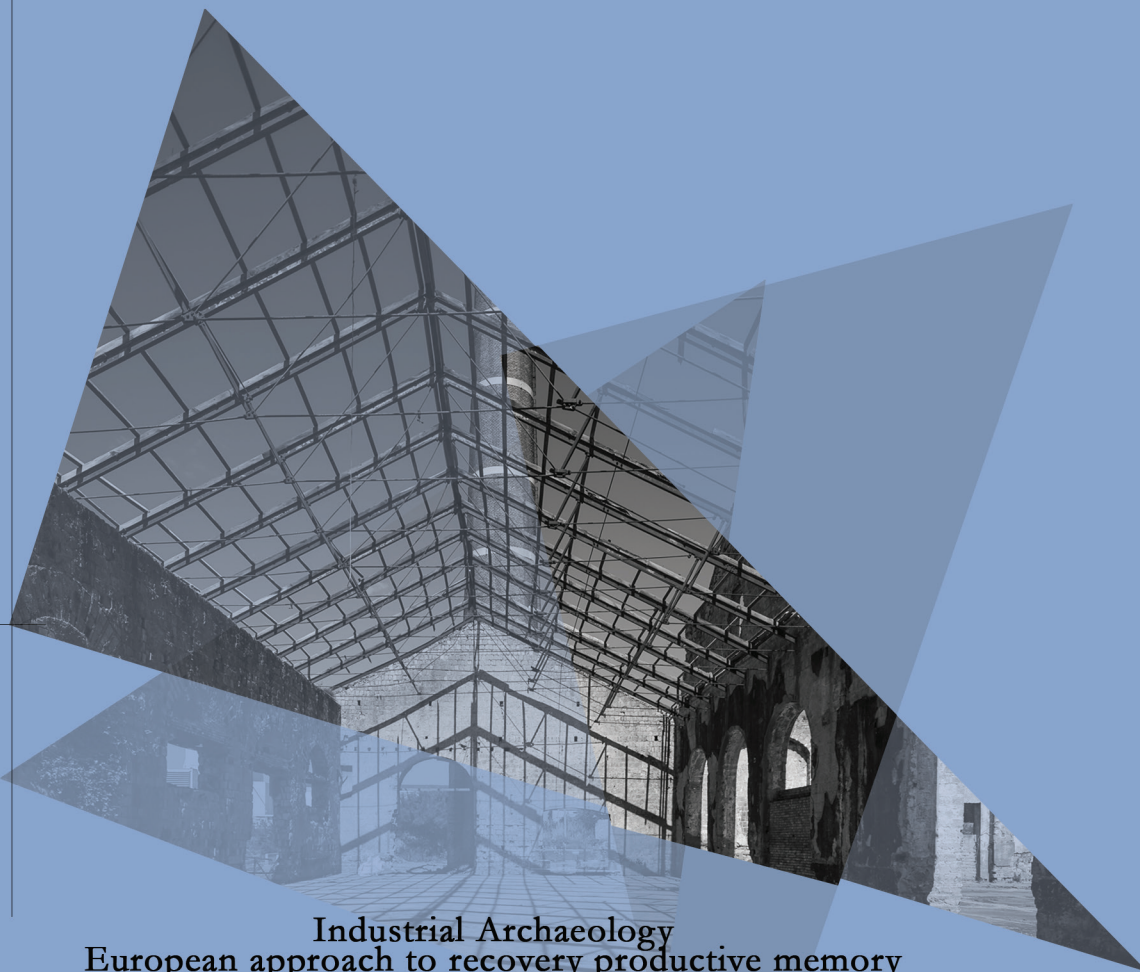


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Industrial Archaeology
European approach to recovery productive memory

Mara Capone, Noelia Galván Desvaux

Luis Agustin-Hernandez, Lucas Fernández-Trapa

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BLENDDED INTENSIVE PROGRAMME

Industrial Archaeology. European approach to recovery productive memory

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Digital model

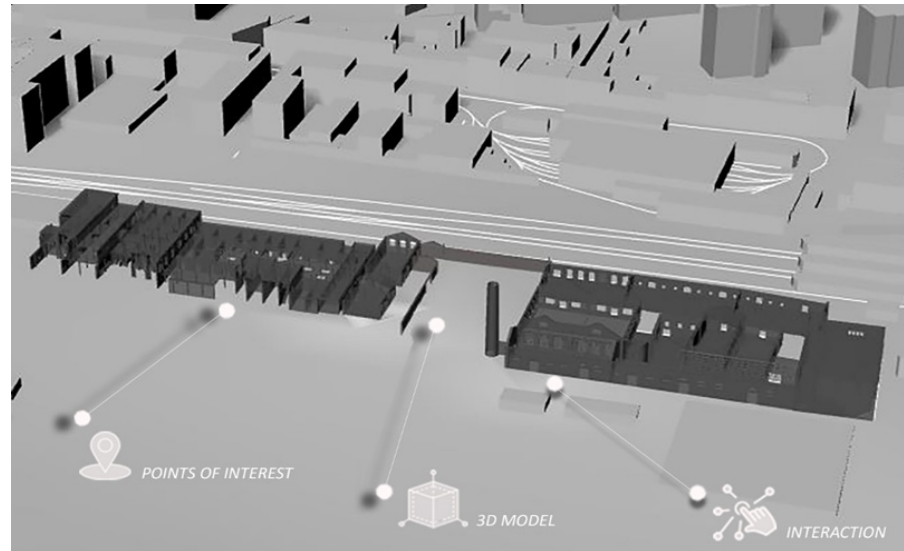
Digital Open Data. Evolution of the digital model for the community

Marika Falcone, Giovanni Angrisani

Introduction

The digitalization processes and disclosure strategies represent a fundamental aspect for the conservation and valorization of industrial heritage. The use of the most modern software and the possibility of building digital models, *mimesis* of reality, aided by technologies has undoubtedly contributed to provide new opportunities for documentation, conservation, and regeneration also in the field of industrial archaeology. Undoubtedly techniques such as terrestrial laser scanners, mobile mapping scans, terrestrial and aerial photogrammetry are examples of methodologies that allow the creation of digital models that can be explored through interactive web-based platforms. These three-dimensional data management platforms offer a variety of options, from archiving, rendering and annotation tools to more advanced features, such as point cloud alignment and/or scan registration. Furthermore, it is possible to integrate data from different sources with the possibility of creating specific virtual tours and highlighting the different historical phases as well as the changes of the site through an immersive virtual space in which users can interactively experience the present and the past. The possibility of building a digital model and exploring it within it calls for fascinating and interesting experiments that until recently were unthinkable. In this context, the promotion and exploration of industrial heritage opens new scenarios that make it possible to explore places that are not always accessible due to multiple reasons (Spallone et al., 2015;

Fig. 1. The research methodology for the Corradini industrial complex in Naples (image: M. Falcone, G. Angrisani).



Bakhmut et al., 2021; Gabellone, 2023; Fascia et al., 2024; Gaspari et al., 2024). This intertwining of technology and enjoyment has led to a new model that changes the way users interact with industrial heritage, offering opportunities for learning and exploration. Starting from this assumption, the didactic, scientific and operational objective of the research carried out, within the Erasmus + KA131 Blended Intensive Program (BIP) project, on the industrial archeology complex of the former Corradini foundry in Naples has privileged the methodological and procedural aspect to reread through the construction of digital interpretative models the characteristics of the overall structure and the articulation of the individual parts to return a database capable of representing and communicating reality as well as the evidence of the diversified articulations typical of industrial archaeology [1]. In this perspective, the research on the former Corradini factory aimed to draw up, also at a cognitive level, a sampling of the volumes that highlighted the complexity of the place. Therefore, the study underlying the work of representation of the digital model set itself a dual objective: one

aimed at exemplifying a methodology aimed at analyzing, representing, and synthesizing the signs of reality through a cognitive strategy; the other aimed at the dissemination and use of the model itself. In the first case, a modeling phase has been conducted which, through photographic documentation, *eidotypes* and the cloud of reference points, was able to prepare the work for the next phase, that of fruition. In fact, alongside the modeling, has been developed a documentary *corpus*, based on analytical sheets accompanied by a descriptive report relative to each of the pavilions of the former Corradini industrial complex, necessary for the fruition phase. [2] (Fig. 1).

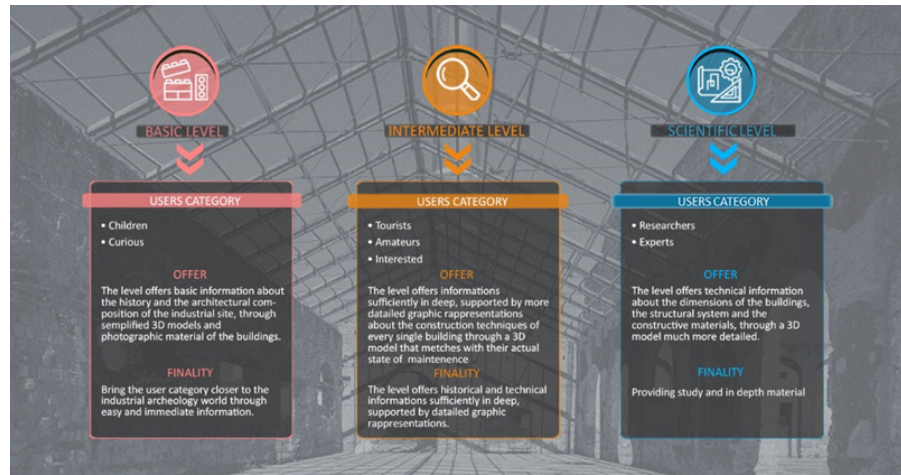
Three-dimensional modeling as a cognitive strategy

The use of three-dimensional digital models for the construction of a set of representations able of illustrating a site, an object or a project is an indispensable tool full of potential. These systems allow three-dimensional simulations that contain homologous, isomorphic and analogous properties, allowing, in a single digital representation space, “*the totality of possible vision mechanisms*” (Docci & Migliari, 2000; Derkach, 2023). This type of representation therefore has the aim of conveying the legacy of a place, giving the possibility of codifying the historical memory of a reality that is no longer visible today. The possibility of returning data in a 3D environment, in the field of cultural heritage, has led to a radical change in the interpretation of architecture in which it can be stated that three-dimensional modeling is identified as a cognitive strategy in which the different communication levels. In fact, it is possible to create different digital models with a different level of geometric/informative detail depending on the audience it is aimed at.

For this purpose, three different levels have been identified for the communication project, through which reading the multiple aspects of reality, that is three interpretation keys:

i) the basic level, aimed at children and the curious, which offers basic information on the history of architecture and uses a simplified three-dimensional model. These are simple solids made by extrusion and each

Fig. 2. The three-dimensional model as a cognitive strategy: three levels of knowledge (image: M. Falcone, G. Angrisani).



single solid volume is associated with a point of interest from which it is possible to access a summary descriptive sheet, which indicates: identification code, name, description and image.

ii) the intermediate level, aimed at tourists and interested parties, which offers sufficiently accurate historical and technical information supported by very refined graphic representations. In this level of knowledge, it is possible to explore the digital model which is characterized by a more detailed geometry compared to the previous level with the possibility of also accessing significant information relating to the materials, color or degradation phenomena that characterize the work. Finally, this level also includes association with multimedia content such as photos and video clips.

iii) the scientific level, aimed at researchers and, in general, at an expert public, which offers accurate historical and graphic documentation with a level of scientific detail. At this specific level it is possible to analyze the three-dimensional model in detail. For each different point of interest, it is possible to access specific documentation such as, for example, 2D technical drawings, more specific information sheets, even about construction techniques.

The objective of the research has been focused based on these parameters, i.e. the development of a project to gain knowledge of the industrial archaeological heritage of the former Corradini factory in order to recover the historical memory of this specific architecture.

In this sense, the project of knowledge has been organized for the former Corradini foundry into three levels, distinguished by type of user, level of geometric detail of the digital model and types of connected information.

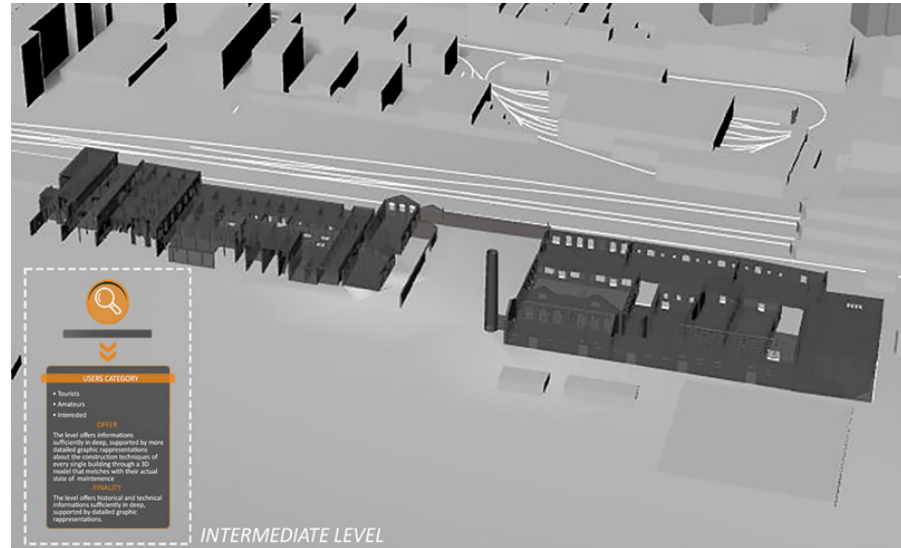
For this reason, it has been necessary to create three different models for the three different levels of knowledge:

- i) the basic level which offers generic information on the different buildings that make-up the former Corradini through a simplified 3D model made up of extruded volumes.
- ii) the intermediate level which offers somewhat detailed information on the construction techniques of each building through a 3D model which matches the actual state of conservation of the buildings.
- iii) the scientific level which offers technical information on the dimensions of the buildings, the structural system and the construction materials through a more geometrically detailed 3D model.

Therefore, for the basic level it has been necessary to model all the buildings in the area as simple volumes and draw up a sheet for each of them showing: name, function and photographic reference. For the intermediate level it has been necessary to model the buildings according to the current state of the art (without walls, without roofs, etc.) and prepare for each building a sheet with the information from the previous level and in addition a description of the construction techniques and photo on the state of conservation.

Finally, for the scientific level the basic model remained the same as the intermediate level with detailed modeling only for some buildings, in which some elements of the structure have been modeled (for example the trusses) and some functional elements such as ovens for cast iron. For each building it is necessary to prepare a sheet containing the information of the previous level and in addition some sheets with technical drawings

Fig. 3. Intermediate level of knowledge of the former Corradini in Naples (image: M. Falcone, G. Angrisani).



and sheets containing a graphic representation of the construction techniques (Fig. 2).

A three-phase operational workflow.

Management, reconstruction and communication of the former Corradini industrial area

The architectural, constructive and formal characteristics that today define the value of the former Corradini foundry as an episode of industrial archaeology, unique in its kind, are the result of the numerous transformations that have occurred over time. In this perspective, starting from the analysis of historical data and archive documentation, a valid support for the knowledge of the morphological evolution of the site, a series of information was deduced relating to the transformations that have affected the area over the years, which have allowed to validate the modeling phase.

Considering, in particular, the transformations that affected the industrial area during 1900, the phases relating to the temporal configuration of the

past and present were set. In fact, to fully grasp the complexity of the place and to interpret the sequence of stratifications and transformations that over time have led to its current configuration, it was necessary to define a methodological research process as well as a historical formative process that generated it.

The research line has developed into an operational workflow divided into three main phases.

In the first phase, it was necessary to systematically plan and organize the collection of bibliographic and archival sources relating to the knowledge of the characteristics of the buildings (historical information, stylistic characteristics, typological structure). For the historical analysis and archival research, the consultation of textual sources, general plans of the area, graphs relating to the characteristics and construction techniques of the individual buildings, maps and historical photos was fundamental. These sources have provided a general framework of knowledge of the area with respect to the context in which it is inserted, and, at the same time, have allowed a first evaluation of the buildings that characterize it in constructive and functional terms.

This phase was followed by cataloguing, digitization and reconstruction of the digital model. In this area of graphic restitution, a three-dimensional model of the area under examination was specifically developed in which both the archive sources and the data deduced from the aerial photogrammetric survey were integrated (Azzola et al., 2019). Therefore, some pavilions of the industrial area were examined in depth in the 3D space as they were transformed or completely collapsed with the aim of transmitting and disseminating a broader knowledge of the industrial heritage with an “intermediate” level of information (Fig. 3).

Finally, the third and final phase was dedicated to the dissemination and use of the digital model. In this step we made use of the help of web platforms that allow an immersive experience accessible to all users. The functions that these platforms integrate within them allow the exploration of the 360° model on which an information system has been connected to the different scales of representation.

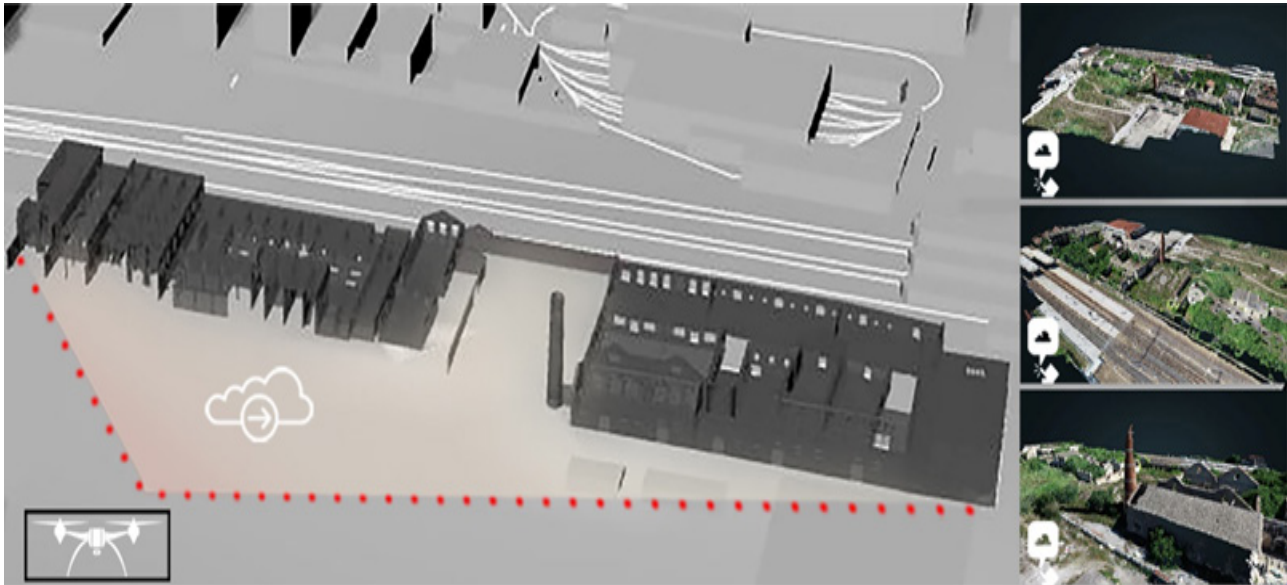
Fig. 4. State of some pavilions of the industrial complex of the former Corradini foundry in Naples (image: M. Falcone, G. Angrisani).



The case study. The former Corradini foundry

The methodology described was applied to the case study of the former “Corradini” steel industrial complex. Located in the east of Naples, precisely in San Giovanni a Teduccio, Corradini preserves the historical memory of what was one of the most important steel mills and arms factories in Italy. Founded in 1882 by the Italian-Swiss entrepreneur Giacomo Corradini who expanded the pre-existing eighteenth-century metallurgical plant, the factory expanded to an area of about 6000 square meters counting on a workforce of about 7500 workers.

Initially, the structure occupied only the first pavilion, but with the arms race of the late 1800s it was able to expand becoming a specialist in the production of heavy weapons. Subsequently, the government decided to cut funds on the production of weapons, so the company fell into crisis, until in the early 1900s it was purchased by the Officine Meccaniche Milanesi. This slow recovery, however, was short-lived, until 1949, a year that marked a progressive collapse of activities following the damage suffered by the Second World War, and which gave way to an inevitable



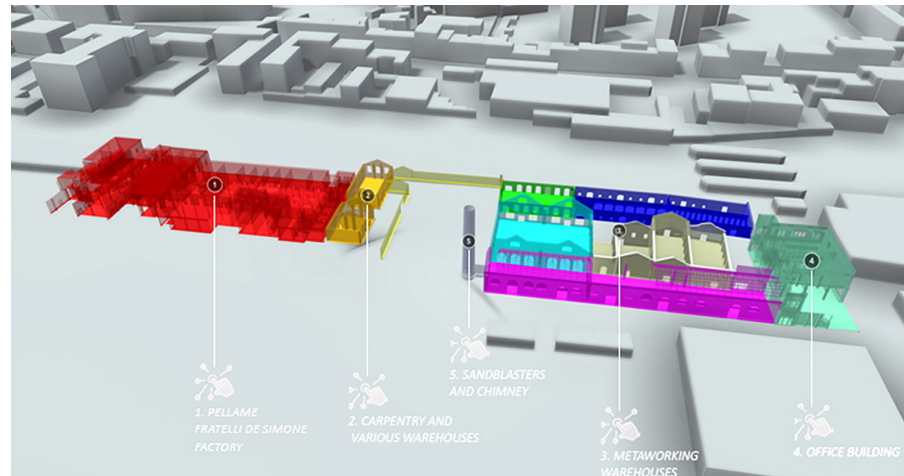
decline and the abandonment of the entire complex that still persists today (Fig. 4).

From the 3D model to the digital fruition model

In this specific case, the working group focused on the configuration of the current state of the site. In order to conduct an appropriate survey of the industrial complex of the former Corradini foundry and achieve the above-mentioned objectives, the modelling was carried out by simulating an “intermediate” interpretation. In applying this level of communication to the digital model, it appeared necessary to prepare multidimensional documentation for reading the current state. Therefore, a series of 3D modeling operations have been carried out in the *Rhinoceros 3D* application necessary to understand and document the industrial site in its entirety and in its transformations (Capone et al., 2015; Moore et al., 2018). The tools used by the software dedicated to this modeling are usually vector type, and find wide versatility through sets of basic 2D and

Fig. 5. From acquisition to 3D modeling. Integration of 3D survey data and archival data (image: M. Falcone, G. Angrisani).

Fig. 6. Visualization of the multi-layer 3D model of the former Corradini in Naples in the Sketchfab application (image: M. Falcone, G. Angrisani).



3D shapes (primitives) that can be used to create complex objects with editing, assembly and deformation operations. Other possible operations are manual manipulations, addition, subtraction and intersection operations, extrusions, path extrusions and revolutions based on two-dimensional profiles. In addition, given the complex articulation of the site, in addition to the procedural modeling, it was considered necessary to integrate some information that made it possible to expand the geometric conformation of the site, importing the point cloud, acquired with aerial photogrammetry, directly into the project environment. This also allowed a constant control of the third dimension by configuring a punctual information system (Remondino et al., 2017) (Fig. 5).

The next step was to export the 3D model in .obj to proceed with the use of the same.

For this operation, the Sketchfab program was used, an interaction platform in which it is possible to publish, share, view and edit three-dimensional models in real time (Flynn, 2019). With this software it was possible to edit the entire three-dimensional model by grouping, with color display graphics, the individual buildings of the industrial complex according to their intended use prior to the decommissioning after the



Fig. 7. Visualization of the point of interest of layer 1: “Fratelli de Simone” Leather Factory Building (image: M. Falcone, G. Angrisani).

Second World War. To date, the complex of the former Corradini is in a state of conservation of the buildings of complete decay. The prolonged abandonment due to decommissioning, the lack of conservation and protection interventions and the continuous exposure of the structures to environmental agents have led many of them to partial or total collapse. Therefore, also on the basis of bibliographic information, five layers have been defined: i) “Fratelli de Simone” Leather Factory Building, the oldest building of the entire complex, dating back in some of its structures to the end of the eighteenth century; ii) Carpentry and various warehouses, with some buildings with tuff supporting structure and iron and wood trusses with double-pitched roofs; iii) Warehouses for metalworking, of which some fragments remain; iv) Offices, a building that dates back to the early 1900s; v) Sandblasting machines and chimney, the latter completely isolated from the complex (Fig. 6).

Finally, a point of interest has been prepared for each individual layer, i.e. a portion of the lot studied and deepened by means of a detailed information sheet (Figg. 7,8).

To support the implementation of the model, space was also given to the point cloud not only as a support for three-dimensional modeling

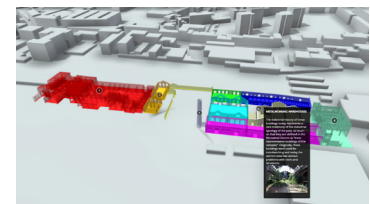
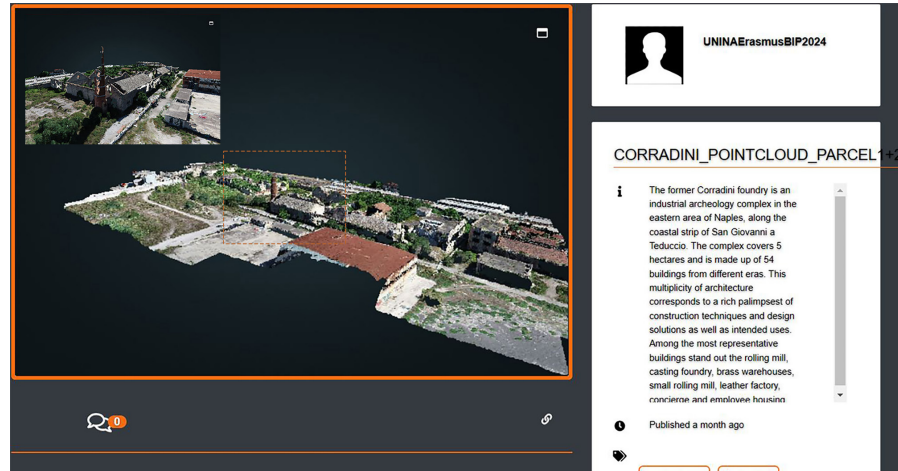


Fig. 8. Layer 3 Point of Interest Visualization: Metalworking Warehouses (image: M. Falcone, G. Angrisani).

Fig. 9. Visualization of the point model in the PointBox application (image: M. Falcone, G. Angrisani).



but as an additional information element of the cognitive project. The point model, in fact, has been uploaded to the PointBox online platform, accompanied by a brief description of the complex and viewable at 360° by any user via link (Fig. 9).

Conclusion

The research carried out as part of the Blended Intensive Programme (BIP) with the case study of the industrial complex of the former Corradini Foundry illustrates a methodology for the digitisation of disused industrial heritage with the aim of developing a process of knowledge and use for a wider audience, i.e. the community, with a multi-key level of information. At the same time, this work highlights how the integrated use of digital models and open-source platforms have been innovating issues such as regeneration, accessibility and preservation for some time now. This integration between real and virtual data allows for a total immersive exploration of the actual state of the architecture. In the wake of modern platforms of use, we reasoned on the best methodology to be used to create a shared system with detailed and timely information of the industrial complex. The decision to use digital visualization

through the three-dimensional model inserted on the web platform has made it possible to make the contents of the research explicit and above all to ensure accessibility and immediacy of the information as well as to verify possible updates of the data itself. In this way, the link between the 3D model and the information sheets constituted a multi-layer model, allowing the description of the complex in the different periods and according to the different transformations undergone. The *information* derived from the analysis, survey and modeling operations has flowed into the multi-layer system. With simple processing tools, it was possible to communicate and share data at different levels of information with web users. In fact, by using these communication platforms such as *Sketchfab* and *PointBox*, it is possible to obtain the widest dissemination of the results obtained. In addition, visual documentation and dissemination to a wider audience will be fundamental in the future for important repercussions on the economic process both from the point of view of cultural tourism and the management of the territory itself. In fact, in the future, research will be functional to the enhancement of the place and will be an important resource in possible regeneration programs on an urban scale with a social impact on the territory and on the citizens who will be the first to read the transformations of the places they love.

Notes

[1] We would like to thank all those who participated in the different phases of the Erasmus + KA131 Blended Intensive Programme (BIP) project on the industrial archaeology complex of the former Corradini foundry in Naples. In particular, thanks to all the students involved in the research phases.

[2] Although this contribution is the result of a joint work, G. Angrisani is the author of paragraph 4 and M. Falcone is the author of all the other paragraphs.

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CHAPTER 4

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The book collects the contributions of an interdisciplinary work carried out during a BIP (Blended Intensive Program) funded by the European community. The topic is related to the abandoned industrial sites that are protected for historical interest. Starting from a comparison between the different approaches based on the study of the best practices and the different methods and tools of analysis, some premises have been defined for the representation of the site and the development of transformation hypotheses for reusing of the ex Corradini in S. Giovanni. Stimulating the cultural debate, dealing with different cultural realities, defining replicable methodological paths are the main objectives of this work.



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