Silent cultural heritage: digitalization of the archaeological artefacts of Santa Lucia di Mendola for an interdisciplinary reconstruction

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Abstract

The conducted research investigated the site of Santa Lucia di Mendola near Siracusa. The site was chosen because it is characterized by "an absence", the Norman basilica, whose decontextualized architectural and sculptural remains are only partly visibly exhibited in museums, others are "invisibly" kept in stores.
The investigation has involved close interdisciplinary collaboration and is based on archive studies and on geometric and formal studies of survey products.
Surveying operations were conducted with high precision techniques which provided a digital scenario of the cultural object. The achieved results make it possible to virtually disseminate the "silent" museum heritage, not to consign it to oblivion and set up a system for knowledge protection and cultural dissemination.

Keywords

Cultural Heritage, Survey, 3D models, Communication, Digital technology

1. Museum Dissemination: extended cultural heritage and knowledge (R. Valenti)

As the Siena Charter 2.0 established in 2016, Italian museums represent a relevant component of the Italian landscape, being in the majority of cases connected to the territory they belong to.

A Museum is a place which collects works of art belonging to the history of that specific territory, in the social imagery it represents the context which, diachronically and synchronically, preserves the traces of the past. Museum dissemination involves reasoning about the different cultural and territorial connotations in an attempt to testify specific identities and the contextualized relations with a specific historical period.

Starting from the museum and from its cultural heritage, the present approach has opened the way to a cognitive path which takes into account the objects which are collected in the museum connecting them to their natural environment.

The conducted study connects the territory, both physically and temporally, using the available tangible and intangible cultural heritage, with the significant contribution of institutions with different cultural specializations which have responsibility for their safeguard.

In particular, the research has involved collaboration with the Galleria Regionale of Palazzo Bellomo, the Regional Pole for Archaeological Museums and Sites in Siracusa – Regional Archaeological Museum Paolo Orsi – Eloro Archaeological Park, Villa del Tellaro and the University of Catania – Laboratory of Representation. A protocol of agreement was signed between the University and the Galleria Regionale of Palazzo Bellomo. Regional Institutions gave proper authorizations.

The involvement of the specific stakeholders is a necessary requirement for an effective assessment of the study in the applied field.

The close cooperation has led to an interdisciplinary research as proposed by the Faro Convention (article 13, 27 October 2005) about "Cultural Heritage and knowledge" (recently implemented in Italy).

Historical studies conducted in the Institutional Archives and the formal geometrical studies on the products obtained with highly

precise survey techniques and methodologies produced the digital scenarios of cultural heritage. Its purpose was the implementation of knowledge as an instrument for the protection of historical goods and for the visual dissemination of culture.

The applied methodology represented a valuable instrument for the historical understanding of collected or non collected goods in museums, necessary to go beyond their inevitable decontextualisation and to adopt new approaches towards knowledge.

With reference to architectural fragments, visibly (exhibitions in the different rooms) or invisibly (safely stored) accommodated in the museum and coming from archaeological sites close to it, their unity was recomposed through a historical and geometrical interpretation which established any possible relations with the territory and its history. (Fig.1, Fig.2)

Fig. 1: Architectural fragments stored in the Galleria Regionale of Palazzo Bellomo.

Fig.2: Architectural fragments stored in different museums.

The distance between place of origin and place of storage, the fragmentary exhibitions and, above all, the fact that some architectural fragments are not on display, reduce scientific knowledge and dissemination.

Actually, the study focuses on "invisible" heritage (not for its real absence but rather for an objective difficulty exhibiting it in appropriate areas) and on "absent" heritage in the territory and, also, on archaeological sites because after excavations the objects were separated from their original context in order to protect them from destruction or degradation.

A "silent" heritage which, introspectively kept in the form of fragments, tells of a past which has to be reconstructed and recontextualized in order to become at the same time "Text and Archive", accessible and visible to everyone.

Museum reality becomes a pretext for the development of an increasingly integrated knowledge into the overall cultural heritage and for the production, with digital visualization, of an extended form of communication directed to an interested community (Valenti & Paternò, 2017).

The value of stored cultural heritage is often so high to prevent their complete perception and even their being saved in stores deprives the community of an extended interpretation of its own past, losing sometimes pieces of historical memory.

Again, museums in their ceaseless innovation integrate their traditional responsibility for the protection of cultural heritage with their function of production and promotion of culture.

In such a context, the museum becomes a dynamic and cooperative place where new analysis and communication methodologies can be experimented with the support of digital technologies (Dall'Asta E., et al., 2016; Clini P., et al., 2017; Nespeca R., 2018).

Today in particular, citing Paolo Clini's words «in this moment of great silence, everything rotates around the key word "digital", which is to say, around the possibility of materialization of our tangible heritage in order to transfer it to a different reality from our usual one» (Clini, International Museum Day, 2020). The purpose is the creation of new communicative scenarios for museum goods.

It means, in the specific case, not to consign the "silent" heritage to oblivion reassembling it with the help of digital technology, integrating the scientific fundamentals of history and archaeological surveying.

The approach has a dual purpose: digitalization, on one side, helps sharing online partly visible and partly "invisible" information about our heritage; on the other side, it makes scientifically collected records available to the community through their virtual showcasing in the complex challenge of their recontextualization.

1.1 Drawing and virtual reconstruction: the cultural experience

Digitalization of fragments, with the production of copies perfectly corresponding to

the original, is functional to formal and geometric studies for the reliable and motivated composition of a unity, with the final purpose of reconstructing the whole building with its parts.

Therefore, not a copy for its own sake, to be virtually explored as a unique piece in the simulation of a virtual museum tour (the only real possibility in the present emergency) rather, a copy to be explored in order to study its geometric and expressive shape, to find out repetitions and similarities for the aggregation of elements and to overcome their fragmentary condition.

A methodological approach which starts from "visible" and "invisible" archaeological finds in order to go beyond, towards the reconnection with the territory and the recontextualization, though virtual, of fragments in their original place.

The final processing phase becomes museum heritage too, almost an added value to the educational and teaching museum social role.

This, of course, fulfils the function of linking the museum to the territory and raises awareness in the fact that «valorizing cultural heritage doesn't mean only to protect its tangible elements, it rather means to entrust it to the community. All actions taken for its protection, from the material condition to the increase of knowledge, make sense if recognized on a social level, favoring cultural dissemination: knowledge, competences and values of a specific society in a determined historical period» (Ippoliti & Albisinni, 2016).

The case study is Santa Lucia di Mendola in the province of Siracusa. In that area a great number of fragments have been discovered and they all belong to the Norman basilica dating to the 12th century, conceived as an "absence" since the 17th century, after the catastrophic earthquake in 1693.

Paolo Orsi, Director of the National Archaeological Museum in Siracusa, on 6 July 1890 wrote an epistle to the Royal Commissioner for Antiquities and Fine Arts in Sicily where he underlines the need to accommodate in the museum of Siracusa some artefacts «worthy of being saved» because staying *in locu* would have caused their «continuous degradation», also to avoid «their hopelessly getting lost, damaged, transformed into lime and plastered» and to guarantee a kind of protection.

Actually, some ruins of the glorious Norman monument represent the "silent" heritage studied in the present research. Only a few pieces are exhibited in the rooms of the Galleria Regionale of Palazzo Bellomo, others are partly stored in the

same museum and in the Museo Civico in Noto, other pieces are still *in locu* under severe degradation processes. (Fig.3)

The combination of archive research with

Fig.3: Architectural fragments in loco.

digital survey technology has produced a real "cultural experience" where digitally transcribed fragments converge into the reconstructive hypotheses supported by documents and iconographic materials.

2. The case of Santa Lucia di Mendola for a project about the digitalisation of museum heritage (C. L. Aliano)

2.1 Santa Lucia di Mendola and the Norman presence

The medieval site of Santa Lucia di Mendola is situated at about 40Km from Siracusa, not far from the Greek remains of *Akrai* but historically connected to the ruined Ancient Noto. It shares with Ancient Noto, whose prestigious remains are on Mount Alveria, a destiny of rise and disappearance as a consequence of the well-known seismic event of January 11, 1693 which modified the landscape of eastern Sicily and the story of its cultural heritage.

Santa Lucia di Mendola is the name of a little district which, in the course of the 12th century, saw the construction of an Agostinian abbey, later Benedictine, connected to the Norman dynasty of the Great Count of Sicily Roger I. The priory of S. Lucia de Montaines was founded in 1103 by a group of French monks coming from the abbey of Santa Maria di Bagnara in Calabria. The historical literature considers it as a *monasterium extra moenia* (monastery outside the walls of the city) in Ancient Noto (Fazello T., 1560; Pirri R., 1733).

Today, the place doesn't maintain *in situ* any architectural memory of the priory whose trace probably is partly covered by a small church built in the 18th century and modernised in 1960s. (Fig.4)

Fig.4: Archaeological site of Santa Lucia di Mendola

In the 12th century the Norman building was erected near a pre-existing paleo-christian structure, evidence of the strong historical and religious value of the area. A rupestrian proto-church with its annexed hypogean chapel and several underground burials gave birth to a cluster of buildings connected to the worship of Lucia Romana, different from the Syracusan saint martyr. In contrast to the paleochristian remains carved out of the stone, only a dozen of burials *subdivo* (open air) of Benedectine monks still exist in the Romanesque abbey church and its monastery.

Several excavations which took place over a long period of time (1948, 1951, 1995) have given back a big amount of Norman architectural fragments, without detecting, though, the exact place of the basilica foundations. The comparison between stratigraphic figures and documents made it possible to hypothesize the orientation of the building plan and some of its artistic characteristics (Agnello S.L., 1951; Agnello G., 1952). It is, however, certain that the abbey plan was near the rocky carved spur incorporating in the worship the pre-existing paleochristian small church, characterised by the presence of a *baptisterium* (baptistery), carved out of stone as well. The worship connected to the saving power of water is an integral part of the hagiography of the Roman Saints Lucia and Geminiano, worshipped there. The consultation of the Pastoral Visits, which took place during the first half of the 16th century, witnessed the continuation of a specific ritual in the presence of a "miraculous" pool of water.

Historical literature with the texts of Tommaso Fazzello, Vincenzo Littara and Rocco Pirri has

often provided useful information about the site, without completely dispelling doubts regarding the real features of the building, both in plan and elevation.

The cross-referencing of these partial data with one of Jean Houel's illustrations dating back to 1777 which represents the post-earthquake ruins of the basilica (Gringeri Pantano F., 2003) allowed Aldo Messina (Messina A., 2007; Messina A., 2008) to hypothesize a longitudinal three-aisled plan with crux immissa (Latin cross). (Fig.5)
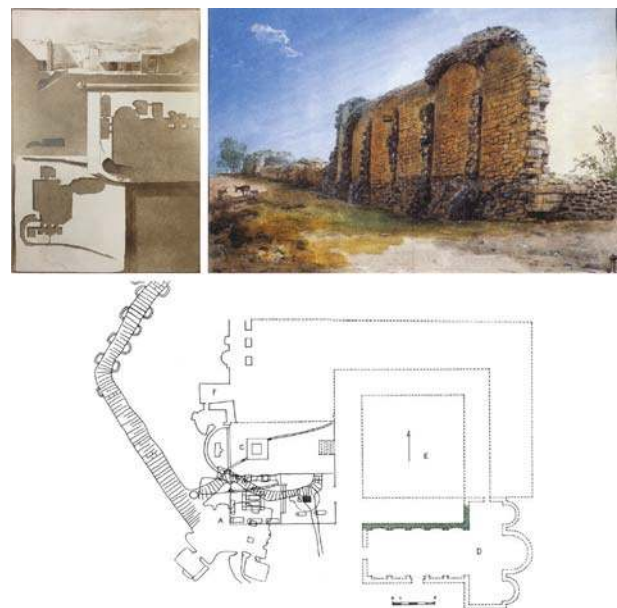

Fig.5: Jean Houël, plan of the rupestral complex and «ruins of a boundary wall in Santa Lucia seen from the other side» (Gringeri Pantano F., 2003)

The reconstruction hypothesis takes into account some data coming from the enlargement works of the small modern church, still existing, made in 1966.

If in the general scenario of religious architecture of Norman times in southern Italy, models characterising the building sites of the different regions clearly come out, it is not the case in Sicily. So, it is hard to find "key monuments" which may lead the research about the most widespread typologies (Belli d'Elia P., 1994; d'Onofrio M., 1994). So architectural decorations consisting of about a hundred of fragments represent the only historical and artistic evidence able to provide information about an absent site, such as the Norman one.

The pieces are stored in different warehouses belonging to Regione Siciliana, such as the Galleria Regionale of Palazzo Bellomo in Siracusa and the

Civic Museum of Noto and also in stores of the Archaeological Park in Siracusa, Eloro, Villa del Tellaro and Akrai. However, it is worth remembering here how they cannot be considered definitive, because of the dismemberment of the collection which also misses a definitive cataloguing. Only a few fragments are kept in the Galleria Regionale of Palazzo Bellomo.

2.2 The architectural and sculptural fragments

The plastic decorations of Santa Lucia di Mendola are represented of several architectural fragments such as capitals, frames, small anthropomorphic heads, parts of jambs, decorated portal keystones and different arcades for the coronation of the Norman church. These elements, in particular, represent the most renowned part of the collection thanks also to the publication of a book by the archaeologist Giuseppe Agnello which still represents a reference point for the discipline (Agnello G., 1927-28; 1955; 1952-57).

An accurate documentation and photographic analysis made it possible to draw up a new list, even if temporary, of 33 arcades. However, a direct analysis has been conducted only on a small number of them. The mentioned arcades are made of local limestone blocks, decorated with a jutting simple or graded ogival vault and with phytomorphic, zoomorphic and anthropomorphic scenes. (Fig.6) There are jamb fragments and also a fragment of a historiated archivolt with plastic characteristics similar to the Byzantine style.

Fig.6: Examples of blind arcades

Even if the fragments of Santa Lucia di Mendola are considered the work of a smaller local artist with a *ductus* (stroke) not very refined and somehow uncertain, they give a chance for an extraordinary case study covering a period of time almost wiped out by the devastating earthquake.

The analysis carried out on the fragments can be quite willing inserted into the lively academic discussion about Norman sculpture and the circulation of models tout court, in the territories included between England and the Holy Land.

As for the Norman south, the sculptural heritage of Santa Lucia allows a type of investigation alternative to the most renowned remains of the period, in Palermo, Cefalù and Monreale. If the mentioned sites say of a direct patronage of the Hauteville family and then of the Hohenstaufens, Santa Lucia di Mendola gives back parts of a disappeared artistic world representing "local" craftsmen and models too, evidence of stratigraphies and building sites absent by now but still able to tell ways and characteristics of the circulation of models opposed to the novelties of the "centres of power" and to the local persistence of the Byzantine tradition and, perhaps, echoing the *Longobardia minor*, represented by the motif of double-grooved ribbons and by wreaths sheltering zoomorphic figures inside medallions (Gandolfo F., 1999; Gandolfo F., 2001).

The analysis starts from a necessary comparison with other sculptural fragments coming directly from Ancient Noto. Here, archaeological excavations conducted in 2007 in the area of the Royal Castle discovered the building of San Michele "al Castello", considered a possible palatine chapel of Norman times. Surprisingly, the same decorative models characterised by the presence of the well-known motif of the double-grooved ribbon and/or of the housed wreaths are being repeated there. The jamb fragments of Santa Lucia, even if of a less valuable quality, are then in relation with at least three sculptural artefacts coming from the mentioned excavation area in Ancient Noto: a jamb fragment, part of a lunette

Fig.7: Architectural fragments of San Michele al Castello, Ancient Noto, 12th century: stores of the Civic Museum in Noto.

with ogival arch pertaining to a portal and a block of apsidal coronation. (Fig.7)

The comparison between the parts confirms the iconographic models of diffusion at a local level and opens wider paths which overcome the interpretation of a simplified "Byzantine ancestry" as the persistence of an almost rural local tradition. It is sufficient to connect, for some common elements, the artefacts coming from Noto with others belonging to the portal of the Church of S. Agata al Carcere in Catania, to understand how it can be considered «one of the few clear cases of plastic relation with the Holy Land, in particular with the archivolt of the Holy Sepulchre in Jerusalem» (Gandolfo F., 2001).

Going back again to the sculptural fragments of Santa Lucia di Mendola, further confirmation of the importance of the local decorations is offered by a possible comparison with the decorative motif of the arcades with some carved slabs coming from the façade of the Chapelle Sainte-Paix in Caen where simple but amazing zoomorphic figures appear: «It was not uncommon among Norman sculptors to decorate walls with sculptures similar to those in Fiquefleur, Quilly, Gaville Sainte-Honorine, Saint-Georges de Boscherville/Seine maritime» (Bailè M., 2005). (Fig.8)

In conclusion, it is possible to say that the studied fragments coming from a "minor" site are the narrative voice of Norman sculpture in Sicily; here the *bauplastik* represents a complex investigation where it is necessary to balance the different contributions of the persisting local tradition of Byzantine-Basilian ancestry with the novelties coming from the East and from the "Channel territories".

3. Knowledge and Communication: techniques for 3D digitalisation of archaeological heritage (E. Paternò)

The conducted research proposes the implementation of modern survey digital technologies and the mapping of archaeological fragments coming from the site of Santa Lucia di Mendola kept in the stores of the Galleria Regionale of Palazzo Bellomo.

It sometimes happens, as in this case, that the findings seem destined, for different reasons, to be hidden forever.

Digital media have an essential role to document and disseminate what is absent because it is the only method to promote an invisible cultural heritage.

As for the analysed archaeological artefacts, the experimentation of strategies of representation and communication is extremely important to promote what probably can never be visible and to give the artefacts themselves the chance of narrating the cultural content they bear.

Specifically, the present contribution analyses survey and 3D modelling techniques which have been applied according to a reverse engineering process for the virtual creation of artistic fragments.

3D modelling is the process starting with the acquisition of metric data and ending with the development of a 3D virtual model interactively visible on a computer screen.

Recently, the development of 3D survey techniques and instruments and the general decrease of prices have shown all the advantages offered by the possibility of documenting with 3D technology museum artefacts, completely transforming the practice of musealisation (Calisi D., et al., 2019;Koehl M., et al., 2019).
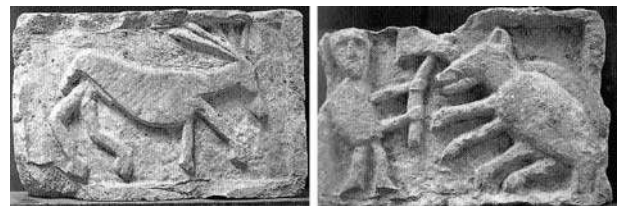
Fig.8: Carved slabs, previously Caen, Sainte-Paix Chapel, façade, Normandy Museum, collection of the Antiquities of Normandy Society.

The purpose of museology cannot be identified as the storing of artefacts within a museum but rather as the recreation of contents and the management of methods able to satisfy the requests of contemporary interactive users with the purpose of promoting virtual exploration and remote fruition.

Different professional figures are involved in this process of experimentation where it is necessary to create a connection between sources stored in different and/or inaccessible places so to virtually unite what is physically separated.

Virtual musealisation implements new ways of representation and fruition of information inserting the results deriving from long studies into the technological sector.

In particular, the research experimented image-based techniques based on passive sensors and range-based techniques based on active sensors, both able to digitalise the archaeological

artefacts with a high precision level and with accurate texture which display geometry, materials and degradation.

Firstly, it was necessary to start with a large-scale survey campaign to identify the urban context the single analysed fragments come from and to acquire the real metric data which can support correct reconstructive hypotheses. The open-air museum of Santa Lucia di Mendola perfectly suits TLS (Terrestrial Laser Scanning) technology and in particular the use of Leica ScanStation C10 which gives long range scanning acquiring a big amount of relevant metric data storage. Considering the morphological characteristics of the site it was necessary to have several scans and to distribute different targets for the subsequent alignement and automatic embedding of point clouds. (Fig.9)

Fig.9: Survey operations with Leica Scan Station C10.

Instrumental and phogrammetric survey have been used for the digitalisation of each archaeological fragment.

The artefacts kept in the stores of the Civic Museum in Noto and some of the artefacts saved in the stores of the Galleria Regionale of Palazzo Bellomo were scanned with laser scanner CAM2 Focus-Faro. This instrument combines ultra high accurate measurements with a small size making survey operations easier allowing fast and reliable motions in spite of the challenging environment. (Fig.10). In this case too, in order to survey each architectural element, it was necessary to position different targets within the area to be scanned for the recording and processing of acquired data.

Fig.10: Survey operations with Faro CAM2 Focus: stores of Galleria Regionale of Palazzo Bellomo.

Post processing was carried out with Cyclone software and each point cloud was exported in .pts file format to be imported on Geomagic Wrap which is able to convert a discontinuous point cloud model into a polygonal model of triangular meshes. After some appropriate retopology operations it was possible to get a 3D model free of distortions and correct from the metric and colorimetric point of view. (Fig.11)

Together with survey operations, a photogrammetric survey campaign was carried out using a digital camera. A great quantity of photograms were shot and from them extremely detailed 3D models were recovered, through SfM (Structure from Motion). To go on with data acquisition it was necessary to isolate, paying attention not to damage the artefacts and employing appropriate equipment, the items to analyse from the adjacent ones and gain the necessary space to allow survey operations. In particular, a camera tripod shot about 30 photos for each element completing a circular path taking shots about every 15-30°.

The architectural object, of course, always remains at the centre of a hypothetical sphere and the photos were shot always orienting the camera towards its centre, regularly changing inclination. At least three photograms were shot for each station point and it was necessary to make some adaptations such as guaranteeing good lighting, keeping the same exposure to avoid different lighting, turning the flash off, turning the automatic white balance off (Fig.12). The images

collected in the course of the survey campaign were processed with Agisoft Photoscan software.

The first processing phase is represented by the extraction of homologous points from multiple photos. During this phase Agisoft aligns the photos reconstructing their spatial position generating a sparse point cloud. In the next phase, the point cloud goes denser detecting the matching points and generating a dense point cloud. In the third phase the discontinuous model is refined in a continuous one made of triangular meshes. The definition of 3D geometry will depend on the number of triangulations obtained interconnecting points in the dense point cloud.

Colorimetric data acquired from photo images are associated to the obtained polygonal surface so to generate a texturized model.

The last phase or model resizing is the scaling of the model to its correct size using data acquired from instrumental survey. In particular, three markers are placed calculating three reference points in the photogrammetric model obtained through Agisoft Photoscan. The values of x, y, z coordinates based on the point cloud data already collected with 3D laser scanning and generated through Cyclone are assigned to each point. (Fig.13)

With 3D reproduction it is possible to obtain a detailed model recreating an almost identical copy of the original artefact without any physical contact with the artefact itself.

The obtained 3D model becomes vehicle for further information about dimensions (length, width, height) and shape. Textures applied to digital models, on the contrary, allow the detection of materials, techniques, conservation and/or alterations. It was also possible to create a digital archive where virtual copies of artistic fragments can be collected and made available for future studies and analyses. (Fig.14)

The role of a digital archive is also that of protecting artefacts avoiding degradation with subsequent manipulations.

However, the technical process described so far runs the risk of creating discredited and devalued 3D objects if logic contextualization is missing. Through 3D modelling it is possible to recreate the missing context in a virtual model and to insert documented artefacts to obtain intuitive virtual representation. (Fig.15)

Modern technology can contribute to cultural dissemination using different modalities and delivering an enjoyable immersive experience.
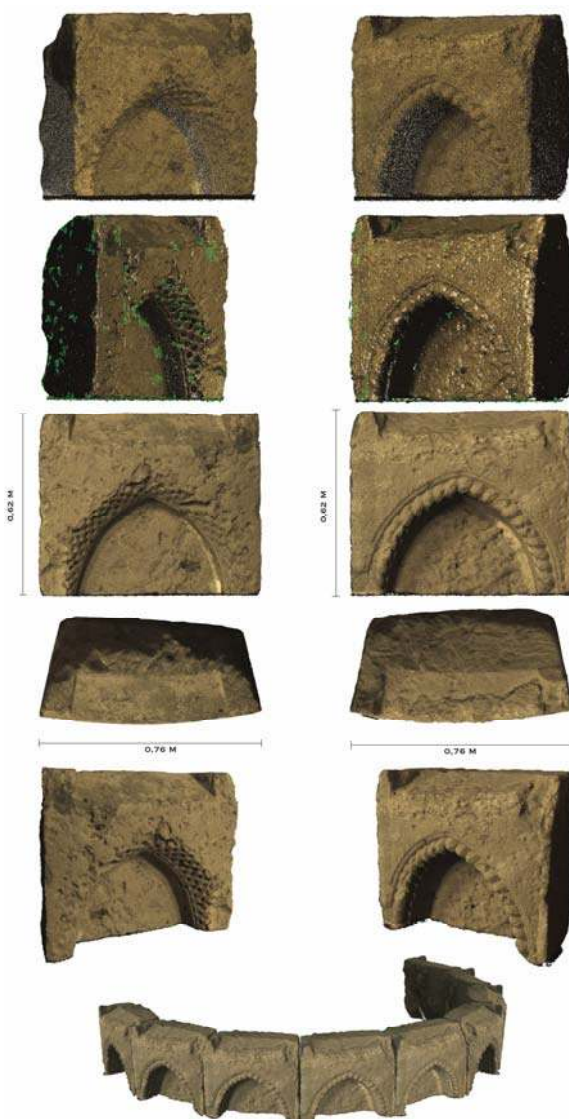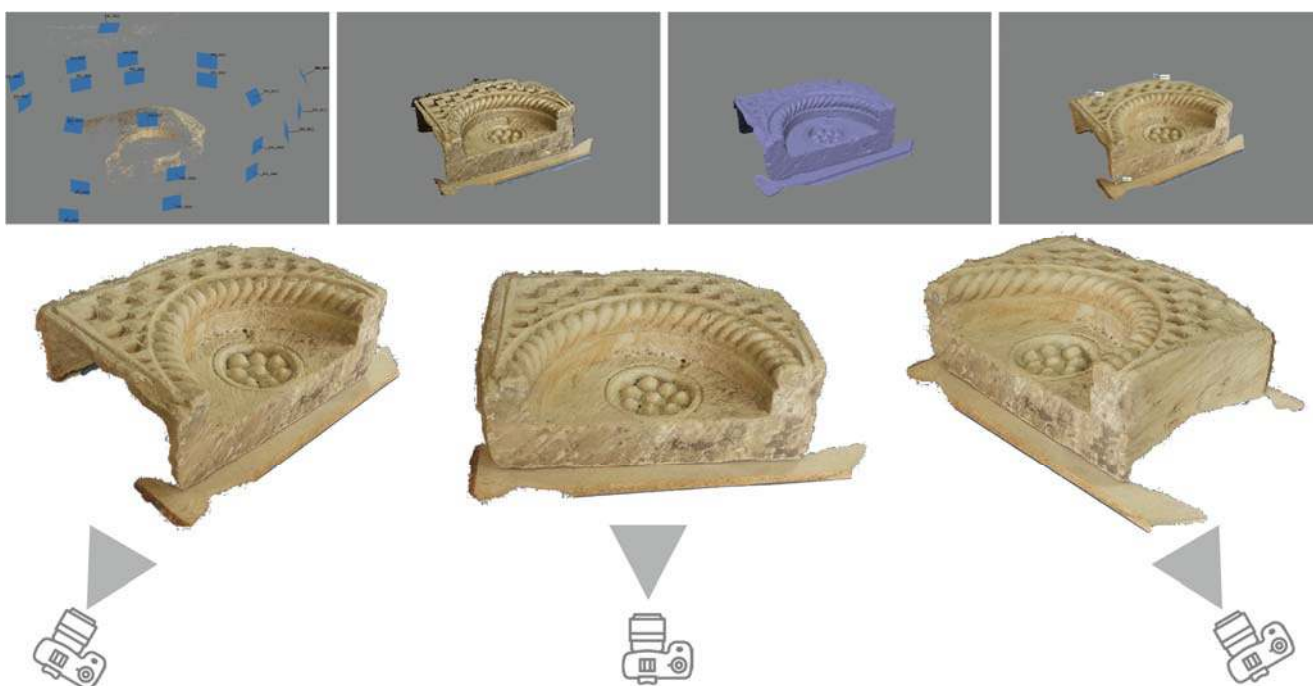

Fig.11: Blind arcades 3D processing: from point cloud to texturized model (stores of Galleria Regionale of Palazzo Bellomo.

Fig.12: Photographic surveying: photogram acquisition operations.

Fig.13: Structure of Motion: generative process of a blind arcade 3D model.

Fig.14: Photorealistic rendering of optimized and texturized models

Fig.15: 3D reconstruction of the Norman basilica with hypothesis about an insert in surveyed architectural fragments

However, the difficult task of cultural dissemination must be, first of all, preceded by a phase of data acquisition and interpretation. It is an articulated procedure especially in archaeology where few documents are available and reconstructive hypotheses are made comparing similar objects from the same geographical area, of the same historical period and from the same building site. Hypotheses must be supported and confirmed with scientific data and criteria.

In conclusion, reverse engineering process applied to research can work both in architecture and archaeology at any level, also thanks to the low price of some instruments and to the relative simple use of applied methodologies. Results are positive and really suitable for the involved disciplines. Moreover, 3D digital models are able to disseminate information about an artefact in a more effective way than traditional systems not only for the precision of the obtained product but also for the speed of data transmission. It is also worth mentioning the possibility of gaining, automatically or semi-automatically, 2D drawings (plan and section orthophotos) from 3D models which allow further studies and researches.

4. Geometric -morphological study for a reconstructive hypothesis of Santa Lucia di Mendola (E. Gazzè)

The research conducted on Santa Lucia di Mendola had the purpose of reconstructing an absent site through the analysis of the architectural fragments belonging to it.

The study of the architectural elements of the whole site started with the consultation of historical and archive documents providing information about the architectural characteristics of disappeared buildings and ended with digital data processing. The second phase dealt with an accurate analysis of digital data acquired from instrumental and photogrammetric survey of what is still available.

The research started from the study of known fragments related to Norman culture and to the disappeared priory. A fundamental role was attributed to the digital survey phase which investigated each fragment from the geometric, volumetric, morphological and physical point of view and which also allowed the cataloguing of fragments increasing knowledge about the whole collection.

Data processing related to the information extracted from the photographic documentation

allowed the detection of a considerable amount of fragments and the formulation of hypotheses about their position. Among the fragments there are portions of string courses, corbels, remains of an apse coronation, fragments of jambs, portal archivolts and blind arcades.

Particular attention received the study of these typical medieval elements which appeared in European ecclesiastical buildings in the second half of 10th century, decorating their façades.

Document analysis helped identify thirty-three blind arcades but only for eight of them, kept in the stores of Galleria Regionale of Palazzo Bellomo, it was possible to carry out survey operations collecting detailed information about their dimensions. Data updating was conducted according to Giuseppe Agnello's work (Agnello G., 1962) which analyzed only twenty-nine fragments. It was possible to add three more items to this list, identified thanks to a photograph offered by the Superintendence of Cultural Heritage in Siracusa. Another element, at the moment exhibited in a room of Palazzo Bellomo, is in fragmentary conditions. (Fig.16, Fig.17)

Fig.16: Archive photo of three blind arcades.

Fig.17: Architectural fragments exhibited at the Galleria Regionale of Palazzo Bellomo.

Attempts were made to find out similarities among the thirty-three blind arcades in order to define a classification scheme. Having, at first, identified four groups of decorations, each item was classified according to its specific group: anthropomorphic, phytomorphic, geometric, zoomorphic. However, it was soon clear that this was not the correct interpretation so they were classified by dimension.

The analysis started from the eight surveyed elements whose dimensions were certain (Agnello G., 1928).

The dimension common to all of them was related to 62cm in width. Images of the twenty-nine arcades were extracted from Giuseppe Agnello's text.

A non-bordered version of the fragment was created with Adobe Photoshop software. After fixing width at 62 cm, all the fragments, except those detected in the photograph of the Superintendence, were scaled because the image appeared excessively fuzzy and unreliable data would be obtained.

After image scaling, two great groups were isolated: the first containing arcades of 32-34 cm in height, the second with arcades of 39-43 cm in height. (Fig.18)

For all the scaled elements a certain margin of error must be taken into account.

This because of the natural degradation of fragments which externally may be damaged by the absence of portion of stone or because of the position the elements had when the photos were shot: they were not always perfectly placed in front of the camera.

After the classification scheme, an abacus was developed which made clear how arcades belonging to the two groups had distinguishable characteristics.

Shorter fragments present very easy decorations with geometric strings and frames.

Arcades are slightly pointed or rounded and only two of them have decorations in the central part, a polylobed rose.

Higher fragments have very different decorations the one from the other, with the exception of two of them which have an almost identical phytomorphic decoration.

In this group, arcades are ogival or pointed with total absence of rounded arches.

Fig.18: Cataloguing of the thirty-three studied blind arcades.

After examining all blind arcades, some hypotheses were formulated about their possible position. These little blind arcades, more or less jutting out, were placed as a continuous row of the building façade for a mere decorative purpose. Often associated with corbels, brackets or pilasters, they functioned as string courses or as coronations of buildings.

The consulted documents contained important information about the distributive scheme of arcades on the façade. In particular, in a document dated 1930, the archaeologist and Superintendent
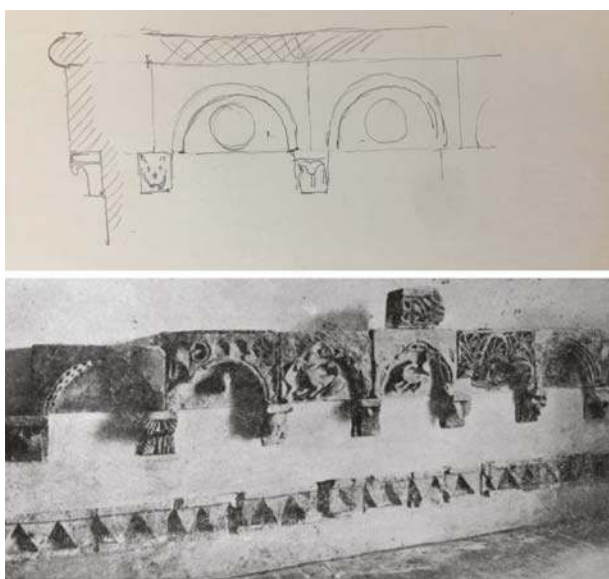
Fig.19: S.Lucia di Mendola: Bernabò Brea's reconstructive hypothesis of a portion in elevation of the basilica

of Cultural Heritage in Siracusa, Luigi Bernabò Brea, starting from the fragments discovered during archaeological excavations, drew a sketch of a possible reconstruction in elevation of the basilica. The drawing shows the arcades, joined one to another, supported by phytomorphic and anthropomorphic brackets surmounted by a frame decorated with triangles ("wolf teeth"). This reconstruction was proposed in 1950s in an exhibition at the Galleria Regionale of Palazzo Bellomo, as shown by an archive photo (Agnello G., 1955). (Fig.19)

After the analysis of each fragment, the research looked for references in order to understand the position of each element in the façade. It is extremely important to know that the study was conducted without any precise information about the design of the basilica both in plan and in elevation. The plan made by Aldo Messina, an expert in the field, was fundamental to

understand its dimensions (Messina A., 2008). (Fig.20) Missing a reference model of the Norman basilica, the adopted method was to look for buildings with similar geographical, historical and
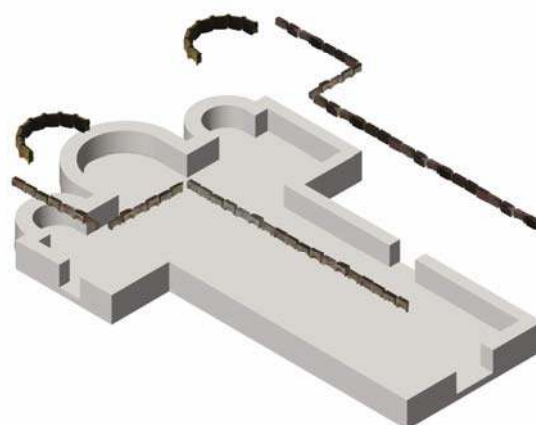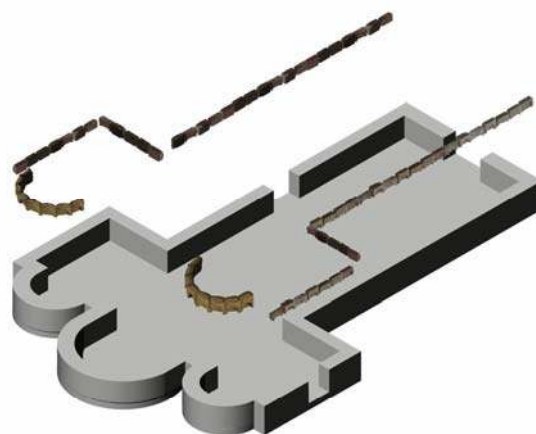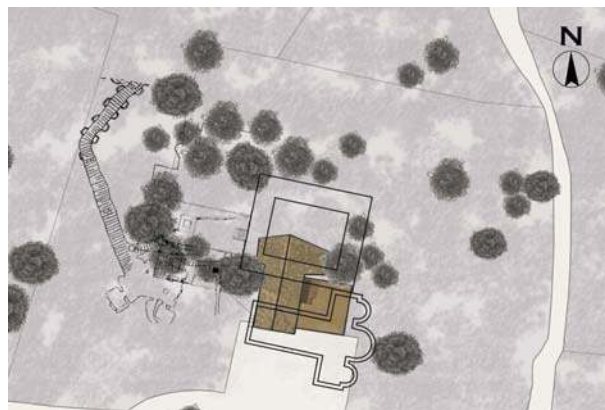
Fig.20: Hypothesis about the insert of Messina's drawing of the Norman basilica with cloister, 12th century, in the present archaeological site; isometric views of the 3D model of the Norman basilica: hypothesis about the recontextualization of the architectural fragments.

stylistic characteristics. At the beginning, the research was limited to the area surrounding Siracusa looking for buildings with similarities with the basilica of Santa Lucia di Mendola. Soon, it was clear that the examined buildings couldn't be an example because their development in plan was quite dissimilar to the case study.

The church of San Michele al Castello (Ancient Noto) and the church of San Nicolò (Siracusa) had a reduced longitudinal development, while Santa Lucia extra moenia (Siracusa) and San Martino Vescovo (Siracusa) were longer, only the church of San Tommaso Apostolo (Siracusa) presented similar dimensions (Agnello G. M., 2014).

Moreover, all the churches with the exception of Santa Lucia extra moenia were single aisled. The main reason why the examined buildings were excluded was the total absence of constructive plastic sculpture or "*Bauplastik*" which characterizes the fragments of Santa Lucia di Mendola. Not existing in the Sicilian territory, a survival reference after the earthquake of 1693, the research was extended to the whole Italian country. Five churches situated in Calabria, Apulia, Molise, Abruzzo were selected (Agnello G., 1955; Balsamo F., 1992).

The five examined churches were built at the behest of the Norman counts or modified under their rule. The churches were chosen because their plan had a longitudinal dimension similar to the one of Santa Lucia di Mendola and, with the exception of the church of San Pietro (L'Aquila),

are three aisled (Arbace L., 2017; D'Ardes A., 1998; Orsi P., 1928; Serafini & Verazzo, 2017; Violante F., 2008). (Fig.21)

The analysis continued with the study of the distributive scheme of all the elements on the façades. This procedure was useful to understand the possible position of the surveyed fragments and, in particular, to establish the position of the blind arcades.

Examining the five churches, Santa Maria di Cerrate (Apulia) was chosen as the one with strongest similarities (Gabellone F., et al, 2011).

The two churches, both of them three aisled, have an almost identical length in plan and hypothesizing a similar development in elevation as well, the dimensions of Santa Lucia di Mendola were defined as corresponding to those of the Apulian church, imagining a salient façade.

All collected data helped hypothesize the characteristics of the basilica taking into account the already mentioned Luigi Bernabò Brea's reconstruction and the distributive scheme of all the identified elements in the church of Santa Maria di Cerrate.

All fragments were placed in elevation. In particular, the arcades were supposed to have the purpose of string course and on the basis of a dimensional study of the church the twelve shortest arcades were placed on the front façade and the highest ones were distributed in the area around the transept and along the lateral façades.
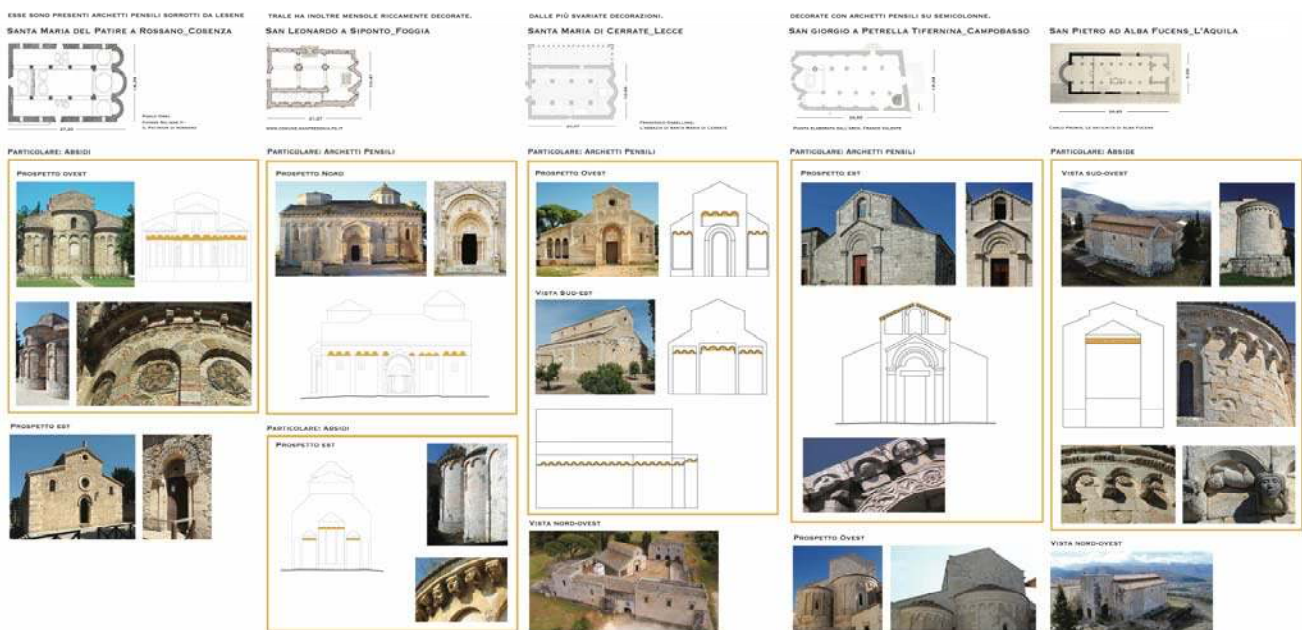

Fig.21: Comparative analysis of the five examined churches.

At the end of the conducted study, a 3D model was produced using specific software. A 3D model of the basilica and the position of the blind arcades were obtained using Rhinoceros software. The file format was exported into .3ds and then imported in Cinema 4D.

In the final phase texture was added to the volumes and the correct parameters and cameras were detected for the rendering process.

After a considerable amount of time used for the rendering tasks the final image, shown in Fig.22, was achieved. (Fig.22)

5. Conclusions

The implementation of digitalization technology in the hypothesis of an absence reconstruction (the Norman basilica of Santa Lucia di Mendola) provides the final product which visibly redefines the historical and archive arguments supported by geometric and morphological cataloguing obtained with survey operations and 3D modeling of the archaeological objects (both visible and invisible).

The interdisciplinary cooperation broadens the perspective and leads to different attitudes towards culture suggesting at the same time new approaches towards the "traditional" digital modeling in museology.

In a wider perspective, the study methodology adopted in the present contribution will trigger a debate about the topic of the "forms" of museum heritage, represented by digital products accessible to art experts and architects and also to the common visitors of the museum.

Digitalization is, in fact, a cultural experience which implements innovative technologies to disseminate researches in the specific field stimulating attention on "silent heritage" as well.
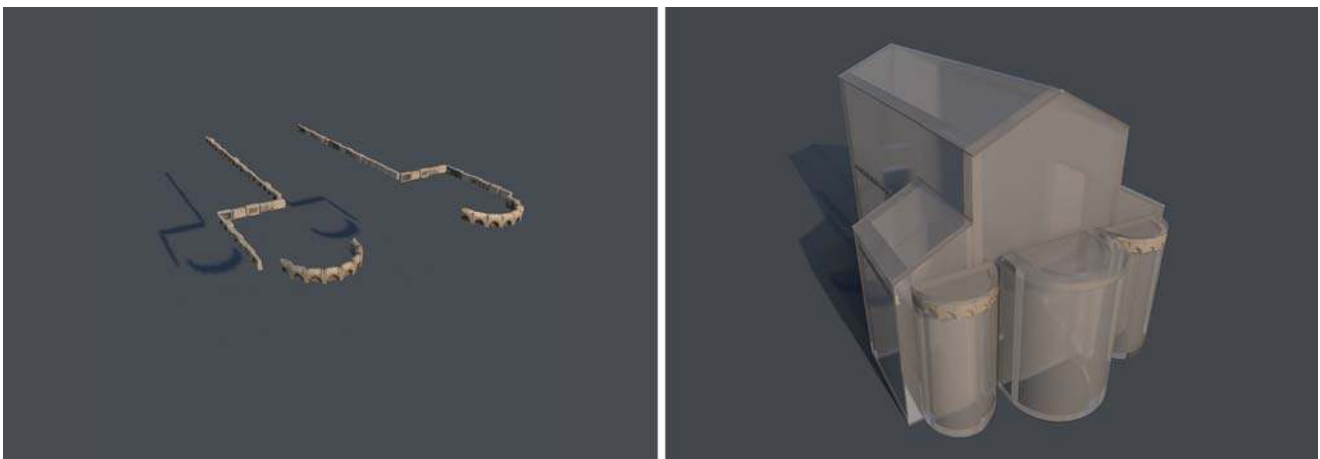
Fig.22: 3D model: reconstructive hypothesis about S. Lucia di Mendola basilica.

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