providers, local markets maps, active organizations in the area
		Local	Local practitioners and service providers in tourism, health, architecture, construction, etc. (73% male, 27% female)	Directory of local providers, local markets maps, active organizations in the area, networking, peer-learning

Table 2. *Cont.*

N	User Groups	Levels	Participants	Needs
5	Businesses and public and private investors	National	Building companies, foundations, banks, entrepreneurs	Calendar of local festivals, territorial development plans, territory maps, directory of local providers, tourism service providers, KPIs
		Local	Local businesses and enterprises (SMEs and LEs) (44% male, 56% female)	Networking with local, regional and national organizations and groups involved in economic development.
6	Citizens/rural residents	National	Teachers, drivers, construction workers, elderly people, families with children, youngsters	Directory of organic farms, information of local service providers, information of training opportunities, child and elderly care services, directory of emergency providers
		Local	Teachers, drivers, construction workers, elderly people, families with children, youngsters (25% male, 75% female)	Learning about CNH, rural territories, examples of good practices, directory of organic farms, information of local service providers, information of training opportunities, child and elderly care services, directory of emergency providers

Table 3. Coherence of end-user needs and RRE functionalities.

N	User Groups	Level	Atlas	DSS	DRHH	Replication ToolBox	My Cult-Rural Toolkit	Monitoring Platform	
1	Policy makers	Global	x			x	x		
		National	x	x		x	x	x	
		Regional	x	x	x	x	x	x	
		Local	x	x	x	x	x	x	
2	Knowledge Organizations	Global	x	x	x	x	x	x	
		National	x	x	x	x	x	x	
		National	x		x				
		Local	x	x	x	x	x	x	
3	Civil society organizations	Global	x	x	x	x		x	
		National	x	x	x	x	x	x	
		Local	x	x	x	x	x	x	
4	Practitioners and key service providers	National	x		x	x			
		National	x			x			
		Local	x	x	x	x	x	x	
5	Public and private investors	National	x	x		x		x	
		Local	x	x	x	x	x	x	
6	Citizens/rural residents	National	x		x		x		
		Local	x	x	x	x	x	x	

4. Results

The RRE is an open platform that hosts and integrates the following: (i) a Web-GIS Atlas co-mapped with local stakeholders to identify CNH features in the context of the characterizations of territories; (ii) a monitoring platform based on key performance indicators for surveying and assessing the performance of each region; (iii) a My Cult Kit, where two apps enable a co-monitoring approach [31]; (iv) a Digital Rural Heritage Hub (DRHH), which hosts educational and capacity-building activities and a forum, with a moderator of discussions, that allows for the sharing and exchange of ideas among role models and replicators on possible actions to be implemented during the co-development phase of the heritage-led regeneration plans; (v) a Decision Support System, which filters data gathered to shape strategies; (vi) a Replication Toolbox for enabling new users to undertake regeneration processes; (vii) a best practices repository; (viii) an inventory of Lesson Learnt; and (ix) a photo contest with the selected photos of the RURITAGE rural areas resulting from a public tender, which was also incorporated into the previous tools. In the distributed software platform, all data are findable, accessible, interoperable and reusable (FAIR) [32,33], enabling the information system to fully re-use databases for the functions of the various tools.

All tools were customized by bottom-up processes through co-shaping activities for local heritage-led knowledge building. Activities were performed throughout four years of the research project in different steps by including data in interoperable datasets. Tool integration and harmonization also include communication strategies for user-friendly accessibility and the final perception by end-users of the RRE as a whole. For this purpose, a unified user interface of RRE was developed with a welcome page as well as tool welcome pages and user guidelines. Having defined the main user requirements and functionalities of the RRE (see Table 2), graphical user interfaces were optimized to allow for accessibility, intuitive use, visual consistency and appeal, as well as easy navigability between the different components of the RRE. Interface optimization was approached from a conventional visualization angle and relevance point of view. While conventional visualization establishes protocols for ease of navigation and generation of “fit-for purpose” information for users, the relevance approach addresses demand-related concerns generated by a host of “W-H questions” (who, what, why, where, when and how).

The optimization process of user experience and user interface design considered three levels or ‘web-layers’ of the RRE:

1. The RRE landing page: User-friendly overview of the platforms’ main purpose and functionalities. The RRE landing introduces the ecosystem as a main digital hub for rural regeneration within rural communities (Figure 1). Tools are visualized by icons and interactive pop-up window briefly explain the functionalities of each tool giving an introductory idea to end-users before fully exploring the specific tool (Figure 2). Another bottom “start here” (the tool on the bottom left in Figure 1), on the other hand, it enables the Replication Toolbox and assists users to apply all RURITAGE tools (including non-digital tools and methodologies) to create their own rural regeneration strategies.
2. Tool landing pages for the six RRE applications: User-friendly introduction to each tool, including main functionalities and capabilities, intended audience and possible use. Each tool presented in Figure 1 has their own landing page, which gives information about different functionalities and capabilities offered by the tool. Furthermore, at any moment during the use of the tool, it is possible to find a manual and a video tutorial for each tool under the button “Guide” (as can be seen in Figure 3).
3. Interaction with RRE tools: The process by which users engage with each tool, e.g., to access or provide specific data. In addition to the landing pages, the interaction with the RRE is designed to be intuitive. An example of the Atlas, which is one of the RRE tools, is presented in Figure 3.

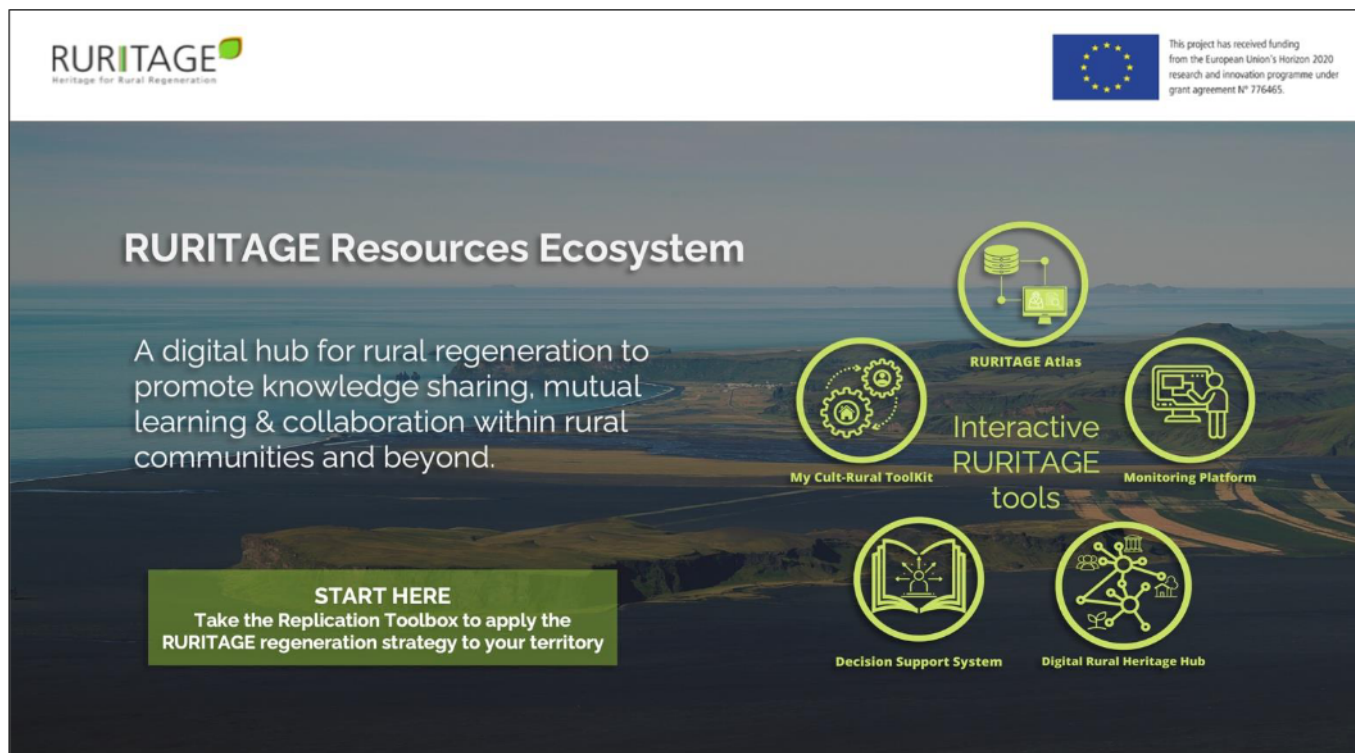


Figure 1. The RRE landing page.

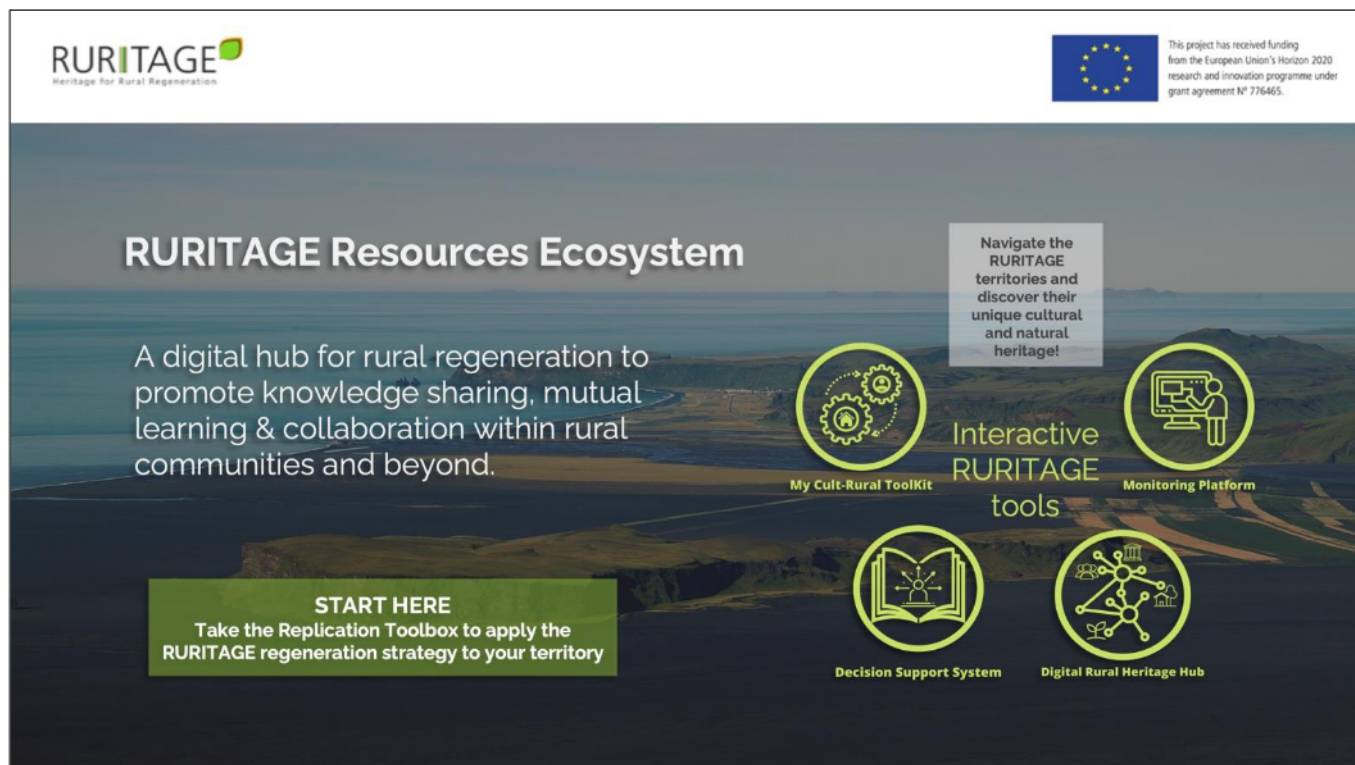


Figure 2. The pop-up window with brief explanation of the Atlas tool in RRE landing page.

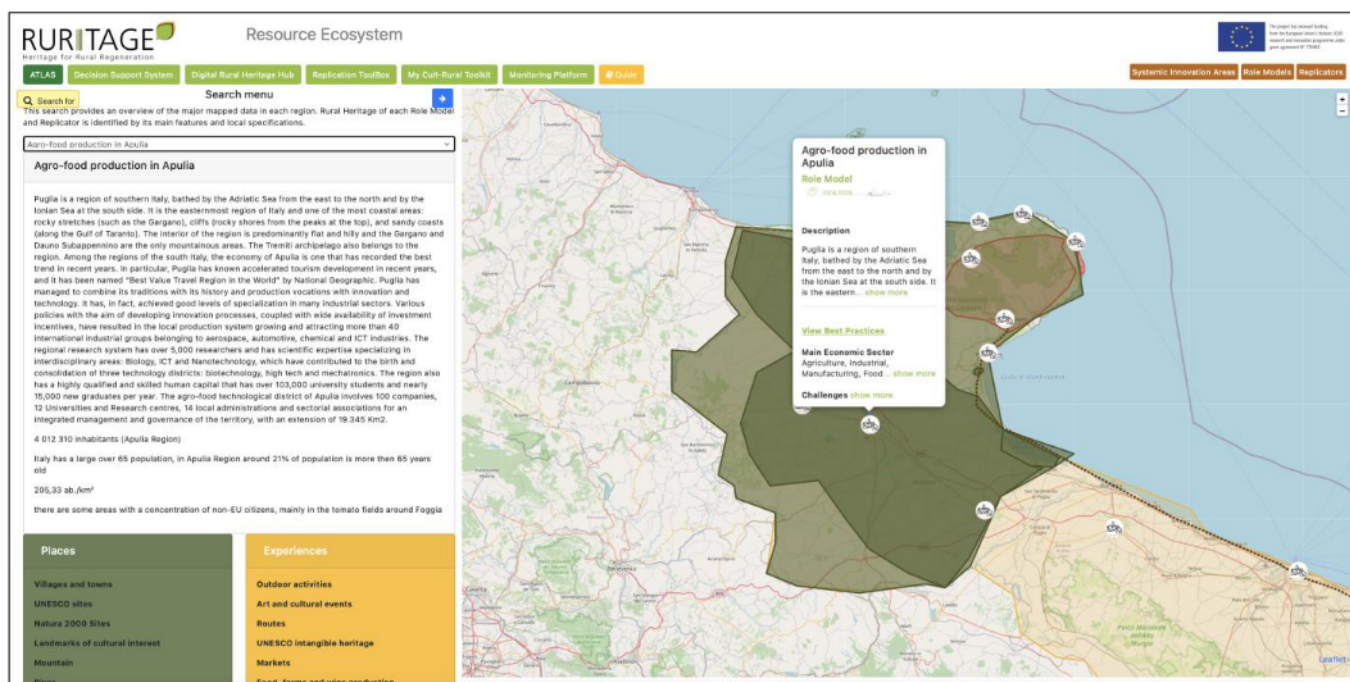


Figure 3. Screenshot of the Atlas tool within the RRE.

RRE contributes to filling knowledge gaps that are related to, as explained in the introduction part, using digital tools for activating processes for a new local heritage-led knowledge with involvement of local stakeholders and management strategies to make heritage more accessible and exploitable. To achieve this aim, RRE proposes an innovative approach in terms of (i) its main objective, (ii) the way it is created and (iii) the way it will be used in the future. (i) The main objective is to guide and support end-users who want to make informed decisions about rural regeneration of their territories based on heritage knowledge. In this perspective, in line with the state of art both in theory and practice, RRE activates CNH as a resource for local community and as a main actor of overcoming challenging problems of rural areas. (ii) To achieve this aim, the RRE provides an inclusive digital ecosystem where the participation of local stakeholders from diverse territories in terms of scale, population, CNH characteristics and local rural dynamics is activated, and knowledge exchanges and transfer are supported. This diversity helped in defining customization and user-engagement needs for each user profile, including a gender perspective. (iii) With the know/how gained from working with local stakeholders, RRE took its final form as a structured integrated platform that provide step-by-step implementation guidelines for its end-users.

5. Discussion

Since the 1960s, user participation has been considered a key element in the successful development of information systems, and specific research has been developed to demonstrate its benefits and identify the nature of the relationship “among user participation, involvement, and attitude” [34]. The vital role of digital technologies in achieving this aim is underlined by the European Commission [35]. Although cultural institutions of heritage (such as libraries, archives and museums) have a long history of collaboration with members of the public [36], such collaborations are not very common in other fields of heritage, especially in rural territories. As presented in the third section of this paper, there are ongoing scientific efforts that make use of digital platforms in the heritage field. However, as the comparative analysis demonstrated, it should be noted that heritage tools are often the object of separate research development that deals with distinct functionalities and aims. The consequence of this divide is not insignificant. It entails repeated procedures

such as the gathering of data for different purposes and the need for users to become familiar with several virtual environments using their own guidelines. This approach is not cost effective, and it also fragments heritage knowledge by weakening the power of a holistic actionable knowledge. The building more effective and user-friendly problem-solving tools can really make the difference in daily life and at work.

As mentioned in the Introduction section, heritage can be a driving resource for sustainable development in rural areas [37], and activating bottom-up participative and collaborative processes is essential in this process, as promoted by the strategy 21 of the Council of Europe [3]. The current heritage management frameworks and collaboration processes, despite being effective for the conservation of the historical physical fabric, do not support—and in some cases even obstruct—the development of a sustainable local cultural economy [38]. The RRE proposes a new framework to overcome these drawbacks through the uses of digital developments. ICT tools are toned to properly address heritage knowledge building. They require customization for the goals of humanities with a new kind of multidisciplinary and intersectoral research. To this end, the RRE considers policy makers, institutions, researchers, knowledge providers and investors as the main end-users. With this in mind, the testers used in building the RRE finally were the local stakeholders of the demonstrators (13 playing as role models, 6 playing as replicators) representing end-users with different needs. Furthermore, 62 additional users (7 playing as additional role models, 17 additional replicators and 38 digital replicators) also tested the RRE as a second step when additional replicators joined the RURITAGE research project. As mentioned above, the gender aspect was also considered, the testing process also considered the COVID-19 pandemic period. Although the threat of limitations to movement and direct interaction among different stakeholders has posed certain limits, the RRE has highlighted the potential of the digital environment with data management, data sharing and tools integrated for activating local stakeholders.

A main engagement of local stakeholders in the RRE has thus been as tester-beds and data providers, and their direct use of the RRE is mainly as co-developers. The end-users of the RRE are supposed to be those who will use the RRE tools after the completion of the research project. In the RRE, following the research methodology, they will find tools and methodologies that will allow for the implementation of strategies, collecting and refining data in order to undertake new processes of rural regeneration based on mutual learning and collaboration within local communities. In addition to the physical engagements, virtual communities can also provide heritage interpretations and help develop a sense of place [39]. Similarly, also in the RRE, virtual engagements provide not only concrete regeneration strategies, but also shape a new heritage building process.

For engaging local stakeholders in RRE building for local heritage-led knowledge, each tool adopted various methodologies. The Atlas provided a co-mapping activity; the My Cult-Rural kit provided apps for co-monitoring. The Digital Rural Heritage Hub supported the knowledge exchange and interactions among local stakeholders. The monitoring platform included activities for tools customization in order to support how to examine the evidence of the role of cultural and natural heritage in rural areas as a driver for sustainable growth, whereas the Decisions Support System supports the discovery and composition of possible heritage-led regeneration scenarios. The photo contest tool fosters further engagement of local communities. Furthermore, the RRE will engage end-users throughout all RURITAGE methodologies through the Replication Toolbox. This tool engages end-users in applying RURITAGE methodologies by using the tools for designing and implementing heritage-led regeneration strategies in diverse rural areas.

In making RRE a user-friendly inclusive ecosystem, various types of expertise were required to mold a new kind of approach to achieve effective local stakeholder engagement and finalize a novel heritage-led knowledge-building platform. To this scope, a non-secondary aspect was also the gender balance within the RURITAGE consortium in its management level, which includes 40 partners from 21 countries and 59% of the total number of people in the workforce are females. Lastly, the RRE is the result of this intense

open-mind multidisciplinary and intersectoral collaboration among ICT specialists and other experts from different fields of humanities.

6. Conclusions

The RRE capitalizes on a novel collaborative creative approach. Besides testing the RRE, the local stakeholders activated by the research project are also to be understood as the main data providers and tool testers. They strongly contribute as co-builders of the strategic information and the customization of the tools of the RRE, which will be made available for future local stakeholders. Lastly, the RRE is an open platform available for contributing to building and addressing a rich holistic CNH knowledge in an integrated vision of territorial development and making it available for new regeneration processes by effectively engaging local stakeholders.

Therefore, the methodology adopted in local heritage-led knowledge building for the creation of RRE based on the collaboration of local stakeholders and bottom-up processes is applicable to other contexts where there is a need not only for a novel holistic heritage-led knowledge of territories and a new consideration of local knowledge, but also for a more effective user-friendly engagement. For this purpose, the same concept of tools integration in a holistic digital platform can be upscaled for the goal of a digital transition at all levels. The RRE integrates various kinds of heritage resources both for its understanding and management at local level. It enables local stakeholders to recognize some strategic innovation axes and identify tangible and intangible features of CNH in the context of historical as well as current development of their territories. Users can interact, for instance, with the Atlas that they have helped develop, which provides evidence on culture and heritage related places, experiences, territories and stories, and supplement this information with more data. Tool integration allows for the display in this environment of the performance graph from the monitoring platform and images from various databases (MyCult Kit, photo contest, Atlas). It allows for the exploration of the best practices of heritage enhancement and management to be extracted. At the same time, the DSS allows for the exploration of data from the Lesson Learnt and DRHH, while the monitoring platform allows for the consideration and measurement of the capitals.

By interacting with the RRE, local stakeholders gain an understanding of rural areas, their heritage assets and their regeneration opportunities and can undertake a supported heritage-led regeneration process properly based on a multifaceted knowledge of CNH. They are enabled to search for and visualize information that also contextualizes CNH in their territories. They reflect on the diversity of heritage and its exploitation as a cultural, social and economic resource for sustainable development. The integrated environment allows for the exploration of good practices and filtering to address the scope of an active exploitation and preservation of CNH by communities in their territories.

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