OpenCity project. Integrated tools for the knowledge of historic cities

From urban to global archaeology

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The protection and enhancement of cultural heritage is a challenge shared by all of humanity, despite the differences in nationality, religion or political affiliation. The close link that cultural heritage has with the history, traditions, culture, identity of people, justifies the commitment to its conservation and the need for protection against all threats that for various reasons are addressed to its destruction.

The protection and enhancement of cultural heritage have its foundation both in the knowledge obtained by scientific research and both in the disclosure of the results to all humanity. The cultural heritage cannot be protected without the contribution of a community enabled to participate in the processes of knowledge of the cultural heritage that belongs to it. The present contribution wants to provide an example of this process, which from scientific research reaches the protection of cultural heritage, through the collection of data and the production of information and shared knowledge with the entire community.

The challenge of cities with a long-life continuity

Cities with a long-life continuity, where the historical landscape is the result of a centuries-old interaction between humans and nature. Furthermore, the need for development and modernization of cities with a long continuity of life are constantly subject to interventions, that threaten their conservation and require appropriate strategies to protect cultural heritage. Finally, historic cities are complex organisms that require multidisciplinary investigations, but at the same time, they offer the best example of the need, nowadays more and more felt, to overcome the different specializations that characterize contemporary archeology to reach a difficult, but necessary synthesis.

OpenCiTy project and the city of Catania

It is precisely in this perspective of a "global" archeology, that the Opencity project is placed at Catania (Malfitana and Mazzaglia 2019; Malfitana and Mazzaglia 2018; Malfitana, Mazzaglia and Cacciaguerra 2016). The territory where the modern city stands has been inhabited since the Neolithic Age until the present day without interruption. This has produced testimonies come to us sometimes in an extraordinary state of conservation, although the city has been repeatedly hit by natural disasters, which have changed the appearance, such as the eruption that in 1669, which erased part of the western sector of the city, or the terrible earthquake of 1693, which razed the city to the ground. The presence of extraordinary monuments, such as the Roman amphitheater, largely preserved under the modern city, extraordinarily preserved thermal baths, as well as remains attributable to the late ancient, medieval and modern age, today poses important challenges for their conservation.

The protection of the cultural heritage of the city, continually threatened by the need for development and modernization, has always encountered different problems: the lack of communication and sharing of the results of research conducted in the city by universities, superintendencies, research organisations; the lack of knowledge of the contexts on the part of the community, which could not play an active role in the processes of enhancement of the urban context.

Operating in this context the OpenCiTy purpose is the creation of a shared knowledge base through the collection of all available material, to be used as a decision support tool for future planning. The core of the project consists d on three different elements: a database, a GIS platform, and a WebGIS.

The database of the OpenCiTy project was developed with the specific purpose of collecting all the different types of data useful for describing the city in its historical stratification. Therefore, it does not regard only the historical and archaeological data, but also the data relating to the different cities that have alternated on the same territory. The Greek city, the Roman city, the Byzantine city, the Arab city, the Norman city, the modern

city, up to the contemporary city. The database collects archaeological information, from finds in their context of origin, to the monumental complexes in which these finds are discovered or the place where they are now stored. This database, therefore, aspires to become a sort of collective memory of the city, in all its historical evolution, a memory that can be questioned, asking countless questions about the stored data, the connection of which ensures the generation of ever new knowledge.

The GIS platform, on the other hand, is the true work environment. This is the place where the collected data can be managed, interrogated and visualized through a graphical representation within a three-dimensional space. The levels of the modern city: streets, squares or building. The Levels of the ancient cities, with archaeological excavations; archeological finds; historical cadastre; historical building; geological maps; historical tematic maps. The city of the future is the city that we can create with a urban planning based on a real and shared knowledge of the value of the cultural heritage.

Finally, the last element of the project is the WebGIS platform. It has the purpose to make freely accessible online and to share data collected and information produced in open data mode. The WebGIS platform makes it possible to query the project database through multiple predefined search criteria, to download the data of interest, to elaborate thematic maps of extremely detailed and to share them in real time with other users.

OpenCity project from virtual to real urban space

The structure just illustrated has provided the basis on which to conduct an extensive research program in order to solve some historical and archaeological questions still open. To make the whole system work, however, it was necessary to find an answer to the necessity of the exact location in the space of all the information collected. In fact, space is the common denominator that keeps together all the data collected within OpenCiTy.

The first activity carried out within the OpenCiTy project was therefore aimed at creating a reliable and sufficiently precise reference base for the urban fabric of the modern city. To achieve this goal, it was necessary to develop a methodology of survey and restituzione, based on the integration of topographic surveys with Differential Global Positioning Systems (DGPS), laser scanners, close-range and aerial ortho-photogrammetric, obtained from pictures acquired by a drone in low altitude flights. The processing of the collected data allowed to reach a three-dimensional digital model of large portions of the modern city, with a margin of error less than one centimeter. The cartographic base, which has been obtained, has allowed reaching a very high level of precision in the geolocation of the data stored in the database of the OpenCiTy project. The integration of archival data and historical-archaeological documentation produced over the past few centuries, with increasingly more scientific methods, starting from the first observations of the scholars of the sixteenth century after Christ has formed the basis of knowledge from which take the steps for further study. These were conducted by the IBAM-CNR with several non-invasive investigations, which thanks to the use of georadar, geoelectric and magnetometer have allowed to reach an estimate of the presence and dislocation of the structures still buried in the subsoil.

At the same time the availability of point clouds of entire sectors of the modern city, realized through laser scanner surveys and integrated with the images produced by an ortho-photogrammetric survey, formed the basis for the realization of 3D models of the current urban structure and an accurate digital model of the ground. These 3D models, realized at different levels of detail, are currently the subject of a new project that the IBAM-CNR started last year in close connection with the aims of OpenCiTy. The new project, called Spider, making use of the collaboration of an interdisciplinary group of archaeologists, architects, engineers, is making "semantic 3D models" of entire portions of the urban area of The city of Catania, obtained by applying BIM methodologies, Building Information Modeling to the historical building. The decomposition of a 3D model of a historical building into the technical-functional elements that compose it, the attribution to each element of the technical and material information that characterize it, the placement of each model within a three-dimensional space, allow to reach the mapping and management of the single building element, monitoring the state of conservation, the interaction with the surrounding environment, the relationship with other structures belonging to the same context.

To sum up: what the OpenCiTy is trying to obtain is a virtual model of the city, in which it becomes possible to generate new dynamical knowledge, through the selective analysis of different types of data. Useful knowledge from many points of view. A knowledge able to narrate, in an extremely innovative way, the history of the city, combining the great historical-political event, with the micro event, that characterized the private life of those who lived in the city and left their mark, in a document of buying and selling, in the registers of a parish, on the tombstone of a tomb (Mazzaglia 2018).
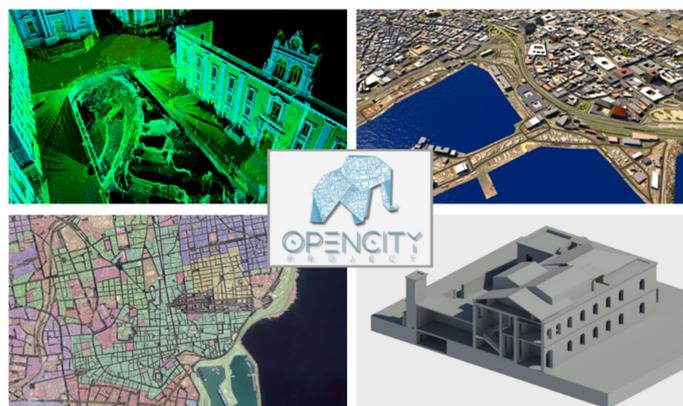

Fig. 1 Opencity project

Reference

Malfitana, D. and Mazzaglia, A. (2019), Innovazione e ricerca vs immobilismo e assenza di programmazione. Prospettive e opportunità per la ricerca applicata all'archeologia, in Modolo, M., Pallecchi, S., Volpe, G., Zanini, E. (eds), Una lezione di archeologia globale. Studi in onore di Daniele Manacorda, Bari, Edipuglia, pp. 471-480

Malfitana, D. and Mazzaglia, A. (2018) Archeologia globale a Catania. Nuove prospettive dall'integrazione di ricerca archeologica e tecnologie ICT. Nuovi dati sull'anfiteatro romano, in Belvedere, O., and Bergemann, J (eds), La Sicilia Romana: Città e Territorio tra monumentalizzazione ed economia, crisi e sviluppo. Studi e materiali 1 - Atti del Convegno di Gottinga 25-27 novembre 2017, Palermo, Palermo University Press, pp. 327-352.

Malfitana, D., Mazzaglia, A., and Cacciaguerra, C., (eds.) (2016), Catania. Archeologia e città. Il progetto OpenCity. Banca dati, GIS e Webgis.Vol.1, Catania, IBAM-CNR Edizioni

Mazzaglia A. (2018), Il paesaggio storico: fra legislazione, tecnologie e complessità, in Malfitana, D., (eds), Archeologia quo vadis? Riflessioni metodologiche sul futuro di una disciplina, Catania, IBAM-CNR edizioni, pp. 256-282.