sous la direction de
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Villages et quartiers à risque d'abandon

Stratégies pour la connaissance, la valorisation et la restauration

TOME 3

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Chaque volume est soumis à une procédure d'acceptation et d'évaluation qualitative fondée sur l'examen par les pairs et confiée au Comité scientifique de Firenze University Press (FUP).
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Les essais naissent d'une réflexion sur le patrimoine méditerranéen et proposent des idées de recherche sur des études de cas particulières par le biais d'un apport conscient des différentes disciplines architectoniques. La dimension matérielle et technique est exprimée à travers une mise en relation entre des domaines de connaissance strictement interconnectés, ce qui permet de partager non seulement des méthodes et des approches conceptuelles, mais aussi des outils d'investigation et de représentation. Les publications ont pour objectif d'étudier le sens et la signification, la continuité et la diversité culturelle de l'espace dans le bassin méditerranéen.

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RESILIENT TECHNIQUES AND METHODS TO SUPPORT A RESILIENT LIFECYCLE OF VILLAGES AND NEIGHBORHOODS

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"Laboratory of Places – Ghesc and surroundings – History, survey, evolution" – On field activities: topographic network, laser scanner acquisitions, close range and UAV photogrammetric survey, material recognition, decay analysis, sample collections.

The paper focuses on planning and Heritage lifecycle documentation and management as main activities to support the sustainable planning of villages and neighborhoods and to improve their resilience.
With examples from the last twenty years of progresses, we will seek lessons to better use the next wave of 3D innovation that is coming, to overcome the current critical moment linked to the COVID19 pandemic, to develop resilient systems and techniques able to support the next generation of visual information tools from reality capture (3D scanning, photogrammetry and more) to reality computing (3D modeling and data management), and reality creation (VR, AR & 3D printing).
Focus is on villages and neighborhoods as part of the so-called 'Widespread Built Cultural Heritage' (WBCH) which constitutes a large part of European and Mediterranean Built Heritage and bears great cultural and economic interest.
A discussion on the regeneration of Rural Landscapes through Cultural and Natural Heritage was premised, letting notice that if, on the one hand, the COVID-19 pandemic has threatened rural areas, posing challenges, on the other hand it has shown the potential for a 'rural renaissance', where rural areas would assume a central role in developing sustainable and resilient communities.

Keywords: Widespread Built Cultural Heritage, rural areas, Heritage lifecycle documentation, Heritage lifecycle management, reality capture, reality computing, reality creation

Introduction

Villages and neighborhoods are part of the so-called 'Widespread Built Cultural Heritage' (WBCH) which constitutes a large part of European and Mediterranean Built Heritage and bears great cultural and economic interest. They currently play, unfortunately, a marginal role as argued by many authors in recent years, and major magazines surveyed the problem as in a recent impressive article by CNN style magazine (Marchetti, 2020).
From our point of view, there are three reasons for this loss and degradation of WBCH.
The first cause lies in the lack of a 'guiding information system' that would allow cultural institutions, local cultural policies, and cultural tourism to rise to levels that are proportional to and indicative of the quality and quantity of the assets present in the managed areas. Such a system would allow the replacement of 'ad hoc' funding policies for conservation and exploitation with a mechanism based on small and micro interventions fulfilled by multiple

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Lamia Hadda, Saverio Mecca, Giovanni Pancani, Massimo Carta, Fabio Fratini, Stefano Galassi, Daniela Pittaluga (edited by), *Villages et quartiers à risque d'abandon. Stratégies pour la connaissance, la valorisation et la restauration*, © 2022 Author(s), content CC BY-NC-SA 4.0 International, metadata CC0 1.0 Universal, published by Firenze University Press (www.fupress.com), ISBN 978-88-5518-537-0 (PDF), DOI 10.36253/978-88-5518-537-0

RURITAGE paradigm for heritage-led rural regeneration: the six Systemic Innovation Areas.

and complementary resources and based on the participatory involvement of all citizens.
The second reason is that widespread cultural assets represent a type of Heritage in which ICT-based technological innovation has not yet made substantial advantages in this context but remains desirable with regard to the management and use of those assets.
Nonetheless, 'smart' interaction with this widespread Heritage is very limited because of the user's lack of specific cognitive capabilities (of perception, comprehension, and use) that would allow him/her to easily establish a connection to the relative asset, of which the main property is that it is 3D.
Therefore, we need to guarantee conservation, visibility, and accessibility of these assets both physically and intellectually.
Moreover, villages and neighborhoods represent an extremely valuable strategic complement to the traditional cultural and touristic circuits in the cities of art. In addition to this, we must add the impact that the current COVID-19 pandemic has had on our lives and on the use of CH too. "Italy's remote villages now make an ideal escape" titled a recent article of on-line magazine of "The Guardian" underlining that "the country's historic but often half-empty villages are emerging from the shadows" (Imam, 2020).
This process represents a huge opportunity but could also lead to an unplanned gentrification issue. Secondly, the existing Heritage risks of disappearing or to be engulfed by too fast development. In practice, the greatest quality of these sites is likely to be damaged: their resilience.
How to minimize COVID-19 and the actual social decay and progressive abandonment effects on resilience?
Surely a key point is to carefully plan and manage the process, but also innovative actions able to improve the resilience are needed. Between those, Heritage-led new types of actions are required, besides more traditional activities, as the restoration of historical buildings.
Moreover, how support Heritage-led regeneration innovative plans in the digital era?
Despite huge technological progress, the human challenges of what, how and why we document, manage, and view, have not still disappeared. A new generation of developers and users is improving our everyday tools but is also repeating many early missteps.
In this paper, we focus on planning and Heritage lifecycle documentation and management as main activities to support the sustainable planning of villages and neighborhoods and to improve their resilience.
With examples from the last twenty years of progresses, we will seek lessons to better using the next wave of 3D innovation that is coming, to overcome the current critical moment linked to the COVID19 pandemic, to develop resilient systems and techniques

able to support the next generation of visual information tools taking in account that from reality capture (3D scanning, photogrammetry and more), to reality computing (3D modeling and data management), and reality creation (VR, AR & 3D printing), our digital heritage world is still a far cry less real than that which it seeks to document.

Regenerating Rural Landscapes through Cultural and Natural Heritage

EU territory is covered for the 44% by predominantly rural regions (EUROSTAT, 2018), to which a further 44% of intermediate regions is added, while urban areas represent only the 12% (DG AGRI, 2018a). The 45% of EU population lives in predominantly urban regions, while over the half of the EU-28 inhabitants lives in intermediate regions (36%) and predominantly rural regions (19%) (ibid.). Nevertheless, most rural areas suffer from economic problems, with these areas counting only for the 13% of the GDP of EU-28, as opposite to the 56% of GDP which is produced in urban areas (DG AGRI, 2018b). Therefore, rural areas are characterized by continuous demographic and socio-economic challenges giving raise to increasing depopulation, ageing, disengagement, reduced service provision and inhibited accessibility, and, at the same time, their rich Cultural and Natural Heritage (CNH) is threatened.

This condition can be overturned by demonstrating the tangible and intangible heritage potential for the sustainable growth of rural communities. Indeed, the recognition of rural areas as 'poles of excellence' in heritage capitalization could counter long-standing urban-rural unbalances and acknowledge Europe as world-leader in promoting the innovative use of heritage for rural regeneration.

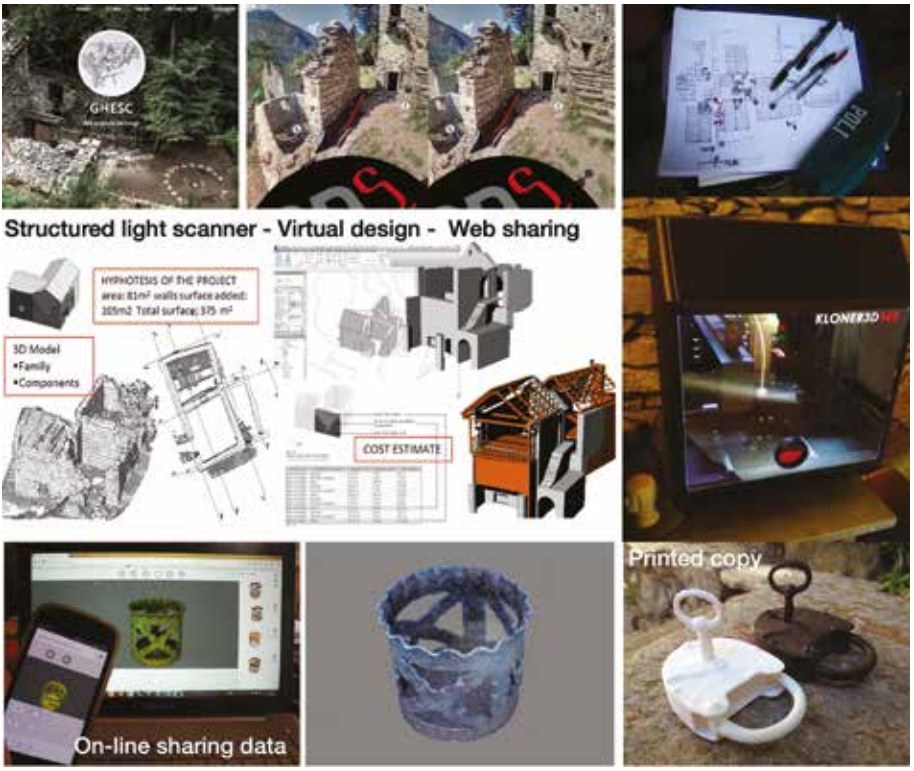
RURITAGE H2020 project aims at demonstrating that rural areas can be transformed into sustainable development demonstration 'laboratories' through the enhancement of their unique Cultural and Natural Heritage potential. The proposed paradigm for regenerating rural communities lies on the identification of six powerful drivers that boos regeneration

Appignano del Tronto RHH.

"Laboratory of Places – Ghesc and surroundings – History, survey, evolution" - Data elaboration in teamwork, constantly face to face: structuring collected survey information, 3D hypothesis, virtual design, digital copy, printed copy, on-line visualization, on-line sharing data.

in rural communities all around the world, the so-called RURITAGE Systemic Innovation Areas (SIAs), and namely Pilgrimage, Local Food Production, Art and festival, Landscape Management, Migration and Resilience.

If, on the one hand, the COVID-19 pandemic has threatened rural areas, posing challenges exacerbated by low available financial resources, not easily accessible health services and greater isolation issues, on the other hand it has also shown the potential for a 'rural renaissance', where rural areas would assume a central role in developing



sustainable and resilient communities. Indeed, rural areas have started to be safe shelters compared to urban agglomerations. Social distancing, the lack of adequate open public green areas and the possibility of remote working could drive people living in densely populated settlements to look for moving to more natural environments (De Luca et al, 2020).
This perception could lead to big opportunities for repopulating ageing rural areas, and to make rural areas attractive poles of development by enhancing the role of CNH for building resilience against the threats of climate change, natural disasters, and social and economic crisis, simultaneously boosting economic growth, creating jobs and livelihoods, strengthening access to health and education, and contributing to foster the responsible ownership of cultural and natural heritage.
For achieving the goal of revitalizing rural areas, opening new possibilities for counterbalancing depopulation and ageing, CNH should be exploited as an opportunity to promote rural areas as multifunctional places beyond the traditional agricultural-related activities. Heritage

"Laboratory of Places – Ghesc and surroundings – History, survey, evolution" - Public discussion and data elaboration in Ghesc, discovery Ossola territory, discover places and traditional architecture and habits.

should hence be acknowledged in its wider sense, including both intangible forms of traditions, social practices, knowledge, and tangible monuments, landscapes and minor heritage, i.e. CH assets that are left aside from large official heritage programs.

For a regeneration process to take place, tangible and intangible features must be combined, by linking together historical or significant buildings with social and cultural practices and new activities.

For bringing back life in rural areas, new functions can be hosted in old buildings and public spaces. For example, a former school can be renovated to host training courses and other activities, like in Izmir in Gediz-Bakircay Basins (TK) or the restoration of a former nursery school damaged by the earthquake allow to host an auditorium and the RURITAGE "Rural Heritage Hub (RHH)", which is both a physical space and a community of local stakeholders (research institutions, policy levels representatives, industrial partners and citizens) that co-develop and co-implement its own path to rural regeneration, like in Appignano del Tronto (IT).

In the case of the Camino de Santiago, RURITAGE Rural Heritage Hub is in monastery of San Zoilo in Carrión de los Condes (EN). It was built in 948 and has hosted a mixture of culture for a millennium. Today the old monastery has the function of a hotel, which can host more than 300 visitors and of hub for the community to discuss about its future opportunities of regeneration.

Moreover, the availability of many un(der)used buildings is an opportunity for new functions through the diffuse adaptive reuse of the built asset; this opens to the possibility to repopulate those territories that have lost their inhabitants and that therefore already offer many opportunities to host newcomers, i.e., by renting or selling second houses underutilized, thus revalorize the already existing built capital. Cultural tourism also could benefit from the availability of those buildings, that could increase the capacity of locals for more touristic offers, both boosting this economic sector the model of the 'dispersed Hotel' and offering cultural experiences to the tourists.

This cannot be a spontaneous process, since it requires local authorities to improve basic infrastructures and services, but also properly plan future development of the areas, to repopulate ageing and uninhabited rural areas but also avoiding unplanned gentrification issues.

Lifelong learning in rural context, the Ghesc experience

European countries take care of the accessibility of the population to didactic activities, promoting work and training paths, through innovative ways of disseminating knowledge.

In this sense, the relevance of the theme 'education and CNH' is evident. The interest of the scientific community confirms the need to organize better-structured study paths, towards both theoretical and practical learning more strictly connected to the territory and its identity. Collaboration among universities, public or private research institutes, local authorities and professional associations is progressively strengthening, to promote training activities or specialization schools to identify new professional figures active in promoting and conserving CNH (Bonfantini et al., 2019). Sustainable development laboratories can be planned directly in rural areas by promoting their Cultural and Natural Heritage potential, regenerating their resilient community, and revitalizing the site as multifunctional place.

In this direction, the training course organized in Ghesc (IT) (Quaderni di Ghesc, 2010) village can be defined as lifelong learning, which is ongoing professional update and knowledge integrating formal education proposals and current learning opportunities. This process has the purpose of modifying/replacing learning that is no longer adequate for new social or work needs, in a professional or personal context. Indeed, the term refers not only to occupational goals but also to personal, social, and civic ones (Biondi, 2021).

Andrea Palladio - 3D geodatabase (2012): interface with a descriptive card.

In this sense, the experiences conducted in recent years through the international summer school "Laboratory of Places – Ghesc and surroundings – History, survey, evolution" (Achille et al., 2017; Achille et al., 2018) must be understood.

This Laboratory offers different activities that integrate the university teaching and concurs to the training of professional roles operating in the safeguard, conservation, and valorization of CH. This activity is patronized by ICOMOS Italia and from 2017, the summer school is also sponsored by ISPRS society. The field schools take place in the suggestive medieval partially abandoned village of Ghesc. From the first edition, it was considered essential to organize the course in collaboration with the local authorities and with the Canova Association (Canova Association, 2021), which resides in the area and promotes rural villages protection by supporting local projects.

Specifically, the Laboratory proposes a training project aimed at deepening the 3D digital techniques of geometric survey (image-based and range-based) and the methods of conservation and enhancement of Cultural Heritage. The Summer School is structured in theoretical and practice activities: lectures, best practices seminaries, on-site surveys, data processing, technical drawings restitutions, critical analysis, rural stone architecture knowledge and discovery of local territory. The course trains scholars and professionals to tackle methodological and practical problems with a critical approach and research skills by applying national and international standards.

Over the years the participants were a heterogeneous group of people that work or will work in CH field: university students (architecture, engineering, history, archaeologist); professionals (surveyors, architects, archaeologists, photographers, public employees); employees of university institutes. The different geographical and cultural backgrounds, the different ages, skills, and personal experiences make the group activities truly interdisciplinary and allow participants to appreciate the different points of view of other professional, researchers and students working in CH.

The summer school aims to enable students to know how to use tools and methods after adequate theoretical preparation, and thus to be able to process the collected data critically and develop the aptitude for teamwork and the ability to confront.

The main goals of the Laboratory are: i) encourage the learning of 3D survey methods (topographic instruments - laser scanner - close-range photogrammetric approach - UAV acquisition-structured light scanner); ii) develop the capacity of data elaboration (point clouds management, floor plans elaboration, vertical sections and profiles extraction, 3D polygonal models generation, textured mesh model generation, orthoimages production); iii) acquire methods to recognise materials (material mapping, state of decay,

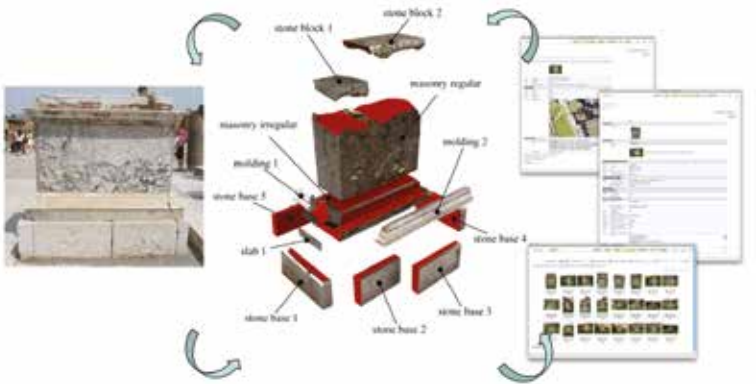
collection of samples); iv) build the capacity of 'virtual design' based on real geometric data collected and develop project hypothesis; v) develop data-sharing procedures and employing online platforms, creating 3D models and movies viewable/accessible through the internet; vi) promote the dissemination of low-cost technologies; vii) contribute to the conservation process thanks to the dissemination of best practices and through ongoing dialogue between scientific and local communities, to avoid duplication of effort; viii) help establish guidelines that ensure the compliance of conservation practices.

These training and study opportunities aim to increase the people involvement dedicated to the safeguarding and protection of the local and/or European heritage of ancient rural stone architecture.

The close collaboration with the Canova Association combines "local knowledge" and "traditional approach" with the most innovative technologies, tools, data processing methods (web, HBIM, GIS, new media, digital archives, information systems, and others). This integrates the necessary skills and helps develop the personal professional skills. A real case study allows students to test what they have learned and verify the set objectives feasibility. Working in a semi-abandoned rural village is also an opportunity to rediscover less known or forgotten places.

Managing CHN with integrated services platform

Over the past years, digital innovation led some changes in the lifecycle management of CH; however, complexities remain related to the intricate chain of decisions, to the many



The Parco Archeologico di Pompei Unified IS (2010): the outputs developed to drive 3D model construction for the IS.

The Neptune Fountain lifecycle management IS (2016): GUI key features: (1) buttons to drive the interactive visualization; (2) retrieving/ searching menu; (3) list of records stored in the IS and related to the selected element.

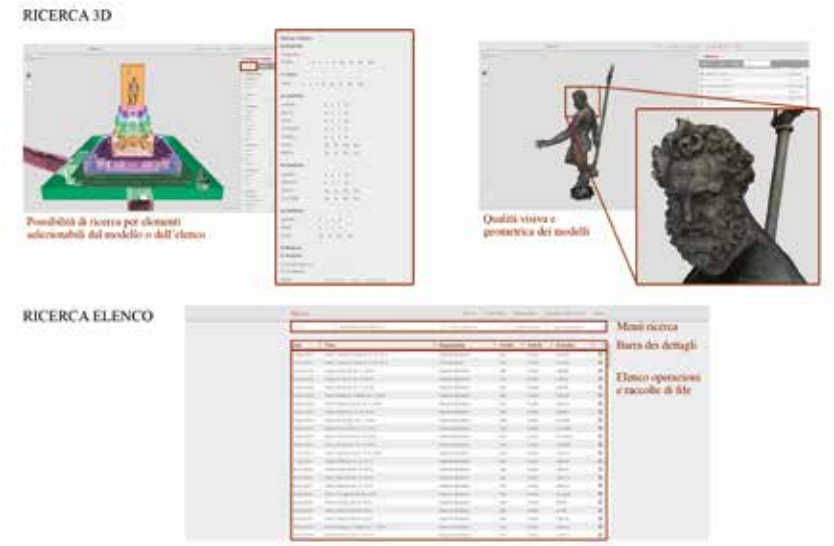
and different disciplines and professionals involved, and to the heterogeneity and fragmentation of data generating the widespread of the information in isolated Information Systems (IS). To overcome this last problem, a specific line of research has developed techniques for building 3D-based IS. The guiding idea behind is the concept of 3D database as operating tool exploiting the fact that a digital model can be seen as a vast, cognitive spatial information system that can be edited and implemented over time (Gaiani, 2012). These 3D-based ISs represent a fundamental change in our cognitive model of CH: to capture and visualize the artefacts; in the technique of archiving them; in the method of illustrating the knowledge, in the techniques to navigate through the cognitive corpus. We could learn not only how to examine the objects but also how to recognize and create new relationships between them (Gaiani, 2017).

The approach to the problem introduced by the 3D nature of the managed objects and the development of 3D-based IS has led, over the last 20 years, to the definition of the Information Conceptual Model (ICM). This development is not only related to the type of data and their semantic links but is also strongly rooted in the digital data generation processes, allowing their easy organization and retrieval and their environmental links, avoiding trivial solutions consisting simply in the use of a new technology (Apollonio et al., 2019).

In our opinion, this allows for resilient systems capable of supporting innovative actions able to improve Heritage-led resilience. Our statement is supported by various motivations:

The theoretical ground is based on strong concepts as the knowledge by vision, largely motivated by the inherently 3D nature of CH items (Zeki, 1999; Marr, 1982);

Systems can support the whole lifecycles of CH artefacts;



Data are common, but specific interfaces are addressed to different users: professional operators, tourists, citizens;
It is based on standardized, low-cost or open-source technologies;
The ICM is rooted in the used type of representation and in the real objects features and problems;
The ICM comes from 20 years of experiments and tests on different solutions;
The IS model is multiscale: from single monument or artefact, to urban or territorial scale.
The concept of "Reality Capture", coined by Autodesk, meant as the process of taking the analog world around us and putting it into digital forms that can be brought into design tools, well represents the gap that an 3D-based IS introduces with respect to the traditional method of surveying the existing, which allows to generate a 2D spatial subset through plan, views, elevation, section.
A framework, grounded on the Zeki and Marr's considerations, has been developed from 1997, working on different subject and context. These applications were designed for different types of users, with a largely scalable interface, able to support different output devices and to work at different levels of iconicity; the Parco Archeologico di Pompei Unified IS (2010) (Benedetti et al., 2010), The Palladiolibrary (2012) (Beltramini, Gaiani, 2018), the Neptune Fountain IS (2016) (Apollonio et al., 2018).

The 3D Life Cycle Management for Cultural Heritage Information System: buildings 3D models visualized in the platform, in this case the Bologna's porticoes.

The 3D Life Cycle Management for Cultural Heritage Information System: semantic graph of a building. the 3D Life Cycle Management for Cultural Heritage Information System.

This kind of solution present critical aspects in the implementation, needing appropriate answers to achieve the goals set out above:

A data organization able to contain all the types of data involved in the artefact's lifecycle;

High level of usability, so that users need limited training before being able to use the system;

High-quality reconstruction of geometry and color, since very small details have to be found and mapped;

A rendering tool able to provide high quality visual feedback, even with limited bandwidth;
Powerful and flexible search, retrieval, and exploration features enabling an easy access and data extraction from the final documentation.
The developed solution is based on five main concepts:
a. the use of 3D models as replica of original artefact with its attributes (color, shape, …) defined analyzing the real object. This allows to know the object with its visual and shape properties;
b. 3D models built as 'knowledge representation', structured and described as a series objects based on specific architectural/archaeological lexicon. This allows to know the semantic structure, the technique of construction and to organize information, according to (Apollonio et al., 2012; Apollonio, 2018), of a wide set of objects, ranging from a simple brick or bas-relief to a whole building;
c. a common database for different purposes, and for different type of users. This allows to have common contents between the users;
d. the content retargeting between different types of devices: to efficiently return the contents to a specific device and to allow the user to access the same information across multiple devices;
e. the geo-localization of the artefacts: to locate the object and to understand the object in its context.
The result of our many experimentations led to the development of a general system: the 3D Life Cycle Management for Cultural Heritage Information System part of the SACHER (Smart Architecture for Cultural Heritage in Emilia-Romagna) project, funded by POR FESR 2014-2020, and led by CIRI ICT-University of Bologna (2016-2018).
Assuming that the CH management system was lacking in efficient ICT platforms for the management and integration of heterogeneous and fragmented data sources and interconnection between private and public subjects involved in CH, the SACHER project provided a distributed, open source and federated cloud-computing-based platform able to support the complete life cycle management of various kinds of data concerning cultural assets (Bertacchi et al., 2018). Indeed, the general-purpose infrastructure integrates a variety of user-friendly services for supporting professionals in the field of CH, with advanced facilities and customized interface design for cultural services (Apollonio et al., 2017).
One of these services is SACHER 3D CH, the 3D Life Cycle Management for Cultural Heritage, aimed to manage data relating to architectural heritage and to control all phases of the related restoration process. SACHER 3D CH is dedicated to the many professionals involved in restoration activities, such as operators and public administrations, allowing the

collection, storage and conservation of the numerous data generated, with documental and operational purposes prior to the restoration project, during the works and relating to subsequent maintenance activities.
The system is based on three-dimensional digital models with a semantic structure of Cultural Heritage, used as an operational hub to connect information and geolocate data through 3D references. Access to the service takes place via the web, on any device, without installing any software and can be used in multi-user mode, through an intuitive and easy to use interface both in connection and in consultation.
3D representation is the main core of this kind of IS, and therefore visualization and interaction procedures are key elements for its overall usability. This means the availability of a semantic structure, meant as conceptual and generative structure of a 3D model-based knowledge system; tools for visualizing and browsing throughout the 3D models; user interface for adding annotations directly onto a 3D model; three-dimensional exploration of the Information System.

Conclusions

Resilient villages and neighborhoods need tools and methods able to support a sustainable planning and a resilient lifecycle. In this paper, we described the aims and the whole framework, the techniques to make new knowledge and the new digital-related approaches resilient and, finally, the possible new infrastructure able to help the whole lifecycle management of actual built environment and of pertaining CH, supporting high level complex knowledge formation by vision. Mainly, these new solutions are well-rooted in the today IT drivers: general purpose devices-based processes, mobility-based and cloud-based services, crowdsourced data exploitation, automated processes. This property will allow a constant and quick evolution without any change at level of system structure, generating more and more efficient, simple, and user-friendly processes and allowing a new vision of our WCH in the country, in the villages, in the marginal parts of the cities.

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