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The management of cultural heritage and landscape in inner areas

edited by Mara Cerquetti, Leonardo J. Sánchez-Mesa Martínez, Carmen Vitale

Guardo le canoe che fendono l'acqua, le barche che sfiorano il campanile, i bagnanti che si stendono a prendere il sole. Li osservo e mi sforzo di comprendere. Nessuno può capire cosa c'è sotto le cose. Non c'è tempo per fermarsi a dolersi di quello che è stato quando non c'eravamo. Andare avanti, come diceva Ma', è l'unica direzione concessa. Altrimenti Dio ci avrebbe messo gli occhi di lato. Come i pesci[1].

Quando cammino nei prati attorno al Santuario, quasi sempre solo, ripenso a nonno Venanzio che, da giovane biscino, pascolava il gregge negli stessi terreni. Mi affascina il fatto che in questo luogo la cui cifra, agli occhi di chi guarda adesso la mia scelta di vita, è la solitudine, nei secoli addietro abitassero oltre duecento persone. Ancora negli anni Cinquanta, ricorda mio nonno, erano quasi un centinaio gli abitanti di Casette di Macereto tra contadini, mezzadri, mogli, pastori e un nugolo di bambini che costringeva il maestro a salire ogni giorno da Visso per fare lezione a domicilio.
Era una comunità compatta, coordinata come lo può essere quella delle società operose degli insetti: api, formiche, tremiti, ma cosa più sorprendente che mai, una comunità niente affatto statica o chiusa[2].

1 Balzano M. (2018), *Resto qui*, Torino: Einaudi, p. 175.
2 Scolastici M. (2018), *Una yurta sull'Appennino*, Torino: Einaudi, p. 50.

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Archaeological landscape and heritage. Innovative knowledge-based dissemination and development strategies in the *Distretto Culturale Evoluto Flaminia NextOne*[*]

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* Although the present paper was carried out together, the §§ 1 e 3 are by Paolo Clini; § 2 is by Roberto Pierdicca and Ramona Quattrini; § 3.1 is by Roberto Pierdicca and Emanuele Frontoni; § 3.2 is by Ramona Quattrini; § 4 is by Roberto Pierdicca and Mariapaola Puggioni; § 5 is by Emanuele Frontoni.

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Abstract

The adoption of dissemination strategies based on Information and Communication Technologies (ICTs) has generated a paradigm shift, empowering users to identify, customize and exploit tourism services. The paper outlines an innovative way to disseminate the archaeological landscape, based on the *Flaminia NextOne Distretto Culturale Evoluto* (DCE) research project. The contribution summarizes the main achievements of the project in the light of technical improvements in AR applications and mobile cloud management, and also describes the collaborative approach of a public-private partnership. Data analytics from the web platform are also provided, in order to understand the potential and the drawbacks of this methodology. The discussion of the method, the pilot cases and their scalability derive from the main objective of the project which is to promote cultural heritage throughout the territory and to study the socio-economic implications of digital mediation, as discussed in the 2016 *L&A En Route* seminar.

L'adozione di strategie di comunicazione basate su tecnologie dell'informazione e della comunicazione (TIC) ha generato un cambio di paradigma, consentendo agli utenti di identificare, personalizzare e sfruttare i servizi turistici. L'articolo delinea un modo innovativo per veicolare il paesaggio archeologico, basato sul progetto di ricerca *Flaminia NextOne Distretto Culturale Evoluto* (DCE). Il contributo riassume i principali risultati del progetto alla luce dei miglioramenti tecnici ottenuti nelle applicazioni AR e nella gestione di un *cloud* dati, nonché nell'approccio collaborativo del partenariato pubblico-privato. Viene fornita anche un'analisi dei dati della piattaforma web, al fine di comprendere le potenzialità e gli svantaggi della metodologia. La discussione del metodo, i casi pilota e la loro scalabilità derivano dal valore intrinseco del progetto per promuovere il patrimonio culturale diffuso sul territorio e studiare le implicazioni socio-economiche della mediazione digitale, come discusso nel seminario *L&A En route* del 2016.

1. *Introduction*

The adoption of dissemination strategies based on Information and Communication Technologies (ICTs) has generated, in the last decade, a new paradigm shift, empowering users to identify, customize and exploit tourism services; the main reason lies in the development of novel tools and infrastructures for managing and distributing services on a worldwide scale. Increasingly, ICTs play a critical role in the competitiveness and value awareness of cultural destinations. Following this trend, one of the research domains that benefits the most from this new policy is the so-called "digital heritage", which has begun to transform the process of re-creating and understanding the past. This new field integrates the traditional expertise of heritage management, museology, history and archaeology with the powerful new tools of digital information technologies, with great potential for addressing the new challenges associated with the sustainability of the heritage sector. ICT is able to transform heritage from the domain of specialists to that of a wider public, as well as it is a means

for boosting the economic development of local communities and regions, by strengthening cultural identity and cross-cultural communication. At the same time, these technologies have produced a wide range of applications for collecting and processing historical data, for documenting and monitoring the conservation of objects and monuments, and for creating interactive information networks that can link professionals and scholars with students, museum-goers, and anyone interested in cultural heritage.

In line with this trend, this paper attempts to outline an innovative way to disseminate and enhance the archaeological landscape, based on the *Flaminia NextOne Distretto Culturale Evoluto* (DCE) research project (fig. 1). The project aims to activate and develop new strategies for the representation, organization, dissemination and promotion of local cultural heritage, based on paradigms of technological intelligence, which represent challenges for Smart Cities and the smart environment indicated by the European Union. In particular, there is the need for integrated management of the widespread cultural heritage which represents the identity of a territory: these forms of management have been exploited and validated by the public-private partnership involved in the project, thereby enabling the endogenous development of local communities.

2. *State of the art and related works*

The H2020 European funding program, despite the initial disorientation of both public and private operators due to the substantial replacement of the cultural heritage field with a cultural and creative approach, is now generating new forms of collaboration aimed at enhancing and creating sustainable processes based on technological innovation and ICT applications. In fact, these processes are easily reproducible and scalable because they are based on standardized knowledge and involve a strong cost competition in the short term[1]. These considerations constitute a key point in the project presented in this paper, as well as in their measurable outputs, and therefore contribute to highlighting cultural heritage not only as a productive asset but also as a process owned and managed by the citizens.

From its preliminary stages, the *DCE NextOne* project also took into consideration the vision of the Faro Convention, which regards heritage not just as one aspect of tourism but as a fundamental factor for every day, ordinary "real" life, at both local and universal level. It sees heritage as a process and, what is more, as a continuing process, which creates, constructs, uses and modifies the heritage itself; in a sense, heritage is redefined by Faro as a verb,

[1] Montella 2015.

rather than a noun. This emphasis on process rather than product highlights the relevance of heritage for sustainability[2].

Starting from previous considerations and the good results obtained by two editions of DCE, the Marche region launched other actions in order to enhance the capability of the district and to develop integrated territorial policies. The Marche regional framework actions are in line with the *National Strategy for Inner Areas*, which aims to oppose the process of marginalization that, in the last fifty years, has affected the Apennine mountain areas. This process is due primarily to the progressive increase in the aging phenomena and the low birth rate, lack of infrastructures (roads, railways and broadband connections), and unemployment. These factors are accompanied by a gradual decrease in the quantity and the quality of local public, private and community services[3]. Such challenges can be dealt with by setting up some interconnected projects focused on a few selected priority fields of intervention and linked with ordinary policy (supply of services). Strategic projects concentrate on a limited number of fields: land management and forests; local food products; renewable energy; natural and cultural heritage; traditional handicrafts and SMEs (*Saperi Locali*). Our approach deals with both the last two fields, trying to harmonize the exploitation of natural and cultural heritage with new ICT skills that are also linked with forms of creativity and local know-how.

The cultural heritage sector is particularly affected by a digital mediation in Cultural Heritage (CH) Digitization. Online or on-site accessibility of cultural contents (thanks to mobile and AR applications) shake up traditional models, transform value chains and call for new approaches to our cultural and artistic heritage. The process is robust enough and well demonstrated by the most recent literature. In fact, whilst a few decades ago CH-related tourism was entrusted to direct experience in the field, nowadays it is more oriented towards the digital approach. The journey starts on the web, where visitors can find preliminary information about what they are going to visit, supported by feedback from other users. After arriving at the destination, users can collect digital information that can be shared by means of mobile tools, and at the same time can obtain contextual information thanks to geo-localization services. Finally, after the visit, the experience continues on social networks and/or on the web[4]. Recent research trends demonstrate that the mainstream relies on intelligent tourism recommender systems[5]. In these examples, systems enable the users to plan their visit and, at the same time, keep track of user preferences with two kinds of services:

[2] Fairclough *et al.* 2014.
[3] Bocci *et al.* 2016.
[4] Rezaei *et al.* 2016.
[5] Borràs *et al.* 2014; Emmanouilidis *et al.* 2013; Gavalas *et al.* 2014.

– applications that implement a search for information about the tourist from Internet sources;
– applications that have their databases with information about attractions and provide this information to the tourist.

Even if the web has changed how tourists search for their cultural destination, there is no doubt that the appearance of mobile devices in our daily lives has changed the way in which the surroundings are experienced. From a customer perspective, the literature on mobile technology examines the adoption of technology, and studies the impact of behavior and technology on the overall experience of the trip[6]. The prevalence of smartphones has had huge implications for planning journeys during, before and after visiting a destination. It has been demonstrated that the planning process has become easier as a result of having ubiquitous access to the Internet using mobile devices[7]. Among countless services and apps that can be useful for the cultural sector, Augmented Reality is promising, since it enables the location-based information of real-world objects to be explored, thanks to the contextual visualization on the screen, with the same viewpoint as the user. With an AR-enabled mobile device, it is possible to easily access additional information about a Point of Interest (POI)[8]. Location-based services can change the way people experience their surroundings, and, unlike the use of simple maps, AR allows a continuum with the surroundings without the need to pay attention to the screen; indeed, the possibility of using AR to discover new POIs represents a state-of-the-art approach[9].

For the sake of completeness, after considering the most relevant works about web- and app-based applications, it is fair to say that the future of the tourism sector lies in the development of services that are able to provide information for the users and, at the same time, to collect their data. An example that is worth mentioning is the European project known as *CyberParks COAST* action.

By providing users with digital services, managers and decision-makers can collect so-called User Generated Data (UGD)[10]. Currently, the digital footprints left by individuals in their daily activities can be used as data to draw up statistics and to extract metrics about our surroundings, directly from the users[11]. The advantage of collecting digital footprints changes according to the different domains; however, the tourism sector can benefit the most from such an approach since the collection and the analysis of digital footprints can be useful in understanding tourist behavior with respect to a destination. In fact, there is a mutual advantage for both tourists and stakeholders: tourists are more knowledgeable about the place they are going to visit, whereas

6 Wang *et al.* 2013; Wang *et al.* 2016; Tan *et al.* 2017.
7 Yovcheva *et al.* 2013.
8 Garau 2014; Aluri 2017; Pierdicca *et al.* 2016.
9 Jung *et al.* 2015.
10 Simon 2016.
11 García-Palomares 2015.

digitally active stakeholders, like insiders and operators, can easily obtain user feedback to evaluate the performance of their offers. This goes alongside the possibility to promote the cultural value of a specific, and maybe unknown, area throughout the world. Data analytics can improve the planning process by forecasting trends, marketing, measuring economic impact and benchmarking tourism data[12]. In this respect, there is clearly a need to set up an integrated platform which is able to provide services and to monitor tourism performance. The work presented here attempts to solve this issue; some results[13] and pilot projects[14] or outputs[15] from the *DCE NextOne project* have already been published. The present contribution aims to summarize the main achievements of the project in the light of technical improvements in AR applications and mobile cloud management as well as through the collaborative approach of public-private partnerships.

3. *Method*

The ancient consular route, that connected Rome to the Adriatic Sea, served as the main street connecting the Roman towns of *Fanum Fortunae*, *Pisaurum* and *Ariminum*. The area along the Ancient Flaminia is extraordinary, offering a significantly layered landscape[16] (i.e. archaeological remains, historical monuments and natural scenery, ancient and modern infrastructures). For the documentation and preservation of this complex and remarkable heritage, it is mandatory to use cutting edge survey technologies, integrated data management and innovative communication systems. Although previous research studies and several scientific surveys have already been carried out, a major drawback is their fragmentary non-reusable nature. In order to promote economic culture-based development, in 2013 the Marche Region launched the project called *Distretto Culturale Evoluto* (DCE), which is now in its final stage, the methodology and outcomes of which are worth sharing with the research community. In fact, this project represents a good example for strengthening the relationships between the identity of local communities and the territory. The project stressed the potential of digital cultural heritage for stimulating a new born cultural industry, fostering economic growth and occupation in this area of the Marche Region and implementing the guidelines of the European agenda for culture, by integrating the cultural and creative sectors into regional and local development strategies. This paper, therefore, demonstrates how it is

12 Szopiński, Saniewski 2016.
13 Clini *et al.* 2015.
14 Crinelli *et al.* 2016
15 Clini *et al.* 2017.
16 Luni 1989; Luni 2002; De Sanctis 2010; Luni, Mei 2013.

possible to increase this identity and promote cultural tourism in the region, thanks to the survey, investigation and representation of the Architectural and Archaeological Heritage (AAH).

It is well known that sharing information is very important at all times. Information must be able to flow quickly and accurately and ICT has become an almost universal feature of the tourism industry. To that end, several methods and best practices were tested and developed in a real scenario. First of all, a complex infrastructure was built, using a cloud-based architecture, for the management of multiple kinds of data with a multi-purpose vision. All these data (consisting of archaeological surveys, 3D reconstructions, historical information, 360° spherical images and so on) have been organized to be available at different scales; in particular, a web-portal allows the visitor to browse the Points of Interest (POIs), which are geo-localized and enriched with multimedia contents. While navigating, users can choose their personalized paths. Moreover, a mobile application (for iOS and Android) is available for use once they arrive at the destination. In fact, thanks to geo-localization services, an Augmented Reality (AR) browser allows users to search for the nearest POIs in a more efficient and interactive way. A further already ongoing, an application is the development of a vision-based AR application, which enables the user to see a 3D reconstruction in real scale. For the validation of this methodology, some pilot projects were performed.

3.1 *The cloud repository and the web/mobile app*

The *Flaminia NextOne*[17] web portal was developed, following the cloud-based services paradigm, with the aim of creating a long-term and linked open data platform, designed for CH-related repositories (fig. 2). As stated by EU MEMO/11/745:

> Through digital libraries people can visit the past in a virtual way to experience Europe's cultural wealth and history. Once digitised, cultural material is a valuable resource for creators and businesses, who can reuse it to develop innovative products and services, for example for education and tourism or games and animations[18].

According to this assumption, the cloud-based architecture allows interoperability between different platforms (on-site, online, mobile) and between different users (augmented usability of metadata for both experts/non-experts). Based on these criteria, the web platform was developed with Simplit CMS, which allows the portal contents of sites (Internet and intranet) to be managed and maintained in a simple, fast and secure way. Particular attention

[17] <http://www.flaminianextone.eu/it/>, 30.09.2018.
[18] <http://europa.eu/rapid/press-release_MEMO-11-745_en.htm?locale=en>, 30.09.2018.

was paid to the integration of the information. In fact, while populating the database, different stakeholders, as well as heterogeneous data, were involved. For this reason, web-services were developed in order to facilitate the integration of information from external Data Bases. This portal is programmed using an open source general-purpose scripting language Hypertext Preprocessor (PHP), the Google Maps API and JQuery libraries and components (fig. 3). All graphic solutions are programmed by Cascading Style Sheets (CSS) 2.0 files according to modern web standards (XHTML and HTML5). This allows the appearance, the constructive elements of the page (tag), and the content to be considered as separate elements. W3C recommendations have been followed and all pages have been submitted for HTML/CSS validation. In order to reach a wider public, the portal is compatible with all browsers and mobile operating systems. Particular attention was paid to the possibility to share the contents on the most important social networks, in order to increase the popularity of the network itself. Following Web 2.0 philosophy, the contents can be evaluated by users. Moreover, the back end was designed for web-based management, making it accessible from any browser using personal credentials. The application uses an open source database and is multilingual given the importance of contacting foreign visitors. Although the web portal is mandatory for spreading information about the *Flaminia NextOne* project, the mobile solution is also important, both for retrieving the same information from the Data Base and for exploiting more functionalities directly on site.

The mobile application is a cross-platform mobile app available on Android as well as on iOS devices. It provides information such as product news, company lists, contacts etc., also allowing user participation by sending comments, ideas, suggestions, etc. The geo-localization service, which retrieves the information from the Data Base, has the twofold advantage of suggesting a preferred itinerary to the users and enabling the Location-Based AR service, as explained below. Within the app, a specific AR engine has been developed. This tool permits the registration of virtual objects in the camera scene, based on the user's location and orientation. To determine these two, the device makes use of a GPS receiver to retrieve the user's location in the real world, and a gyroscope and compass to obtain the user's orientation. In other words, the system relies on (geo)localization services to determine the distance between the user and the Points of Interest (POIs) that are present in the surrounding area. Archaeological sites might have countless objects which are worth noticing, and the closer the user is, the higher is the risk of error, caused by the GPS receiver's lack of accuracy. Notwithstanding this drawback, several tests have been performed to achieve a good visualization of both Geolayers with textual information and 3D model visualization (fig. 4). The iterative improvements of the digital 3D clone are enabled by the interaction of external expert users who create/view/edit/update a view of a given AAH 3D object. The view on an AAH model provides the following advantages over a classical model:

– views can represent a subset of the Data in a given time with a given Level of Detail (LoD); a given user may have permission to view/edit/update/create a new view without modifying the original data but extending it;
– views can hide the complexity of the data;
– views need little space for storage;
– views can be linked to other views and to other data within the metadata set.

After this description of the digital services developed for the project, tests and validation pilot projects will be described in the following section.

3.2 *The pilot projects: tangible digitization and knowledge-based representation for the archaeological landscape*

The project allowed four pilot studies to be set up (fig. 5) along the Flaminia road: the "Virtual Museum of Via Flaminia" in Fano, the mobile app for augmenting contents at the *Forum Sempronii* archaeological excavation, the VR/AR exhibition at the Furlo Gorge and the interactive installation in Cagli Museum. This paragraph presents the main achievements and novelties for each pilot project, because they are conceived not as a result but as an incubator for further progress.

The first pilot project developed is the "Via Flaminia Museum" in Fano[19]: it is a completely Digital Museum, conceived as a gateway to the district as a whole, using innovative media to show high-quality contents (from a multiplicity of survey and representation systems) through Mixed Reality (AR/VR) and cutting-edge devices. This Digital Museum metaphorically contains all the evidence found along the consular road because it brings together the research experience of the survey and the digital representation of the archaeological heritage. The preparation of digital documentation dealing with museum attendance in such a large and complex area required multidisciplinary contamination, ranging from computer scientists to digital documentation experts collaborating in a transdisciplinary team with archaeologists and architects (fig. 6).

[19] A DCE pilot by the Municipality of Fano (Massimo Seri Major; Stefano Marchegiani; Grazia Mosciatti; Claudia Cardinali; Ivan Antognozzi Project manager *DCE Flaminia NextOne*), in partnership with Fondazione Cassa di Risparmio di Fano, Soprintendenza Archeologia, Belle Arti e Paesaggio delle Marche and Centro Studi Vitruviani. Scientific consultancy Università Politecnica delle Marche-DICEA, leaded by Paolo Clini. Exhibitions: Anna Paola Pugnaloni, Adriana Formato. Multimedia: Romina Nespeca (supervisor), Floriano Capponi, Roberto Catozzo, Adriano Mancini, Gianni Plescia, Ludovico Ruggeri, Luigi Sagone. Assistants: Renato Angeloni, Roberta Barcaglione, Claudia Brocchi, Elena Camerini, Anna Marconi, Roberto Pergolesi, Giulia Crinelli, Massimo Orselli, Laura Bertuccioli, Laura Invernizzi, Gianluca Gagliardini. Partnership with Università degli Studi di Urbino Carlo Bo: archaeological contents by Valeria Purcaro, Oscar Mei. Equipment: Esserci s.r.l., Grottini Lab e Si2G.

The "Via Flaminia Museum" is divided into three main sections. The first part of the museum itinerary shows the visitor the original layout of the road from Rome to the Marche Region: here the main role is played by a carpet representing paving stones, and by a giant canvas representing the architectural and monumental highlights of Roman history, such as Ponte Milvio, the Colosseum and the Arch of Augustus. A second section investigates all the municipalities along the consular road from Scheggia to Fano. A final specific section is dedicated to Fano during the Roman age. The representation of such a vast archaeological heritage and the availability of a large amount of data from different surveys allow new communicative formats[20] to be experimented, ranging from videos and art galleries to more immersive experiences, i.e. 360 virtual tours, 360 videos, 3D models and point clouds and their exploitation through AR/VR (fig. 7).

In accordance with the London Charter and the Seville principles, the content was generated with a focus on intellectual integrity and the reliability of the historical sources. Another innovative solution adopted consists in the collection and organization of data on a cloud server system which has the advantage of providing a great number of models and 3D captures that can be used for various outputs: the main goal achieved was the extension of data scalability across various technological installations within the same museums. In addition, the system allows further installations and the use of the same data and their semantical organization and interpretation to be used even in other contexts or with other project partners.

The development of the contents required dedicated data capture campaigns (photographic and geometric), using cutting-edge and standard technologies (photogrammetry, laser scanners, 360 cameras, HD photos, RPAS, etc.). Thanks to a helicopter flight, arranged in collaboration with the Corpo Forestale Italiano, for this project it was possible to carry out a survey of the whole Via Flaminia landscape, from Fano to the Scheggia Pass.

A totem touch screen welcomes visitors in the museum entrance and introduces users to the cloud data system for consulting the DCE digital library and the portal that connects the whole itinerary. After this area, a panel system integrates a touch screen that focuses on the appearance of the city of Fossombrone, also known as *Forum Sempronii*, in Roman times; this is one of the richest historical sites as regards the quantity of findings along the Via Flaminia. This section will be "dynamic" as it will change periodically, so as to also focus on other DCE partners. Another multimedia workstation along the itinerary allows both the virtual navigation of the area through geo-referred geographic interfaces and, at the same time, visualizes the contents from the cloud data. This section consists of a horizontal touch screen and a vertical screen, with a dedicated html system, and both the display interfaces retrieve contents. A fourth area

[20] Garau, Ilardi 2014.

is dedicated to evidence from the ancient *Fanum Fortunae*, displaying roads, findings and three-dimensional reconstructions. Above all, the most important feature is the video of the 3D integral reconstruction of the whole city as it would have appeared, according to studies, in ancient Roman times. This last exhibition section is closely linked to one of the most popular and interactive workstations in the Museum: the desk dedicated to AR and VR applications. The museum provides a tablet to display reconstructed models of the Augustus Arch, the Roman Theatre, and Vitruvius' Basilica in Fano. Google Cardboard allows for immersive navigation in the panoramas of these archeological areas both as they are now and in their historical reconstructions.

Through the "Museum Visitors Behavior Analysis"[21] system, it is possible to have a precise and innovative understanding of the interaction between visitors, the environment and cultural proposals by monitoring the number of visitors and the effectiveness of the interactive systems. Within the museum, two observation points have been identified that provide user action data and analytical reports. The Museum Analytics technology monitors visitor activities through advanced sensor tools for digital vision. Moreover, a team of Data Scientists is currently working on the information produced by these tools in order to make it useful for verifying the museum's performance. Each observation point provides dashboards with information on three indices: *attraction*, number of steps and stops (to define to what extent visitors are interested in the various proposals); *attention*, the average stay time that visitors dedicate to the proposals; *action*, number of stops and interactions (which provides a measure of interest and interaction with the proposed installations).

Considering the potential of Augmented Reality (AR) technology[22], based on mobile devices and the effectiveness of its outputs and possible applications when 3D contents with photorealistic textures are managed, the pilot project of *Forum Sempronii*[23] was conceived to develop immersive AR on a real scale. The workflow, from the generation of contents to the processing and the development of the final application, encountered several difficulties. The improvement and assessment of dedicated workflows[24] is still a matter of debate, despite the availability of proprietary or open-source platforms for AR/VR and so on. The *Forum Sempronii* app[25] develops new types of interaction on a real scale and enhances existing evidence with immersive experiences. In

21 The system was developed in collaboration with the project partner Grottini Lab.

22 Pierdicca *et al.* 2015.

23 Luni, Mei 2013; Luni, Mei 2014.

24 Clini *et al.* 2016.

25 The *Forum sempronii* AR app was developed by DICEA and DII which are departments of the Università Politecnica delle Marche. Supervision: Aldo Franco Dragoni and Ramona Quattrini. Supervision of archaeological contents: Oscar Mei. Virtual reconstructions: Laura Invernizzi, Laura Cocon, Anna Marconi. 3D modelling: Ludovico Ruggeri, Floriano Capponi. APP development: Elia Alesiani, Luca Quercetti, Angelo Serafini. Layout: Anna Paola Pugnaloni. Other contents: Romina Nespeca, Gianluca Gagliardini, Luigi Sagone. Technical partners: EVE spin off, EB World.

fact, a major achievement of the application presented here is the fact that it offers users the chance to move around and browse the model from their position in the area.

The *Forum Sempronii* AR app has been developed for Android and iOS, using the Unity development platform and the Vuforia library for the real scale AR. The app consists of a main scene, a top view picture of the archeological area, from which the user can access the pages dedicated to the point of interests (POIs) of the *Forum Sempronii*, and can then switch to AR mode, activating the real scale AR. In the main scene, the users can select one of the four POIs, according to their current position in the archeological area: the "Decumano", the "Botteghe", the "*Domus* Europa", and the "Anfiteatro". Once the user selects a POI, the app displays a written description as well as a button to activate the AR. The four POIs are able to perform three distinct types of function: the "Decumano" is used to show the Level of Reliability (LoR) of reconstructed parts of town; the "Botteghe" and the "Anfiteatro" use AR to provide the virtual reconstruction of lost architecture. Finally, the "*Domus* Europa" demonstrates the repositioning of artifacts, by superimposing a mosaic which is currently conserved in a city museum onto the floor of the house which is decorated in ancient times (fig. 8).

In Cagli, in a traditional and recently renovated museum dedicated to the Via Flaminia, the *DCE NextOne* project has introduced an interactive installation[26] based on a video projector, the so-called StarkMatrix. It can be used to project on the wall or the floor, generating interactive surfaces without frames and screens. In this way an integrated system of projection and interaction is obtained, which creates highly effective and extraordinary pictures and videos of the Via Flaminia, revealing simple details like flowers and water. The effects are generated by the people walking in the area. The effects are customizable and are developed using high quality 3D technology, which highlights the great potential and the natural assets of the region.

The last pilot project was dedicated to the natural and cultural heritage in the Furlo Gorge area. This is a relatively small installation, based on a screen and an AR/VR access point. The main success of this project was the complete interoperability of the new installations with previous contents (such as the cloud contents or the Museum of Fano contents), thereby achieving another main goal of the project, i.e. the replicability of digital contents and their potential in the sustainability of CH promotion. In addition, the replication of similar or the same contents in several places and sites of the DCE realized the network. In this regard, each pilot project became a gateway to the *Flaminia NextOne* District identifying the archaeological influences and the potential of the area.

[26] The system was developed with the *DCE NextOne* project partner Stark.

4. *Analysis and discussion*

One of the main outcomes of the project is a multichannel tourist information system with a website and mobile app, enriched by some on-site experiences as described in the pilot project section. All the contents are managed from a cloud-based service that brings together and shares all the information and multimedia contents. Furthermore, it is important to underline that the platform was also designed for collecting different types of user statistics on tourist behavior and, more in general, for monitoring the performance of the service, and hence the tourism services provided. In fact, the novelty introduced by *DCE Flaminia NextOne* is fundamental for sharing knowledge on various archaeological sites and micro-museums along the Via Flaminia. However, it is important to mention that the funding of the project is sufficient for only a small area of the whole territory encompassed by the Via Flaminia, even if an extension to the entire cross-regional area would be desirable. The geographical position of the Via Flaminia in fact cannot take advantage of the flow of tourism which is generally oriented towards the coast or places located near the main highways with a consequent negative impact on sites of cultural relevance. For this reason, one of the missions of the project is to spread awareness of these outdoor and indoor sites, which are found throughout the Marche Region from Fano to the Apennines, bordering the Umbria Region. Indeed, the part of the Via Flaminia involved in this project stretches from the valley of the River Metauro to near Cantiano. The role of ICT becomes paramount for attracting visitors even to those areas which cannot be reached using the normal and well-established tourist routes.

ICT can help to direct this flow of tourism towards less accessible sites but, in order to understand their popularity, it is necessary to provide local administration with real data coming from the users[27]. This is, to date, the only way to improve the decision-making process so as to intervene with a data-driven approach.

The data collection period spans over one year – from May 2017 to May 2018 – analyzing data from both the web site and the mobile app, in order to understand the potential and the drawbacks of the proposed methodology. The first consideration that arises from the data is that tourists prefer to enhance their knowledge with the use of desktop applications (web-browsers) rather than during the visit with the mobile app. This means that the platform is mainly used either before or after the visit. This preliminary information should make the platform managers understand that the mobile app needs to be advertised, especially as an interactive guide along the itinerary of the Via Flaminia, to involve the tourists more with the use of digital services.

[27] Chung *et al.* 2015.

All these data can be matched with those related to the category of the device which confirms that most browsing on the platform is from desktop applications; only a small subset of the sample (6%) makes use of the AR service, mainly using tablets. It is worth noting that 64.32% of the sample uses the Google Chrome search engine, which is an indicator that the platform is well indexed and has a high degree of visibility (fig. 9).

Some insight is also available as regards countries and languages. It is interesting to note the involvement of non-European users (10%), demonstrating that these kinds of applications allow cultural heritage sites to connect with a vast range of visitors, even from foreign countries. The Multilanguage function of the platform is therefore fundamental (fig. 10).

Further analysis of the data shows that during the winter months there is a slight reduction in the number of accesses, meaning that advertising should be supplemented in order to attract more visitors in those periods (tab. 1). From the weekly accesses, it can be inferred that the platform is used more during the first days of the week. This is presumably because the website is used after a direct visit to the site, which is more likely to happen during the weekend (as demonstrated by the on-site use of the mobile application). Hence the users are more interested in learning about the site if they have already visited the museums or the POIs.

In the light of this information, the potential of the platform is enormous for both visitors and policy makers. An analysis of the data indicates that the former find the platform of interest and useful for increasing the knowledge and understanding of the area they visited, while the latter have at their disposal a platform which at the same time allows the visitors to be monitored and tourist services to be promoted.

Month	Visitors	% w.r.t. the total
May 2017	183	10.70%
June 2017	183	10.70%
July 2017	157	9.22%
August 2017	146	8.57%
September 2017	114	6.69%
October 2017	114	6.69%
November 2017	139	8.16%
December 2017	117	6.87%
January 2018	133	7.81%
February 2018	129	7.57%
March 2018	150	8.81%
April 2018	137	8.04%
	Tot. 1702	

Tab.1. *Flaminia NextOne* web portal visitors, numbers and percentages (Source: Google Analytics, authors elaboration)

Given the main aim of the project which was to promote cultural heritage throughout the territory and to study the socio-economic implications that can arise from this type of digital-mediated approach, some action should be taken to further develop the system:

- the promotion of the platform should be bidirectional, meaning that it should also be promoted by each municipality;
- the information should be spread using different channels to attract schools and/or other sectors of users, especially during the low season with fewer tourists;
- UGD should be monitored in order to understand the real behavior of visitors directly on site.

Another positive outcome of the DCE *Flaminia NextOne* project was the Landscape &Archaeology (L&A) seminar, that was held in 2016. The need to foster – as a tourist attraction and a cultural asset – and to maintain such an outstanding heritage, motivated local politicians and public administrators to begin a series of actions in the framework of the Roman past surrounding the Flaminia region. The remarkable territorial setting (i.e. archaeological remains, outstanding rural and natural landscapes, ancient and modern infrastructures and heritage) is well known, but there is a recognizable need to scale up its reputation in various scenarios. To that end, thanks to the involvement of the Centre for Vitruvian Studies (CSV), local administrators acknowledged a joint initiative by our University and Urbino University. The L&A En Route seminar, with the patronage of Uniscape, was dedicated to discussing smart forms of cultural tourism and rural-environmental tourism. In order to strengthen the relationship between the inhabitants and the places where they live, it also raised important questions concerning the revitalisation of territorial and historical heritage, and the demand for its sustainable development and conservation. More in detail, the seminar investigated how it is possible to increase cultural identity and promote cultural tourism in the region, thanks to the knowledge, representation and promotion of the architectural and archaeological heritage and landscape, a broad sense. One main goal for the "Landscape & Archaeology" seminar was to share and compare positive experiences in several different areas of the tourist industry, and in the use, preservation and dissemination of landscape and archaeological heritage. In particular, the event discussed how to make the preconditions and their results SMART (specific, measurable, achievable, realistic and time-related). The seminar provided a forum conducive to sharing best practices (by researchers, designers, SMEs) deriving from real experiences. In many European countries local cultural heritage is a powerful driver for developing various economic activities related to tourism. Management and open access to cultural heritage are challenges in territorial democracy, enabling local communities to conserve their resources. There are three main preconditions for the development of sustainable cultural heritage tourism: a) a good knowledge of cultural heritage;

b) a strong awareness by local people for the protection of cultural heritage in any economic activity; c) the possibility to access innovative and creative ICT tools to design tourism solutions which have a low impact on the environment but are relevant for local identity. The key topics, discussed during the itinerant seminar, were: Smart Landscape, Archaeology and digital documentation and Smart Industrial Archaeology. Furthermore, a special session attempted to shed some light on the sustainable promotion of heritage and on Cultural District initiatives. These subjects are of interest to a wide range of public and private stakeholders in the Marche Region, many of whom attended this special session[28]. Overall, the staging of this event can be defined as a success: in fact, the seminar was the first initiative organized and managed by the partnership as a whole.

A further achievement, which arose from the *Flaminia NextOne* project conclusions, is the scalability of some actions developed by similar online networks for the dissemination of cultural heritage, such as the online website for the archaeological heritage of the Marche Region. This latter project, now in its final stages, is called *Marcheology* – Portal of the Marche Archaeological System and comes within the framework of the Museums and Development of Territorial Systems program (MuSST). Thanks to this funding, the Directorate-General for Museums aims to support regional museum networks in the promotion of territorial networks, in participatory dissemination and in the creation of integrated cultural itineraries. The project, jointly developed by our research group and the Polo Museale Marche, concerns the promotion of the uniqueness of archaeological heritage and aims to strengthen the identity of local communities thanks to a network between cultural heritage sites. Undoubtedly, this was made possible, in a short time and with limited funding, thanks to synergies with previous projects such as *DCE NextOne*, involving part of the archaeological heritage of the Marche region. Thanks to the Marcheology[29] portal, the Flaminia cloud is now scaled up to a larger territorial scale.

5. *Conclusions*

At the end of this four-year project, it is possible to state that it has represented a great opportunity to provide the territory with digital tools, developed to create a clear and uniform system that can be used by both the local population and tourists. The proposed system, that is integrated and modular, allows multiple information to be managed ensuring an interoperable and multi-channel approach. All the data can be conveniently displayed in different ways:

[28] Further details are shown in Clini *et al.* 2016.
[29] <https://www.marcheology.it/it/>, 30.09.2018.

web portals, fixed installations (indoor), mobile devices (smartphones and tablets), thereby guaranteeing a useful granularity of the system which can be exploited at different levels of detail.

The proposed cloud architecture is also tailored to satisfy two major needs. The first objective was to make significant progress in design methodologies and general reference architectures regarding robotic-assisted surveying/processing/management and communication of cultural heritage. The second consists in providing a way to open up and share the data within the community (experts, art lovers) using a cloud and connected open-source services based on the Web 2.0 observation that users can enrich data. In that direction, one of the main purposes is to allow users to comment, better describe, complete and add multimedia material to these Open Data concerning CH contents; every action performed in a participative manner is considered as user-generated content and described as a second level layer with respect to CH official data which is produced by experts working in the relative public administrations.

Another important aspect is that the system developed was also designed in order to monitor and track the so-called User Generated Data (UGD), which represent the future pathway for analyzing, observing and recording the dynamics of our environments (i.e. urban open spaces, cities, rural areas etc.) and, more in general, the behavior of people visiting an area. The digital footprints left by individuals in their daily activities can be used as data for statistics and for extracting metrics about our surroundings representing a valuable source of information for the local authorities.

As foreseen in the main expected impacts of the project, the DCE acted as a flywheel for R&D in/for the cultural heritage sector, stimulating a public-private partnership with some SMEs engaged in technology and in extending cultural heritage. The project is still promoting local development, based on tangible and intangible cultural heritage and ICT tools, thereby increasing the competitiveness and the appeal of suburban areas. Heritage and cultural identity are becoming catalysts for creativity and innovation. Given the promising results, we are now extending the present approach to inner areas scaling up the available platform to other kinds of Cultural Heritage, one of which is the project for the Montefeltro Inner Areas (*Asili d'Appennino*).

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Appendix

Fig. 1. The *Flaminia NextOne DCE* project: graphical abstract

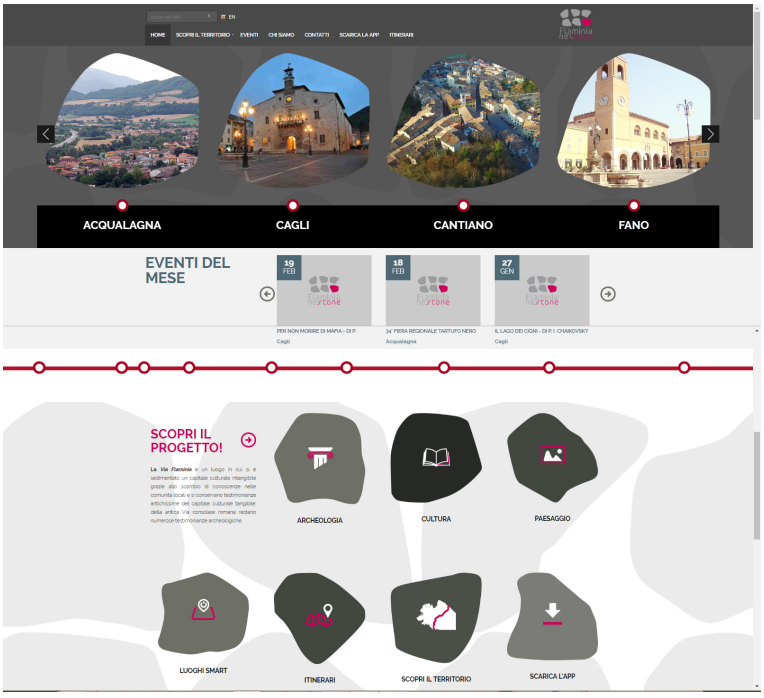


Fig. 2. The Home Page of the website

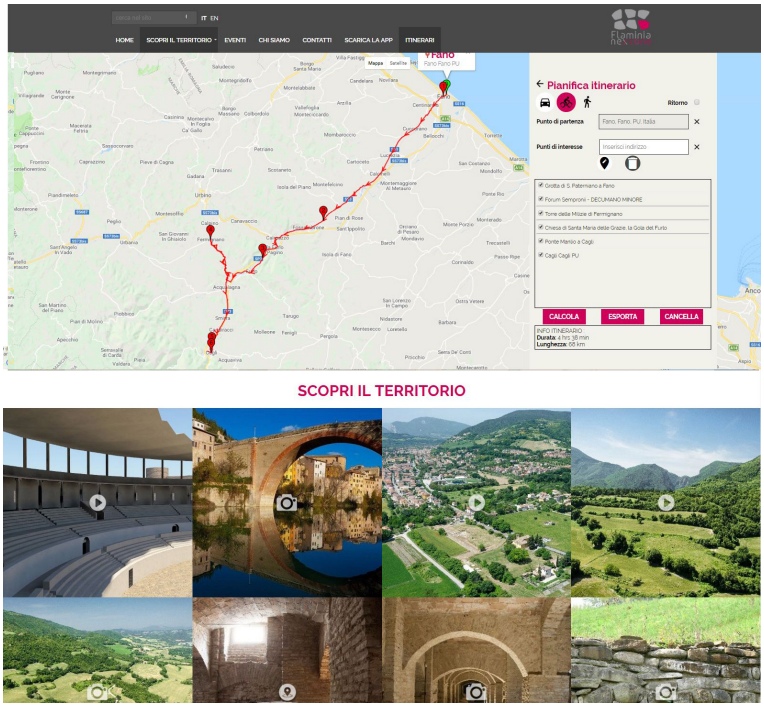


Fig. 3. Two sections of the website: top, “itineraries”; bottom, “destinations”

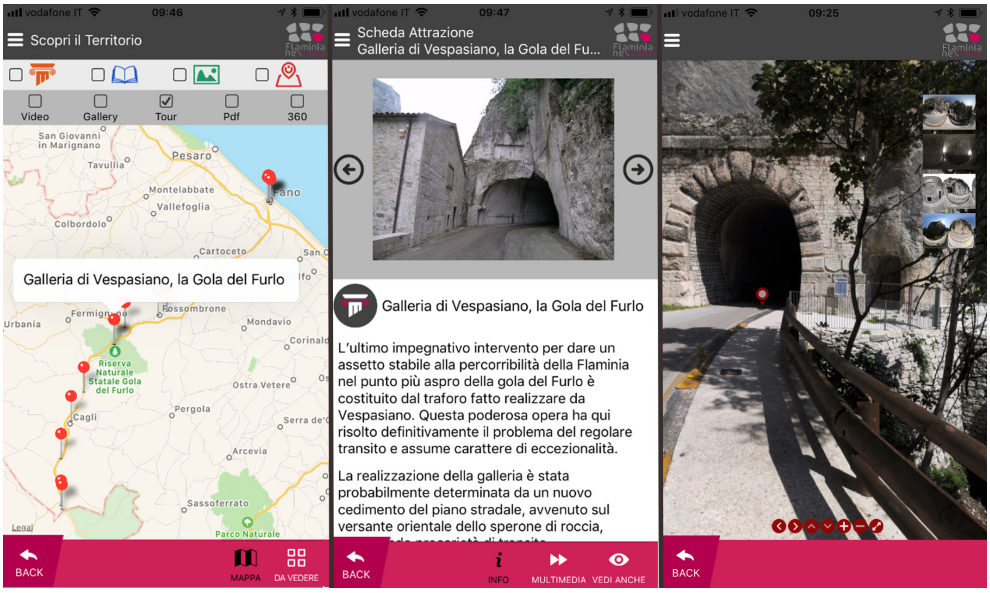


Fig. 4. The *Flaminia NextOne* app: a POI with linked multimedia; on the right, a full dome view

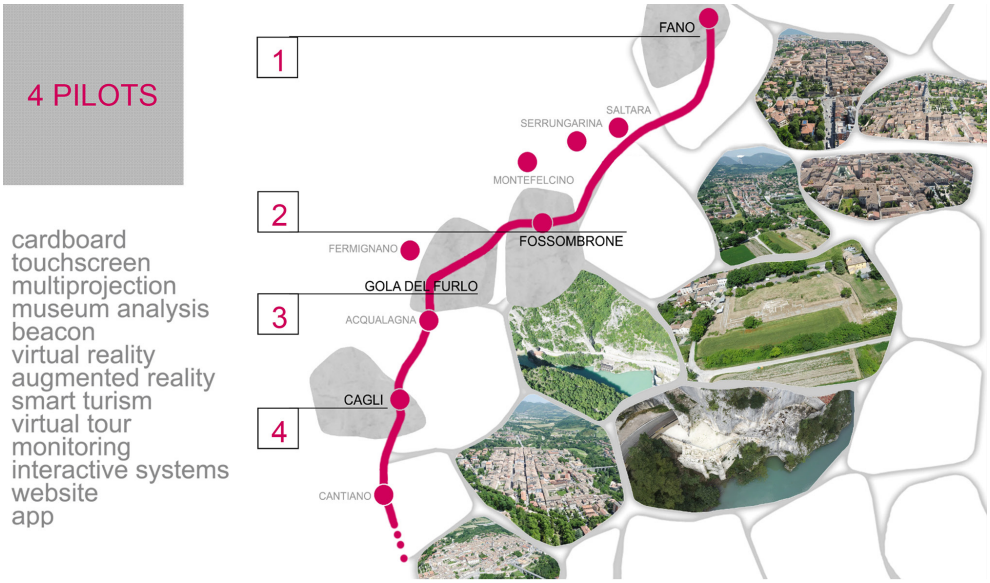


Fig. 5. Keywords and location of the 4 pilot projects along the Via Flaminia within the boundaries of the Marche Region

Fig. 6. A picture of the "Via Flaminia Museum" in Fano

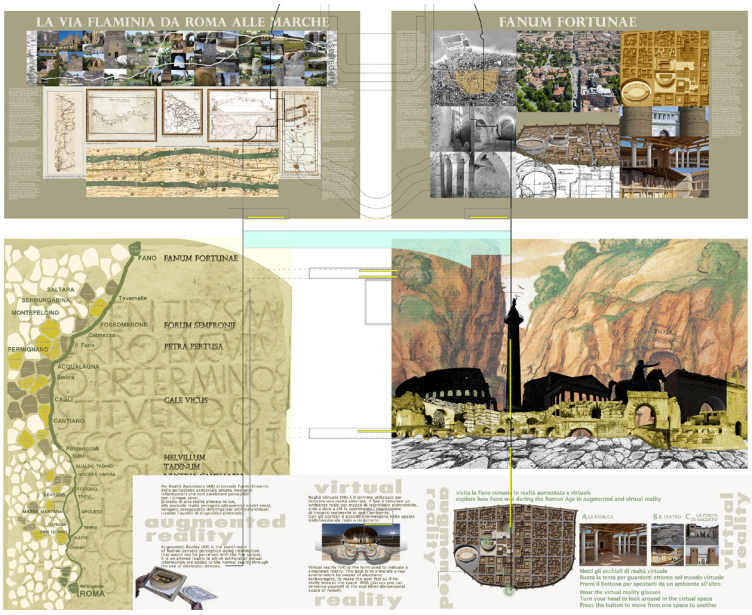


Fig. 7. Main contents of the Museum

Fig. 8. *The Forum Sempronii AR* App: top, screenshot of the App during the superimposition of the mosaic; bottom, a picture of a user in the Europa *Domus* using the App

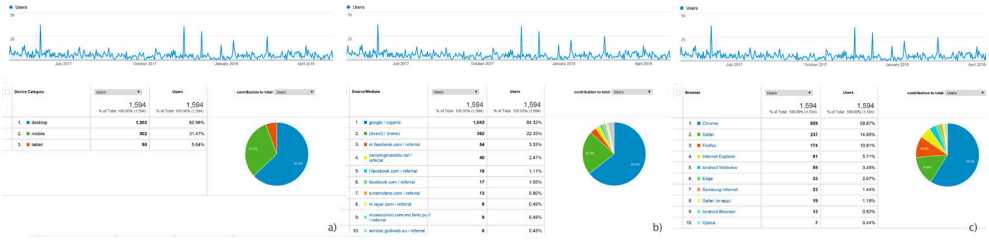
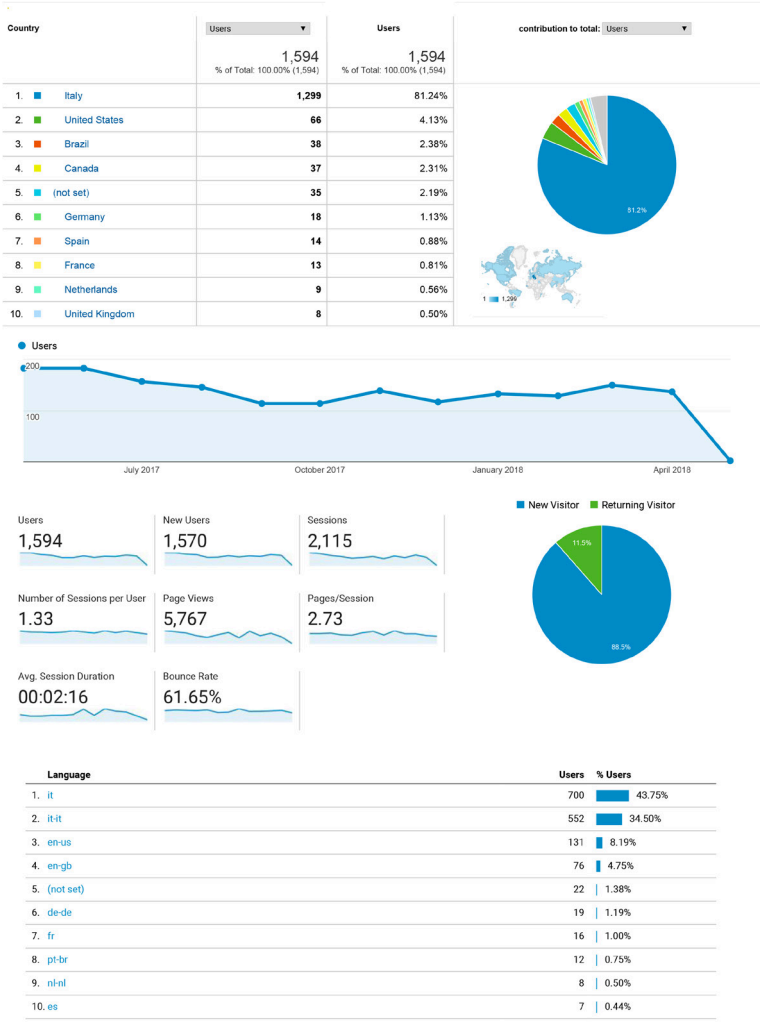


Fig. 9. Analytics of access to the *NextOne* web platform: a) device category, b) medium, c) browser



Country	Users	Users
	1,594 % of Total: 100.00% (1,594)	1,594 % of Total: 100.00% (1,594)
1. Italy	1,299	81.24%
2. United States	66	4.13%
3. Brazil	38	2.38%
4. Canada	37	2.31%
5. (not set)	35	2.19%
6. Germany	18	1.13%
7. Spain	14	0.88%
8. France	13	0.81%
9. Netherlands	9	0.56%
10. United Kingdom	8	0.50%

contribution to total: Users

51.2%

Users

200
100

July 2017 October 2017 January 2018 April 2018

Users	New Users	Sessions
1,594	1,570	2,115
Number of Sessions per User	**Page Views**	**Pages/Session**
1.33	5,767	2.73
Avg. Session Duration	**Bounce Rate**	
00:02:16	61.65%	

New Visitor Returning Visitor

11.5%

88.5%

Language	Users	% Users
1. it	700	43.75%
2. it-it	552	34.50%
3. en-us	131	8.19%
4. en-gb	76	4.75%
5. (not set)	22	1.38%
6. de-de	19	1.19%
7. fr	16	1.00%
8. pt-br	12	0.75%
9. nl-nl	8	0.50%
10. es	7	0.44%

Fig. 10. Analytics of access to the *NextOne* web platform: top, country; bottom, language

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