Proceedings of the first ArCo Conference

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Art Collections 2020

Design and Museum Design,
Digital Heritage, Historical Research,
Posters

Editors:
Francesco Valerio Collotti,
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Alessandro Brodini

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1st ArCo – Art Collections

Cultural Heritage, Safety and Innovation

International Conference

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Università degli Studi di Firenze, Italy

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PROCEEDINGS SUMMARY

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Design and Museum Design Session

(ARCO 2020, DMD)

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Art Collections 2020, Design and Museum Design Session (ARCO 2020, DMD)

Shaping spaces for exhibitions

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Abstract

This paper is inspired by my personal experience in the field of exhibition design since 2005. I have been responsible for the design of over 20 exhibitions in various countries, each with its own specific characteristics. These have included temporary and permanent displays and have been set up both inside museums (in those spaces assigned for temporary exhibitions or in the rooms of the museum itself) as well as at other sites either normally used for different purposes or "abandoned".
Spatial variables are considered in relation to the works to be exhibited, which can vary in terms of value, size, intrinsic significance, "type", media, etc. I have, in fact, had to deal with issues regarding both ancient and contemporary art, the presentation of both abstract and concrete subjects, objects, even stories.
Each of these variables and their mutual interaction have induced me to adopt specific design approaches aimed at reaching solutions that successfully harmonize the space and the works exhibited, while simultaneously taking into consideration other creative figures in the staging process – the curator, the artists and/or lenders, the representative of the institution hosting the exhibition and the technicians, and, finally, the available budget.
Several experiences will be described to show the variety of solutions adopted in specific contexts:
_same exhibition in two different spaces: "Urban Manners, artisti contemporanei dall'India", Hangar Bicocca, Milan (Italy) 2007 and "Urban Manners 2 – Artistas Contemporaneos de India", SESC Pompéia, São Paulo (Brazil) 2010 / what it means to adapt a single concept to be seen by visitors on two different continents;
_historical artworks set up in a historical building: "I grandi bronzi del Battistero - Vincenzo Danti, discepolo di Michelangelo", Museo Nazionale del Bargello, Florence (Italy) 2008 (in collaboration with arch. Fabrizia Scassellati Sforzolini) / design for a very limited space divided into 3 different parts for a large number of masterpieces, and without any possibility of working on the building itself since it is itself a historic monument;
_central exhibition "Everywhere but Now", 4th Biennale of Contemporary Art, Thessaloniki (Greece) 2013 / using a trade fair pavilion to stage an art exhibition;
_design in a French public museum: "Food", MuCEM, Marseilles (France) 2014 / how to deal with a complex system of regulations regarding every aspect of the setting-up of an exhibition and tackle the objective difficulties associated with the architecture of this specific venue (an important contemporary building designed by Rudy Ricciotti);
_looks like no intervention: "Armenity/Hayoutioun, Island of San Lazzaro degli Armeni, Venice (Italy) 2015, winner of the Golden Lion award as best National Participation at the Biennale Arte 2015 / every detail was carefully studied to make

Keywords: exhibition, design, shape, biennale, art

the works of sixteen artists blend in perfectly with the existing space of the monastery, thus expressing the concept of integration as opposed to that of diaspora;
_a happening: ULAY - "Invisible Opponent", Musée d'Art et d'Histoire, Geneva (Switzerland) 2016 / everything has to be ready for that unique handful of minutes during which "something" happens in the presence of an artist.

1. Introduction

The staging of an exhibition involves several different requisites: the curator has a concept to express, a space is required and artworks to display are needed, an idea for the set-up is developed after having verified what the space can provide in terms of general conditions and specific regulations, artists are involved (if the exhibition concerns contemporary art), all in all reaching compromises on each single point. Costs inevitably are also a fundamental part of the process, with all sorts of possibilities: the definition of a pre-established budget, selection of a exhibition company through competition based also on its costs, even the scenario of having little idea, for various reasons, of the costs to be sustained.

My personal experience is the result of my work on the design of more than twenty exhibitions staged in a number of different countries, with various institutions, and involving a wide variety of different spaces (both in and out of museums). In certain situations, it was appropriate to intervene in a precise and very measured way to integrate works in a particular context, in others it was necessary to build special structures and surfaces to complement the works without unduly affecting their individual impact.

An exhibition is, by its very nature, a temporary phenomenon, an ephemeral architecture capable of communicating an idea "in a single day", as the etymology of the word suggests (from the Greek εφημεροσ = επι over + ημερα day). The set-up has to be perfect in every detail from the very beginning as materials tend to be perishable and susceptible to deterioration, maintenance is variable, etc.

In the following paragraphs there are descriptions of several set-ups that I myself designed and took care of. They will provide an overview of different shapes for exhibition spaces.

2. Same exhibition in two different spaces

The first case concerns the proposal of the same exhibition in two diverse locations that varied in a number of different ways.

The subject was the presentation of contemporary Indian artists accustomed to conceiving large works with a lot of people available for their production and installation. The idea of the exhibition was to organize it like a village in which the visitor would encounter the single installations.

The two locations were in different continents, the first in Italy (Milan) and the second in Brazil (São Paulo). Both were industrial buildings typical of those cities in which ways of life, climate and type of visitors were particularly distinctive.

As a whole, the different impact of the two proposals for each country was given by choices made accordingly to the previous considerations.

2.1. "URBAN MANNERS – Artisti Contemporanei dall'India", Milan, Italy, 2007

Hangar Bicocca, where the exhibition was staged, was formerly an industrial warehouse used by the Pirelli company (tyre manufacturers). In 2005it was just starting to be used as a site for contemporary art exhibitions. In and around it nothing was really developed, so there was no interaction other than that with similar semi-abandoned warehouses. The overall sensation was of being in a dark cavernous place made up of metal structures and a dusty concrete floor (Fig. 1). Despite the situation, basic security measures and anti-seismic calculations made by engineers were obligatory to produce the single parts of the set-up.

As far as the design was concerned, I was free to conceive volumes in this very large open space (83 m by 35 m = 2900 sqm, by approx. 5 m in height) to present the village concept: seven small houses accommodating single installations were distributed throughout the hangar, while among them other artworks were assigned

their specific area and at the end a large wall with shelves was specially built for a work on Ghandi's last speech.

Moreover, I chose different colours to characterize the new structures, an idea that created a carefully balanced contrast with the greyness of the place and that worked perfectly (Fig. 2).

Fig. 1. Hangar Bicocca in 2007, Milan.

Fig. 2. "Urban Manners" installation view.

2.2. "Urban Manners 2 – Artistos Contemporaneos de India", São Paulo, Brazil, 2010

The location for the exhibition was a former industrial building composed of a structure of 5 x 5 m squares re-designed by the brutalist Italian architect Lina Bo Bardi in 1977 for SESC (Servicio Social do Comercio). It is now used as a public area overlooking an inner street of the SESC Pompéia; in addition to the exhibition space, a library, a theatre and a leisure and entertainment area with chess and other board games are available

in the building. On one side there is an irregular pool of water that contributes to the unclear perception that is created between "inside" and "outside" (Fig. 3).

Here the set-up remained the same in its basic idea of a "village", though certain aspects were appropriately modified: the colours of the little houses, for example, disappeared in favor of white walls due to the presence of bright sunlight at that latitude at that particular time of year. This contributed to enhancing the “presence” of the external works. On one side of the space the village was distributed around the pool of water (1800 sqm) while on the other side four artworks were more isolated from the life of that same village (1000 sqm), a fact that affected the unity of the exhibition. The size of the exhibition area was the same as the one in Milan, though here was not unaffected by other things happening within it, so the attention of visitors who had completely free access was stimulated by this fortuitous confusion (fusion) of different functions (Fig. 4).

Fig. 3. SESC Pompeia, Sao Paulo, outside “street” and inside the exhibition building.

Fig. 4. "Urban Manners 2" installation view

The heat and the sunlight caused a few problems: their impact on Singh’s photos needed to be reduced so a protective anti-UV film was applied to the roof windows; the little houses needed ceilings so that air conditioning could be installed inside. Apart from some associated consequences (Reena Kallat's work got

damaged as a result of the air-conditioning device dripping water on the floor), the effect inside the little houses was quite different form that in Milan: everything looked more artificial (Fig. 5).

Graphics, labeling, and captions were all arranged under the strict supervision of SESC, as this private no-profit institution has its own way of dealing with communication. For the same reason, very little was possible to discuss in terms of costs and people working on the production of the exhibition.

Personally, having to work remotely during the preparatory phases of the set-up was a demanding task and when I finally arrived on the site a number of aspects needed adjustment. This undoubtedly impacted on the final outcome. Later experiences I had with SESC went more smoothly, since during that initial experience I understood many things about the Brazilian people and their way of life and the small details of the various processes to follow that are so important for a successful result.

Fig. 5. Reena Kallat's installation in Milan (on the left) and in Sao Paulo (on the right).

3. Historical artworks set up in a historical place

In 2008 I had the opportunity to work (in collaboration with Fabrizia Scassellati Sforzolini) in a very important museum in Florence (Italy), the Bargello, and deal with some extraordinary artworks that even included a number of sculptures by Michelangelo. The exhibition was "I grandi bronzi del Battistero. L'arte di Vincenzo Danti, discepolo di Michelangelo" ("The large bronze statues of the Baptistery. The art of Vincenzo Danti, pupil of Michelangelo"). The organization of the work was also quite special: the Museo Nazionale del Bargello appointed a group specialized in exhibition productions (*Opera Laboratori Fiorentini*) which in turn involved us. We had continuous interaction with the museum curators (the director and an expert) but had no control over the budget.

Fig. 6 – Museo Nazionale del Bargello, Florence: the courtyard and the two rooms for temporary exhibitions.

The exhibition design involved the connecting of three distinct areas: the courtyard, where there was an unmovable statue to be included in the exhibition, and two quite different and fairly small rooms normally used for temporary exhibitions (Fig. 6). Moreover, it was fundamental to consider that there was no possibility of any intervention on the building itself since, being a historic monument, it was protected by special authorities (the *Soprintendenza*).

Fig. 7 - "I grandi bronzi del Battistero" installation view of the courtyard.

Fig. 8 - "I grandi bronzi del Battistero" installation view of the first room.

As regards the former aspect, a curving wooden “wall” was made to wind through the exhibition areas, accompanying visitors from the courtyard into the rooms and out again. To unify the exhibition we used colours, false ceilings and carpets that were used throughout, though not always in the same way. The false ceilings were also necessary for technical reasons such as installing the electrical and lighting systems.

Beside these general features were a series of elements made specifically for each piece:

- a large base to conceal the iron structures with I-beams that supported the enormous bronze statues, which were displayed with a backlit box representing the part of the Florentine Baptistery, in its actual size, from which these important sculptures had been detached to be restored;
- completely transparent showcases and recesses/niches protecting precious pieces made with special attention to their visibility;
- components specially requested for security reasons to keep people at a distance from the statues/bas-reliefs.

We reached a limit as regards usability, given the quantity of artworks included in the exhibition (the two rooms were together only 140 sqm); the consequent result of little free space left was balanced by the rounded shapes of the set-up (Figg. 7-8).

4. Central exhibition "Everywhere but Now"

In this case the issue was how to transform a trade fair pavilion into an art exhibition space. This was the challenge I took on for the 4th Biennale of Contemporary Art in Thessaloniki (Greece) in 2013. The central exhibition "Everywhere but Now” had to show the works of fifty artists distributed over four sites, the main one being Pavilion 6 of the city trade centre, a place that had not been used for quite a long time but was large enough to house the exhibition (Fig. 9).

What the people of Thessaloniki particularly appreciated was the recovery of the place, the possibility of seeing it in a different guise. I decided to uncover the Venetian-style paving with geometric lines in white stone that had always been covered over with carpets. The previous use of the area had left marks on the original floor, but I thought that in any case it was better to expose it again (Fig. 10). Apart from the organization of the overall space into smaller areas to allow people to walk the entire length of the exhibition site, it was important to have well-designed video-installation rooms with particular attention being paid to sound, colour and large-sized images that would capture the attention of visitors.

Many other ideas on how to bring about this transformation could not be applied due to the difficult economic situation in Greece at the time. It is interesting, however, that for some time the pavilion retained the set-up of “Everywhere but Now”, successfully hosting other exhibitions as a new location for temporary art shows.

Fig. 9. Periptero 6, Hellexpo, Thessaloniki.

Fig. 10. "Everywhere but Now" installation view.

5. Design in a French public museum

The Museum of European and Mediterranean Civilizations (MuCEM) is a new museum in Marseilles (France), built to a design by Rudy Ricciotti when the city became European Capital of Culture in 2013. The building is highly characteristic and on the ground floor hosts part of the museum's collection on anthropological heritage. The first floor is given over to two temporary exhibitions at a time, thus making available spaces that are large and attractive but at the same time quite difficult to organize for exhibiting. This is because the "skin" of the contemporary architecture impacts significantly on the exhibition space itself (Fig. 11).

Here "FOOD: produire, manger, consommer" was presented in 2014, starting – as a typical national French institution would demand – the very long procedures a year in advance. The enormous number of internal regulations for every aspect of the management and promotion of an exhibition struck me particularly. It was necessary to go through all of them, and each with specific people in charge of single departments (i.e., exhibition productions, cultural productions, school productions, exhibition techniques, etc.). It was difficult to obtain any flexibility in the compliance of those rules. So I went through a three-step presentation of the design to all the museum staff, with comments and questions from each one of them, the preparation of documents for the public competition to decide on which company should be in charge of the set-up (not just drawings, but also various documents and lists divided into specific batches in accordance with French law on public tenders), a two-stage analysis of the companies' proposals that was finally decided in favour of an Italian company (which was, paradoxically, preferred to a French one on the grounds that it was more flexible!), and the rigorous application of construction protocols with the museum (papers to consign for numerous different aspects) and the *bureau de contrôle* (external control office). The design took into consideration the irregular plan and elevation of the space, the presence of glass all around which allowed the exhibition to be seen from outdoor ramps but also caused not inconsiderable problems due to solar reflections within the exhibition area, the compulsory access to the central technical block, and all security issues.

At the end the U-space was divided into three areas, two of which were characterized by a little pavilion, each for those installations that integrated artists' work with some pieces of the museum's collection. The long central area was dominated by a large modular showcase fifteen meters long to display historical works. White walls and very simple geometric elements attempted to provide a contrast with the richness of the building.

The result was positive, but – as the present paper shows – the massive expenditure of time and effort, the production of countless documents and the vast number of people involved seemed quite out of proportion, as was the enormous budget that had been made available.

Fig. 11. MuCEM, Marseille: outdoor walkway and space for temporary exhibitions.

Fig. 12. "FOOD" installation view of the first area.
Fig. 13. "FOOD" installation view of the second area with the long showcase.

6. Looks like no intervention

This is an example of the essence of exhibition design: preparing a space to show artworks and expressing the concept of the exhibition. It was evident not only to the working team and to the artists involved; it was also acknowledged with an important prize. “Armenity/Hayoutioun” was setup in Venice (Italy) in 2015 for the 56th Biennale on the island of San Lazzaro and won the Golden Lion award “[…] for creating a pavilion based on people in diaspora, each artist engaging their specific locality as well as their heritage. The pavilion took the form of a palimpsest, with contemporary positions inserted into a site of historic preservation. In a year that witnesses a significant milestone for the Armenian people, this pavilion marks the resilience of trans-cultural confluence and exchanges."

The idea of integration in a very special place like the Mekhitarist monastery on the island of San Lazzaro (Fig. 14) had to be made clear in this pavilion, the only one with sixteen artists that were united by the concept

of diaspora. It had to express precisely that it was possible to combine different points of view on the common theme of the diaspora.

The set-up had to work bearing this idea in mind, while at the same time heeding the Biennale regulations and the restrictions imposed by the monastery, obtaining clearances from the Venetian authorities and complying with security guidelines. The design interventions became almost invisible since all aspects were carefully studied to make the existing space blend perfectly with the artworks and vice versa. Such an operation is delicate and made up almost exclusively of details that are difficult to describe. My own professional fulfilment was further enriched by a personal immersion in that evocative place and in the stories of the diaspora recalled by the artists (Figg. 15-16).

The budget made available for the design was fairly low, an element that underlines the fact that what really interests visitors is the importance of the message and how it is conveyed.

Fig. 14. Mekhitarist monastery in San Lazzaro, Venice. Plan and photos of one of the rooms adjacent to the cloister.

Fig. 15. "Armenity" installation view on the ground floor.
Fig. 16. "Armenity" installation view on the first floor.

7. A happening

As Ulay himself said presenting this performance the day before the happening, “for a performance to take place you need a performer, a location and a date”. Ulay showed his “Invisible Opponent” at the MAH museum in Geneva (Switzerland) on the 4th of April 2016.

Fig. 17. Mah Museum, Geneva prepared for the performance.

Fig. 18. "Invisible Opponent" performance.

The dimension of a performance is quite different from that of an exhibition: everything must be ready for that unique handful of minutes during which "something" happens in the presence of an artist and is created by

him or her; this includes instruments that are useful for the performance as well as technical equipment ready and perfectly functioning for the event.

Another aspect to think about and organize efficiently is the public. How many people will come? What does the artist want to be seen? How do people assemble to watch the performance? People recognize signs that guide their way of participating, like marks on the floor or perceptive indications.

A pink mirror measuring 2 by 2 m laid onto an irregular floor and suitable for being walked on, a lighting system illuminating the scene, a video camera recording the performance from above for approximately 30 minutes and simultaneously projecting it onto a wall nearby had very high production costs and only the people who were actually present directly benefited from it. Others perhaps will see the result of Ulay's work on the pink mirror as that object itself became an artwork to be exhibited.

8. Conclusions

There are numerous ways spaces are prepared to present artworks for an exhibition and these depend on a multitude of different factors. In my opinion exhibition design should help to understand, without ever becoming an obtrusive presence. Having had the opportunity to come into contact with contemporary artists, I have learnt a great deal observing their conceiving methods, listening to them as they create their work and understanding how to present them in the best possible way.

The architect's role is a transversal one, that of the professional expert who is able to create a synthesis out of the entities and parameters on which the design is based. His task is to present a narrative scheme that invites every visitor to participate in his own way in what he is observing, one that seeks to generate an overall harmony within the exhibition. The relationship between a work and its background is undoubtedly the dominant theme to be explored in the staging of an exhibition and a successful design depends on its resolution. After all, as Kazimir Malevich affirmed in 1927: "architecture is, in its fundamental elements, a form of pure art".

References

Bertron A., Schwarz U., Frey C., 2012. *Project Scope: Exhibition Design. A Typology for Architects, Designers and Museum Professionals*, Birkhauser, Basel, Switzerland.

Cuberyan von Furstenberg A. (ed.), 2016. *Participation*, Mousse Publishing, Milano, Italy.

Diamonstein B. (ed.), 1981. *Collaboration: Artists & Architects*, Watson-Guptill Publications, New York, USA.

Longheu V., Velo U., 2019. Luogo e luoghi, in the catalogue of the exhibition "Natura naturata", in *Capolavori librari dell'Università degli Studi di Ferrara*, Dal Buono V., Trincherini E., Turrini D. (eds.), 8-9, Unifepress, Ferrara, Italy.

Mastrella R., 1998. *Exhibition design*, Nuova Arnica editrice, Roma, Italy.

O'Doherty B., 2012. *Inside the white cube. L'ideologia dello spazio espositivo*, Johan & Levi Editore, Milano, Italy.

Pellegrini P. C. (ed.), 2003. *Allestimenti museali*, Federico Motta Editore, Milano, Italy.

Ryan Z., 2017. *As seen*, The Art Institute of Chicago, Chicago, USA.

Velo U., 2014. Alignments and oblique planes for Everywhere But Now, in *Thessaloniki biennále: 4 of Contemporary Art*, catalogue vol.2, pp.48-53, Thessaloniki, Greece.

http://www.artdreamguide.com/_exhi/_2007/_ita/han_mi.htm

https://artsandculture.google.com/exhibit/armenity-hayoutioun%C2%A0/-AJyDyLdlPV9Kg

https://www.domusweb.it/en/art/2015/06/15/armenity.html

https://www.exibart.com/evento-arte/urban-manners/

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Architecture, museography and museology in dialogue: analyzing the Museum of Tomorrow

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Abstract

The discussions about museum architecture assume prominence in contemporaneity, considering the expansion of the heritage preservation initiatives, the broadening of the musealization phenomenon and the insertion of the museum in the cultural tourism industry. In recent decades, we observe the expansion of the roles assumed by the museum, considering the creation of new institutions disassociated from material collections that commonly use new communication technologies applied to museography in order to approach the audience. The contemporary museum is commonly considered as a central element of the mass cultural circulation system, as a media event or as a generating pole of new urban centralities. The museum architecture, which assumes increasing functional and representative complexity, faces new challenges in this context, including not only the development of exceptional contemporary forms, but also the challenges implied by the typological and programmatic diversity in the creation processes.

On the other hand, the relations established with communication technologies can generate new solutions that approach to the concept of "multimedia museum" (Dzikean, 2012), understood as a hybrid space resulting from the fusion between the technologies and exhibition space. One can observe the existence of two distinct design strategies: the conception of architecture as a "neutral envelope", considered as a container for changing museographies (Montaner, 2003); and the emphasis on the meaning potential of the architectural object, so that the space is an effective participant in creating exhibition effects (Davallon, 1999). So, we can delineate the relation between architecture, museography and museology, reflecting about how to interpret the museographic role of architecture and the challenges of dealing with digital collections. For this purpose, it is important to point out the importance of the dialogue between architects, exhibition designers and museologists for creating solutions that increment the visitor´s experience (Wagensberg, 2006). Even though, there are not enough detailed studies about empirical experiences related to this theme in recent decades, particularly analyzing the counterpoint established between conception and reception of the museal space by the public. In this sense, this study intends to focus on this gap, proposing the in-depth analysis of the Museum of Tomorrow (Rio de Janeiro, Brazil, 2015), taken as a significant example of the creation of architecture and museography to present a digital collection.

Designed by the Spanish architect Santiago Calatrava, the Museum of Tomorrow was incorporated into the requalification project for the Rio de Janeiro port area known as "Porto Maravilha", implemented by the Complementary Municipal Law n°101/2009 in preparation for the 2016 Olympic Games. The Museum of Tomorrow sought to interpret the relation between

Keywords: museum architecture; interactivity; exhibition design

its theme-generator and the own building. It combines formal design linked to the aesthetics of a future architecture with the exploration of functional solutions that reflect on the theme of tomorrow's architecture. For this purpose, the architectural project includes the creation of solar energy and water reuse systems and, also, the location of an underground sewage treatment station to purify the waters of the bay. Inside, the free plan is associated with the creation of a flexible space, allowing museography to develop itself independently of architecture. The exhibition design was initially conceived by the US office Ralph Appelbaum. It starts from creating interactive audiovisual installations fed both by digital databases in dialogue with partner research institutions and by monitoring visitor´s interactions.

To study the conception design process of the Museum of Tomorrow, we will analyze the following documentary sources: architecture and museography drawings, museological plan and interviews from professionals involved in the process of creating the museum, such as the content consultant Andrés Clerici, the exhibition designer Vasco Caldeira, the curator Luiz Alberto Oliveira, the scientific director Alfredo Tolmasquim, the technological designer Daniel Morena and the culture manager of the Roberto Marinho Foundation, Larissa Graça. From the reception point of view, the research applied the methodology of systematic observation of visiting museums known as "tracking and timing" (Australian Museum, 2009), complemented by the execution of non-directed interviews with visitors (Yalowitz, 2009). Therefore, the visitation path of 150 visitors was observed and 115 people were interviewed. The data collection took place between 08/09/2017 and 09/14/2017 and was systematized in tables and maps that supported the proposed study. From the rebound between the processes of conception and reception of the Museum of Tomorrow, we intend to reflect on the possibilities of articulating the contemporary museum space around the collaboration between architecture, museography and museology.

1. Architecture, museography and museology in dialogue: analyzing the Museum of Tomorrow

1.1. Introduction

Nowadays, the museum architecture is consolidating itself as a central element for structuring contemporary culture. The main role assumed by the museum architecture is related to its insertion in the cultural tourism industry, playing a central role at the mass cultural circulation system. The museum architecture has been commonly considered as a media event or as a generating pole of new urban centralities. Indeed, the privilege of aesthetic experience from museum architecture is also seen as an active strategy for creating new institutional meanings. The visual appeal, by demonstrating technological development and progress, places the museum as an urban landmark that can be associated with the production of new strategies to enhance the global tourism industry. The concepts of "museum as an extraordinary organism" (Montaner, 2003) or "performance architecture" (Sperling, 2005) are often associated with urban speculation, privatization of the public space and gentrification. Museum architecture, which assumes increasing functional and representative complexity, faces new challenges in this context, trying to create exceptional aesthetics and dealing with new architectural programs.

However, it is possible to observe the development of a second strand of authors who understand the museum architecture as a simple functional support for the objects inside it (Montaner, 2003; O´Doherty, 2007). The flexibility provided by the free plan allows the agile installation of media and communication interfaces, allowing the construction of the "multimedia museum" (Dzikean, 2012), understood as a hybrid space resulting from the fusion of new technologies and exhibition space. This context is often related to the creation of new institutions disassociated from material collections that use new communication technologies in order to approach the audience. In this case, the museum emerges as a space for both technological experimentation and content mediation. The creation of new relations between public and digital collections, which explore a wide variety of solutions such as multimedia shows, scenography, interactivity, sound resources, augmented reality, among others.

Regardless of, the synthesis established between museum architecture and exhibition design can be related to the thinking of some authors who consider the exhibition as a communication device. Jean Davallon (1999) presents both the informative dimension of the communication process and the argumentative exhibition design. The exhibition aims to transmit knowledge from communicational tools – such as panels, interactive or presentation modules – which present their own materiality as communicational devices. In this sense, the author points out that the exhibition is essentially multimodal, mobilizing different technical supports – objects, images and texts – and articulating multiple languages that are received by the visitor. The process of signifying the exhibits occurs from the interrelation between these elements. The set of contents that constitute reference networks depends on the ability to create meanings from the visitor´s body in the exhibition space. According to Davallon, every exhibition

follows a spatial logic. The integration between exhibition space and museum narrative contributes to the signification process based on the visitor´s contact with the collection. So, the exhibition proposes a way of interpreting what is exposed. The presentation of the content associated with the proposition of how to interpret it considers the exhibition as a spatial media. The persuasive language is presented in the museal discourse through texts, labels and exhibition design itself, articulated with the architectural space.

As Davallon points out, understanding the exhibition as a communication device suggests the creation of museum narratives based on sequential modules, for which interactivity and technologies can assume a relevant role in the introduction, development or deepening of certain themes in other to contribute to the visitor's interpretation of the spatial experience. According to the author, the aesthetic-formal conception of the exhibition must articulate all the content presented, spatially privileging some elements over others. There is a narrative line that guides the visitor's journey through the exhibition which can be complemented by deepening possibilities offered through interactivity. The sequential discovery of the exhibition units contributes to the generation of meaning effects which are environmentally controlled. The final route derives from sequential small discoveries among the discursive units displayed at the visitor's spatial path.

Two possibilities can be observed to face the role of architecture for the configuration of the exhibition path. At first, the space can be considered a simple functional support for the objects that are placed inside it, alluding to the perspective of "wrapper" or "neutral envelope" (Montaner, 2003). On the other hand, one can also consider architecture as an effective participant of the exhibition effects, contributing to create new spatial meanings. In this sense, we can consider that “the museum spaces are, at the same time, support and builder of the exhibition's message” (Machado, 2015, p. 154). The idea that “the museography begins with the façade of the museum itself” (Santacana and Piñol, 2010, p. 485) suggests that architecture is the first key for understanding the museum content even before entering the exhibition.

As a methodological strategy to create a museum exhibition in which architecture, museography and museology contribute together to the construction of meanings, Jorge Wagensberg (2006) points out the importance of the dialogue between architects, exhibition designers and museologists in order to develop solutions that enhance the visitor´s spatial experience. Although this ideal situation is desired, there are not enough detailed studies about empirical experiences related to the integrative design approach in recent decades, particularly analyzing the counterpoint established between the conception and reception of the museal space by the public. In this sense, this study intends to focus on this gap, proposing the in-depth analysis of the Museum of Tomorrow, taken as a significant example of creating architecture and exhibition designs to present digital collections. This study presents partial results of the doctoral thesis which is currently being developed by the author at the University of São Paulo.

So, this study will consider both the design process and the reception by the public of the Museum of Tomorrow. Firstly, we will investigate the conception processes of the architectural, exhibition design and museology by analyzing architecture and exhibition design drawings, museological plan and interviewing professionals related to the museum creation process, such as the content consultant Andrés Clerici, the exhibition designer Vasco Caldeira, the curator Luiz Alberto Oliveira, the scientific director Alfredo Tolmasquim, the technological designer Daniel Morena and the heritage culture manager of the Roberto Marinho Foundation Larissa Graça. Secondly, for better understanding the public point of view, this study will adopt the systematic observation methodology known as “tracking and timing” (Australian Museum, 2009), complemented by the execution of non-directed interviews with visitors (Yalowitz, 2009). Therefore, the visitation route of 150 visitors was observed and 115 people were interviewed. The data collection took place between 08/09/2017 and 09/14/2017. From the rebound between the processes of conception and reception of the exemplary case of the Museum of Tomorrow, we intend to reflect on the possibilities of articulation about the contemporary museum considering the perspective of the integrative design.

2. The Museum of Tomorrow. Investigating the conception process and the reception by the public.

2.1. Creating the Museum of Tomorrow: choosing the place, inviting professionals and studying references

The Museum of Tomorrow is an interesting case to investigate the relation between architecture, museography and museology, considering that the architecture was designed and built in response to the

challenge of interpreting its own theme-generator. The Museum of Tomorrow was only carried out due to the preparation of Rio de Janeiro for hosting the 2016 Olympic Games. For this purpose, it was implemented the urban revitalization of the port area known as “Porto Maravilha” based on the Complementary Municipal Law n° 101/2009 and according to the guidelines of the Recovery and Revitalization Plan of the Port Region (2001). The project´s main idea was to set infrastructure actions and to implement cultural facilities at the port area. The Museum of Tomorrow was coordinated by the Roberto Marinho Foundation, a private non-profit institution linked Grupo Globo, the biggest Brazilian media conglomerate.

According to the curator Luiz Alberto Oliveira, the first conversations intended to create a "Sustainability Museum" inside two empty warehouses located at the Orla Conde´s Street. The project would be an intervention in the built heritage. However, this idea was very similar to the "Museum of the Environment", inaugurated in 2008 in a place close to the Botanical Garden of Rio de Janeiro. Then, the creation of a different museum came up by the idea of the “Museum of Tomorrow”, which pretends to stimulate the reflection about the consequences of today´s actions for the future, inviting the visitor to glimpse possible tomorrows scenarios (Oliveira, 2019). The Museum of Tomorrow takes an important place between institutions that face the challenges of the future, such as the Futurium, in Berlin; the Museum of the Future, in Dubai; the project for the Museum of Tomorrow, in Barcelona; the Museum of Climate, in New York, and the UN Museum, in Copenhagen (Tolmasquim, 2019).

Both concept, location and architectural design of the Museum of Tomorow have changed considerably during the creation process. The initial idea of implementing it inside the built heritage changed because of the suggestion of the mayor, Eduardo Paes, to transfer the Museum of Tomorrow to the Píer Mauá. He also decided to invite the architect Santiago Calatrava to develop a new building design (Porto Novo, 2015). This decision took place after a trip taken by Eduardo Paes through the cities of Barcelona, Athens and London, in order to better know some examples of urban transformations implemented in cities that would host Olympic Games (respectively in the years of 1992, 2004, 2012) (Ritto, 2012). During the trip, Eduardo Paes got in touch with some architectural works of Santiago Calatrava, especially the City of Arts and Sciences in Valencia. This reference was considered by the mayor an example of good practices related to urban infrastructure and to create global images of cities.

Santiago Calatrava´s buildings often are constructed in the context of urban revitalization actions, such as Barcelona (1992), Valencia (1991-2006), Buenos Aires (1998-2001) and Athens (2001-2004). In addition, the architect's approach to the museum design is evident the project of the Milwaukee Museum of Art (1994-2001) and the Príncipe Felipe Science Museum (2005-2009). If, on the one hand, the Museum of Tomorrow's project seems to develop common processes related to the global architecture, reinterpreting solutions previously adopted in other projects; on the other, there is a strong concern about the relationship between the architecture and the place. In this sense, one of the main urban changes suggested due to the Museum of Tomorrow project was the demolition of the Perimetral Avenue, thought as a strategy to visually and environmentally qualify the Mauá Pier’s area.

Considering this background, we can see the replacement of an intervention in a historical building, what would be a project of low visibility, by a new global architect building. That signs out the intention to create a symbolic icon for the urban renovation of the Rio de Janeiro port area. Calatrava's choice seems to fit fundamentally to this context, considering that he is an architect focused on inventing new architectural objects, seeking to extrapolate the usual limits of the technique by creating sculptural forms. Calatrava's work frequently develop themes related to flexibility and organicity, and it is also concerned with both formal and functional aspects in his architectural works (Lefaivre and Tzonis, 2011; Jodidio, 2016). Calatrava's architecture is worldwide known for proposing organic analogies to the architectural structure, trying to incorporate explicit movements into the buildings. Therefore, experimenting new materials is a fundamental priority for his design process, in order to construct a new imagery power architecture in the global context.

In this way, the Museum of Tomorrow´s design also tries to reflect about the theme suggested for the museum. It combines the development of a formal aesthetic language linked to the future with the experiment of some functional solutions that interpret the possibilities of creating a sustainable architecture, adopting the use of solar energy and water reuse systems, and also the location of an underground sewage treatment station to purify the waters of Guanabara Bay. The Mauá Square emerges as a fundamental element for the articulation between the Museum of Tomorrow and the adjacent buildings, especially the Rio Art Museum.

In addition, the maximum height of the Museum of Tomorrow was established as 15m in order to maintain the view to the São Bento Monastery and to the building called "A Noite" (which are nearby places of historical and cultural interest). In addition to these guidelines, the relation established between the Museum of Tomorrow and its surroundings is marked by contrast, especially regarding to the materiality of the buildings. According to the architect, "*we decided to adopt something different, something so light that gives the impression that it wants to fly. If that architecture is mineral, ours is aerial*" (Calatrava, in. Museu do Amanhã, accessed on 27 October. 2017). The imaginative references associated to the Museum of Tomorrow´s project tries to interpret the poetics of the place.

Inside, the free plan proposes the creation of a flexible space, allowing museography to develop itself independently of architecture. The exhibition design was initially conceived by the US office Ralph Appelbaum, world renowned for the development of spectacular exhibition design. Appelbaum´s office had created not only natural history and science museums – such as the Hall of Biodiversity (New York, 1998) and the Fossil Halls, at the American Museum of National History (New York, 1996); but also multimedia installations for the development of immaterial themes – such as the United States Holocaust Memorial Museum (Washington, 1993) and the Museum of the Portuguese Language (São Paulo, 2006). This last case seems to have been one of the main references taken for the creation of the Museum of Tomorrow, instead of mobilizing other science museum examples (Oliveira, 2019; Tolmasquim, 2019).

It is known that the Cosmocaixa Museum (Barcelona, 2004) was an important reference studied for the Museum of Tomorrow. However, although the ideas of its creator, Jorge Wagensberg, have been thoroughly analyzed and discussed in several meetings, the Museum of Tomorrow´s creators preferred not to follow his ideas. According to the curator Luiz Alberto Oliveira, "the Wagensberg museum is a museum based on material artifacts, which reproduces existing natural environments and creates dioramas. If we did that, we would anchor our museum in the present, and it would not be able to elaborate possible futures" (Oliveira, 2019). In this sense, they preferred to seek some previous experiences taken by the Roberto Marinho Foundation, which use audiovisual museography resources for creating experimental museums focused on the visitor´s experience, in order to develop educational proposals: the Museum of the Portuguese Language (2006) and the Museum of Football (2008), both situated in São Paulo. As a result, according to the scientific director Alfredo Tolmasquim, the Museum´s creators have applied "*a model used in other areas for the science environment, and that contributed to the unique and innovative character assumed by the Museum of Tomorrow*" (Tolmasquim, 2019).

The main idea developed at the Museum of Tomorrow was the creation of critical exhibitions based on the interaction with scientific phenomena and concepts, seeking to include visitors in larger experiences that stimulate the reflection by exploring diversified topics such as science, technology, society and environment. The museal narrative is divided in five main areas: "Cosmos", "Earth", "Anthropocene", "Tomorrows" and "Us", which discuss five fundamental questions: Where did we come from? Who we are? Where are we? Where are we going? How do we want to go? Through these questions, the narrative is structured around some defined objectives: to analyze the polarity between cosmic and terrestrial sciences, to reflect on the dimensions of existence, to evaluate the trends that will define the common future for humanity (such as climate change, increasing population and longevity, diversification of artifacts, integration and decrease of biomes), and to address aspects related to human behavior and ethics, incorporating sustainability and coexistence guidelines through audiovisual environments, interactive installations and technological games. The diverse topics covered by the Museum of Tomorrow are reflected in the wide variety of professionals responsible for its curatorial structuring. The curatorial team includes experts in physics, meteorology, medicine, architecture, philosophy and social sciences.

2.2. Changing routes: redefining the visitor´s path and creating the museum narrative

The design process of the Museum of Tomorrow involved the collaboration of a complex network of professionals. In respect to the architectural design, the original idea was detailed, according to the Brazilian urbanistic laws, by the office Ruy Rezende Arquitetura. The Museum´s construction was developed around three basic elements: reinforcing the Mauá Pier´s structure, making the concrete wrapping and building the movable metal cover. The concrete structure, calculated by Engeti Consultoria e Engenharia, was built with reinforced

and prestressed concrete, with several curved and inclined stretches, which serves as a support for the metallic structure of the roof. For its execution, which occurred in almost three hundred concreting stages, there were created specific shapes for single use. The metallic roof is composed of forty-eight sets with metallic wings which descend to the floor, creating the east and west façades. These structures are moved by hydraulic pistons equipped with photovoltaic plates for capturing solar energy. The roof was also composed of "*unique pieces, each one developed for that particular mounting position*" (Tamaki, 2015).

The North American firm responsible for the exhibition design, Ralph Appelbaum, also did not develop all the design stages, which were assumed by the Brazilian office Artificio Arquitetura Expografia, led by the architect Vasco Caldeira. The initial concept drawings suggested the creation of a progressive path, beginning with the concentrated point "Cosmos" and ending at the ethereal space "Us". However, both the designer Vasco Caldeira and the content consultant Andrés Clerici said that it was necessary to change the initial concept due to the lack of details and to the difficult execution of some solutions sketched by Appelbaum (Caldeira, 2018; Clerici, 2018). The exhibition design faced the challenge of occupying a broad architectural space. The main guideline established for the exhibition design was that it should be independent from the architectural space.

However, both Clerici and Caldeira declared there were no alignment meetings with Ralph Appelbaum, so that the design was adapted several times in order to be aligned with architecture itself, which was already fully defined and would not be changed. The architectural space consisted of a true challenge to be faced to create the linear narrative. According to Clerici, "the important thing about the long duration exhibition is that it should not get lost in such a large space. You have no idea of the scale of space because now it is occupied. But it is too big and diaphanous" (Clerici, 2018). The exhibition design renounced the idea of creating galleries by compartmentalizing the interior space, also rejecting the proposition of creating many elements with little expressiveness, which would easily get lost inside such a big space. The final solution was to propose a few strong, large and self-contained exhibit devices.

Clerici highlights that the exhibit devices should be volumetrically expressive in order to guide the visitor's journey through the museum narrative. The big size of the exhibits contributes to ensuring the suspense throughout the route, hiding the following devices. Whereas there are no architectural transitions that limit the passage from one section to another, the designers proposed to change the aesthetic language of the exhibits in order to delimitate the five sections. In this way, "Cosmos" is a black spherical planetarium; "Earth" is composed by three large cubes with 7m edges; "Anthropocene" is created by six totems roundly arranged; "Tomorrow" is a kind of white origami divided into three sections and "Us" is a visually open structure that refers to an indigenous hollow.

However, a substantial change was made in the visitor's circulation path to enhance the use of architecture as an element of spatial significance (Malincheski, 2019). Although the narrative created for the Museum of Tomorrow was designed in a linear way, the circulation scheme planned for the building suggested fluid flows at the large internal space located on the first floor. Originally, the visitors should climb the side ramps, see the beautiful view to Guanabara Bay and then return towards the Mauá Square passing through the exhibits. The inversion of the internal circulation flow was proposed so that the last point of the visit would be the wonderful see of the Guanabara Bay, concluding the route with a positive message for the future.

A second issue that shows the mismatch between architecture and exhibition design refers to the use of the side corridors as exhibiting spaces. According to Vasco Caldeira, during the design process, several studies have been done trying to adapt the curatorial proposal to the existing space, including the distribution of interactive modules the side aisles of the building, what would suggest fluid flows of visitation, making it possible to cross the building both longitudinal and transversely. However, it was difficult either to adapt the exhibition design to the architectural space or to occupy the side ramps. As pointed by Andrés Clerici: "*the side aisles are narrow, we can´t create anything there. These corridors were not designed as exhibition spaces. We tried several possibilities, but there are curved walls, bathroom entrances. The same thing happened with the ramps. These are more operative places than spaces. They are not spaces*" (Clerici, 2018). As a result, the exhibits were located only at the central space.

As we can see, the integrative design did not properly occur at the Museum of Tomorrow, which goes against the intention declared by the Roberto Marinho Foundation of proposing the integral collaboration between architecture, exhibition design and digital collections. According to Larissa Graça, the culture manager of the

Roberto Marinho Foundation, "*the Foundation monitors the entire process, from conception to delivery. We do not work with the idea of a building occupied by an exhibition, but we think about the integrative design*" (Graça, 2019). According to her, in other projects, such as the Football Museum or the Museum of Image and Sound (MIS-RJ), the processes took place in an extremely collaborative way among professionals. However, in the Museum of Tomorrow, "*it was not possible to do the articulation between the architecture, museography and curatorship projects, due to the context of the Olympic Games*" (Oliveira, 2019).

2.3. Creating and updating digital content for the museum: new challenges

The Museum of Tomorrow leads to the challenge of exhibiting digital collections. There is an evident interest in stimulating the public engagement for sustainability purposes. The adoption of digital interactive resources was the solution found to support a museum that would need constant updating. Another challenge was how to guide the visitor through the presented contents, so that he could find renewed information when accessing the museum´s content.

And, finally, there was also the defiance of stimulating visitor´s contribution in order to collect data that can be incorporated into the museum's digital collection. The answer experimented to these questions is connected to the architectural design. The Museum of Tomorrow develops the idea of creating a multimedia exhibition (Dzikean, 2012). As it does not conserve material collections, there would be no need for designing a large technical reserve area. So, the area occupied by the main exhibition is about 2,238.00 m², while the technical areas turns around of 596.56 m².

The creation of technological systems for supporting the digital collection is another important aspect of this innovative experience. The museum is organized around the "Brain System", which can collect and store visitor´s data, constituting a source of information that feeds the collection. According to Russ Rive, "*the museum is like an organism capable of accompanying a little of its own metabolism*" (Divulgação, 2015, p. 21). It was a challenge to develop a technology capable of operating the large database and continuously updating the exhibits. According to the technological designer Daniel Morena, from 32 Bits office:

> We created the "Agent", a mechanism that runs the digital data for the Brain System. The museum needed to be constantly updated, but the initial idea was to make it almost manually, what would be impossible. It was much more comfortable to change the entire platform. But that was a problem. When I arrived, the contents of the museum were already ready. The Brain System was ready, but it was not possible to automatically update digital data. But the way we created this System was very good. The public doesn't even notice when the pages are changed (Morena, 2019).

The Museum of Tomorrow also explores the "Iris System", which was developed to personalize the interactive visitor´s experience. At the entrance, the visitor is given a radio frequency identification card, which records the data accessed by the public at the interactive screens. There are digital tables where the visitor can associate his card to his personal e-mail account. The "Iris System" can suggest new contents for the next visits. According to Morena, "*the content of the Museum of Tomorrow is massive. There are more than 2000 content screens. And it did not get boring. It doesn't seem that big. The Iris System knows what the visitor has already seen. And the Iris was created before the development of the artificial intelligence technologies*" (Morena, 2019).

Moreover, the "Watson System" is an artificial intelligence technology developed by IBM to enhance the interaction of people with computers. In December 2017, the experience "Íris +" was included in the main exhibition of the Museum of Tomorrow. The interaction is activated by the same Íris card. Then, the visitor can speak directly on six self-service totems located at the end of the route. Through artificial intelligence, the system can answer and ask questions about the topics of sustainability and convivence. At the end of the conversation, the system suggests to the visitor some green institutions in order to encourage social engagement after leaving the museum. The visitor also receives an e-mail with these suggestions. As we can see, experimenting technologies inside the museum is an open field of possibilities that remains undergoing technological renewal and updating processes.

3. The public at the Museum of Tomorrow: observing visitor´s behavior and opinion

3.1. Mapping of visitation flows adopting the research methodology "tracking and timing"

At this part of the article, we will analyze the processes of reception observed at the Museum of Tomorrow. As previously mentioned, the research methodology known as "tracking and timing" considers aspects from the visitors, such as the individual experiences, knowledges and personal interests. It also gives importance to the exhibit designs, allowing a range of degrees for the visitor´s interaction. The social interaction and the physical museum environment are also important factors considered (Australian Museum, 2009; Yalowitz, 2009). Furthermore, the research methodology considers that the museum experience is a voluntary, non-sequential and responsive action to the museum environment. Therefore, it contemplates a great variety of factors that influence the museum experience, such as the visitor intellectual contexts, lighting, colors, sounds and other design factors (such as exhibition resources, showcases, objects, labels and captions) (Tallon, 2008, p. 21).

For that, the researcher needs to create observation sheets to guide the data annotation. It must consider four main aspects: situational variables (pointing to the level of capacity of the museums, the date of execution of the survey, day of the week, the observed period and the occurrence of special events at the institution); demographic variables (considering the estimated age, the number of companions and the gender of the visitor); visitor´s behavior and stops (including the total time spent in the area, the total number of stops per visitor, the proportion of visitors who stopped at a specific element; the downtime spent on each exhibit device and the time spent with other random activities (including breaks to wait for group members, to use the mobile phone and the time spent with social interactions) and also the route taken by visitors (the research must take notes about the approximate location of visitors stops). So, the exhibition path was divided in the following sections: Cosmos (1), Earth (2), Anthropocene (3), Tomorrow (4) and Us (5).

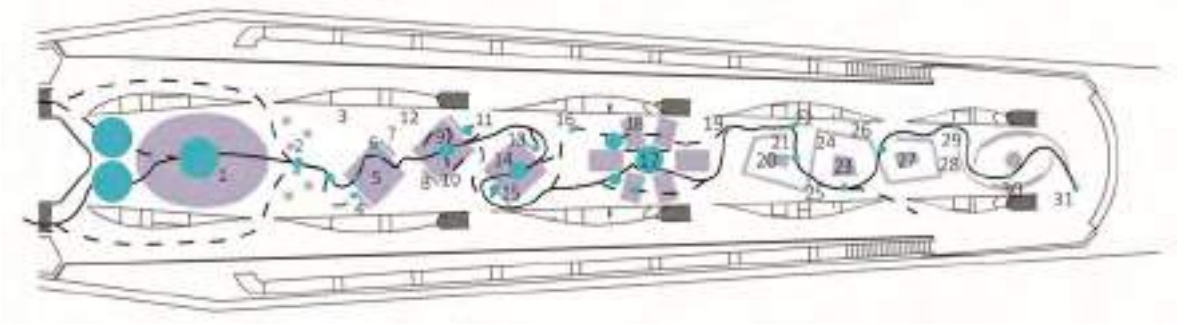

Figure 1- Visitation flows. First floor. Prepared by the author. Unscaled.

Device [% of visitors who stopped / average time per stop]: 1. Cosmos. 2. Interactive tables [53% / 55s]. 3. Text of "Earth" wall [7% /32s]. 4. Interactive tables [77% / 1min45s]. 5. Artistic installation "Materia" [53% / 1min06s]. 6. Wall text (cube 1) [7% / 32s]. 7 and 8. Interactive table. 9 e 10. Cube "Life" (indoor) [77% / 5min29s]. 11. Interactive table. 12. Wall text "Life" [7% / 32s]. 13. Table interactive 14. Cube "Thought" [50% / 2min53s]. 15. Interactive table. 16. Wall text "Anthropocene" [17% / 22s]. 17. Audiovisual installation [100% / 2min13s]. 18. Interactive screens [37% / 1min32s]. 19. Wall text "Tomorrows" [40% / 57s]. 20. Interactive table (1) - Ecological Footprint [30% / 3min37s]. 21. Interactive screens (1). 22, 25 and 26. Wall texts [40% / 57s]. 23. Table Interactive (2) - Human Game of Tomorrow [33% / 2min32s]. 24. Interactive screens (2). 27. Wall text "Us" [13% / 26s]. 28. Interactive table (3) [37% / 1min02s]. 29. Interactive screens (3). 30. Churinga [73% / 16s]. 31. Wall text (final) [13% / 26s].

For this research, it was considered only the spontaneous public of the museum, while group visits mediated by a monitor / educator or school visits have specific characteristics. The average time of each stop is generally conditioned by the mediating agent of the visit (educator, teacher, guide, etc.) and not by the intention of each visitor. It is commonly recommended to associate the tracking and timing methodology to the execution of interviews with the public, in order to better explaining the observed visitor´s behavior. For this reason, it was

decided to carry out non-directed interviews with the museum public as a complementary analysis to the mapping of flows, which result is shown at the Figure 1.

Based on the presented map, we will analyze the spatial relationship established between visitors, architectural space, and museum devices. As the map indicates, there are some points of greater confluence of visitors, such as the planetarium Cosmos (which causes large agglomeration points because its entry is controlled and restricted to a small group of visitors that remain on the device for eight minutes). Next, the access to the Cosmic Horizons section is possible for three entries, so that we do not know if these visitors have passed by the previous experience. Then, in the section Earth, the doors entrance to the cubes are narrow in relation to the flow of visitation observed and that causes agglomeration. In addition, the exit of the cube Materia is quite close to the Life´s cube entrance, so that many visitors do not see the interaction tables located in that area. Still, the exit of the Life´s cube is not well positioned regarding to the linear narrative. Next, in Anthropocene, there is a great confluence but there is not enough space for people who did not want to see it. The passage inside the caverns also seems too narrow. When leaving the section Tomorrows, several visitors were confused with the route to be followed, getting lost in the side areas. At Us, the final wall also creates some flow problems, although it improves the lighting conditions of the device.

The problems observed at the visitation flows occur because of the incongruous relation between architectural and museography design. The dimensioning of the exhibits seems incompatible with the high degree of visitors received by museum – about 581 people/ m² / year. We can also see that the free plan is not perfectly matched with the linear and sequential museal narrative, what causes problems that negatively impact the visitation flows. According to some visitor´s opinion, "*the side aisles of the museum do not work*"[1] or "*there is no sign to follow the correct rout. I felt a little lost. After visiting Cosmos, I went to the lateral hall, but I discovered that the way was wrong*"[2].

By analyzing the map, we can also point some general questions regarding to the visitor´s behavior and to the interaction with technological devices. The interactivity is an exhibition resource widely recognized by the public, being recorded by 17% of the visitor´s testimonies. The character assumed by interactivity, in large part, develops to transmit "information/contents", such as the following sections: Cosmic Horizons, Life, Thinking, Earth (interactive tables), Anthropocene, Caves and Tomorrows (audiovisual resources). These devices average medium current interaction time (Cosmic Horizons: 55s; Life: 5min29s; Thinking: 2min53s; Earth (interactive tables): 1min45s; Anthropocene: 2min13s; Tomorrows (audiovisual resources): 1min32s) and high maximum interaction times (Cosmic Horizons: 6min06s; Life: 7min52s; Thought: 9min11s; Tierra (interactive tables): 6min24s; Anthropocene: 7min42s, Tomorrows (audiovisual resources): 5min15s) (Lupo, 2018).

3.2. Analysis of interviews with the public

By analyzing the interviews with the public, we will reflect on the exhibition design strategies that were better fixed in the visitor´s memory. The use of audiovisual resources / projection was a widely used method, presented at the sensory experiences of Cosmos and Anthropocene. These were the most attractive elements for visitors (80 to 100% stopped in these installations), the most recalled in the interviews (Cosmos was mentioned by 24% of interviewed visitors and Anthropocene, from 7% to 10%) and those which take medium and high time levels of interaction: 8min in Cosmos and 7min42s in Anthropocene. The use of sensorial interaction with visual/corporal devices (inside the Materia Cube, for example) is less attractive than audiovisual projections (around 50% of visitors stopped in this device). The smaller immersion requested may be a factor related to the lower impact on visitor´s testimonies (from 7% to 10%).

The physical-manual interactivity with audiovisual / mechanical / electronic character was used mainly to allow access to digital collections, enabling access to specialized information. It was adopted in Cosmic Horizons, Life (interior), Earth (interactive tables), Caves, Tomorrows (interactive tables) and Tomorrows (audiovisual resources). However, it was possible to observe the repetition of similar contents in supports with

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[1] Visitor testimony interviewed by Bianca Manzon Lupo at the Museum of Tomorrow between September 8 and 14, 2017.
[2] Op. cit.

different designs. In general, it can be seen low times of interaction and low presence in interviews. The last type of exhibit design strategy used was visual / audiovisual interaction, which can be a single video, a big screen or small videos dispersed in the space. Despite this, the times of interaction observed in the sections Thinking (interior and exterior), Materia (exterior) and Life (exterior) were not relevant.

According to the testimonies, the interactivity is an important factor highlighted by the visitors, as we see in: "*we liked so much to interact with the displays and also the information presented"*[3] or "*I am in love with the information, images and interactivity"*[4]. Furthermore, many testimonies many showed visitor´s concern to the themes of sustainability, including: "*it is a clash of information about reality. The Museum talks about the future and opens the mind so that we are more careful with our present actions"*[5]*;* "*it is a place to reflect on our own attitudes and think about the world we want tomorrow*"[6]; "*it is a very important topic that makes us reflect on how the planet can be, on deforestation ... what the museum shows is very important*" and "*it makes you think about the future, about world´s increasing population, about the destruction of natural ecosystems, fauna and flora ... I was very touched"*[7]*.*

4. Final reflections

As the present study points out, the integrative design did not occur in the creation of the Museum of Tomorrow. In practice, the professionals involved found out a project fragmentated situation, what has caused problems in the construction processes of the spatial narrative regarding to the architectural space of the museum, which are visible due to the difficulties encountered by visitors according to the analysis of the visiting fluids. The interviews with visitors help us to clarify interesting aspects about their visitation processes. At the Museum of Tomorrow, the public doesn't seem to know how what they expect of the museum and wish to be surprised.

In their testimonies, some visitors demonstrated a mismatch between their expectations about what could be the "Museum of Tomorrow" and what was presented as a museum narrative. How to explain the extract: "*I think there should be more things about the future. I saw much about the past, the present, but I have not seen the future. We do not see all this pessimism to the future. But the museum lacks the future. Because it is a Museum of Tomorrow, right?*"[8]. The extreme opening of the speech and the proposal to constitute a museum of questions, and the number of answers, was also questioned by some visitors, as shows the excerpt: "*There were not some answers in relation to what I expected. I wanted to know how much we are sustainable and how we could improve*"[9].

In this way, the importance of museum design and architecture is pointed out. In the case of the Museum of Tomorrow, the architecture was not only faced as a container, but also as an active element for the creation of the museum narrative. As an example, the importance of Guanabara Bay as a narrative element, which has not only caused changes in the circulation scheme proposed for the building, as well as it has been a very prominent element in visitor interviews, being responsive for creating a message of hope at the end of the visit, as indicated the excerpt: "*it is incredible this ending that address you to infinity. Looking at the water has a positive impact on thinking about the future*"[10] or "*I loved its beauty. The view is spectacular. We feel within the Sea, within the city. You see all the beauty and think: what you are doing to keep it*?"[11].

From a theoretical point of view, many authors sign out the importance of the relationship between architecture, museography and museology during the museum conception process, in order to enhance significance layers in the

[3] Op. cit.
[4] Op. cit.
[5] Op. cit.
[6] Op. cit.
[7] Op. cit.
[8] Op. cit.
[9] Op. cit.
[10] Op. cit.
[11] Op. cit.

current museum space. Although integrative design was taken as a premise for the Museum of Tomorrow project, it did not properly happen due to the Olympic Games context and to the mismatch between architects and exhibition designers. At some specific points, as the final view, the strategy proved to be successful.

So, the present article tried to reflect on the understanding the process of creation and reception of a museum, trying to understand the relation between architecture, museography and museological conceptions. This research tried to contribute to the reflection about the museum as a space for interaction in contemporaneity. Although interactivity is a frequent theme in the testimonies of visitors, the spaces that most caught the public's attention contained audiovisual projections that interacted with the space. Perhaps due to people's excessive habit of interacting with cell phone screens, and the extreme repetition of this museographic solution in the museum's project, the interest in these solutions sights to be reduced. So, analyzing the Museum of Tomorrow, this study aims to contribute to deepen the knowledge about the integrative design applied to the contemporary museum.

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References

Agência Brasil, 2010. *Rio assina acordo com Barcelona para a preparação das Olimpíadas de 2016*. Agência Brasil. Rio de Janeiro. 18 mar. 2010. In: https://goo.gl/LPPSA9 (accessed 10/2017)

Australian Museum, 2009. *Tracking and observation studies.* Sydney, Australia.

Davallon, J., 1999. *L´exposition à l´oeuvre:* stratégies de communication et médiation symbolique. Paris: L´Harmattan, France.

Divulgação. *Museu do Amanhã,* p.44, Rio de Janeiro: s/ data, Brazil.

Dzikean, V., 2012. *Virtuality and the art of exhibition: curatorial design for the multimedial museum*, Intellect, Chicago, USA.

Jodidio, P., 2016. *Calatrava. Architect, Engineer, Artist,* Taschen, Colônia, Germany.

Lefaivre, L., Tzonis, Alexander, 2011. *Santiago Calatrava.* São Paulo: Folha de São Paulo,.

Lupo, B. M., 2018. Clerici, Andrés. Interview, in: *O museu como espaço de interação.* Arquitetura, museografia e museologia a partir dos casos do Museu do Futebol e do Museu do Amanhã. Dissertação (Mestrado em Arquitetura e Urbanismo), p. 204-208, FAU USP. São Paulo, Brazil.

Lupo, B. M., 2018. *Caldeira, Vasco, Interview*, in *O museu como espaço de interação.* Dissertação de Mestrado, Brazil.

Lupo, B. M., 2018. *Arquitetura, museografia e museologia a partir dos casos do Museu do Futebol e do Museu do Amanhã*. Dissertação (Mestrado em Arquitetura e Urbanismo), p. 201-203FAU USP, São Paulo, Brazil.

Lupo, B. M., 2019. *Morena, Daniel. Interview,* Rio de Janeiro, Brazil.

Lupo, B. M., 2019. *Graça, Larissa. Interview*, Rio de Janeiro, Brazil.

Machado, T. G., 2015. *Projeto expográfico interativo:* da adoção do dispositivo à construção do campo da interatividade, p. 252, Tese de Doutorado em Projeto, Espaço e Cultura. Faculdade de Arquitetura e Urbanismo. Universidade de São Paulo. São Paulo, Brazil.

Malicheski, Isadora Finoketti. *Contradições na espacialidade do Museu do Amanhã.* O percurso do edifício e o percurso da curadoria, Brazil.

Dissertação (Mestrado em Arquitetura). 2019. Universidade Federal do Rio Grande do Sul. Porto Alegre, Brazil.

Montaner, J., 2003. *Museus para o século XXI,* G. Gili, Barcelona, Spain.

Museu Do Amanhã, Rio de Janeiro, Brasil, in www.museudoamanha.org.br, accessed in: 26 abr. 2017.

O´Doherty, B., 2007. *No interior do cubo branco: a ideologia do espaço da arte,* Martins Fontes, São Paulo, Brazil.

Oliveira, Luiz A., 2019. *Interview* [granted to Bianca Manzon Lupo]. Rio de Janeiro, Brazil.

Porto Maravilha, Rio de Janeiro, Brazil, website, at: https://goo.gl/xDRDJw. Access in: 26 abr. 2017.

Porto Novo, Concessionária, 2015. *Museu do Amanhã.* Concessionária Porto Novo. 12 January. In: https://goo.gl/szKSLk. Accessed in: 25 out. 2017.

Ritto, C., 2012. *As lições de Barcelona para os jogos olímpicos do Rio.* Veja. Rio de Janeiro. 26 June Disponível em: https://goo.gl/y1Pjs5. Acessed in: 11 out. 2017.

Santacana i Mestre, J., Martín C., 2010. *Manual de Museografía Interactiva,* Trea, Gijón, Spain.

Sperling, D, 2005. *Museu contemporâneo: e espaço do evento como não-lugar. Atas de Conferência*. Seminário Internacional de Museografia e Arquitetura de Museus. Universidade de São Paulo. São Carlos, 2005. Disponível em: https://goo.gl/7FAmns. Acesso em: 25 fev. 2019.

Tallon, L., Kevin, W., 2008. D*igital technologies and the museum experience:* handheld guides and other media. Nova Iorque:

Altamira Press, 238p.

Tamaki, L. 2015. *Museu do Amanhã.* Revista Construção Mercado. 172. 25 November, at: https://goo.gl/xCpnw7. Access in: October, 2017.

Tolmasquim, A., 2019. *Interview* (granted to Bianca Manzon Lupo). Rio de Janeiro, Brazil.

Wagensberg, J., 2006. *Cosmocaixa. The total museum. Through conversation between architects and museologists*, Sacyr, Barcelona, Spain.

Yalowitz, S.; Bronnenkant, K., 2009. Timing and tracking: unlocking visitor behavior, in *Visitor Studies*, 12, 1, p. 47-64. Abingdon, USA.

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Exhibition Architecture in Turin.

Through the gaze of Pier Luigi Nervi

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Abstract

Expose, from latin Exponere, ex-ponere, show, take out, allow something to be seen, is usually connected to the art exhibition in a museum; art in the widest sense of the word that includes sculptures and paintings, both from the past and from the present, art exhibitions or performances that take place in a closed place like a museum. But if we consider the wide meaning of the word which is to show something out we can include more objects and more places. What we should exhibit, and which should be the character of the architecture of exposition? Today there are many museums on the ancient tradition, that exhibit artisan works such as ceramics, glass, wooden objects and so on; but also museums of visual arts like cinema or photography. Showing is a way to know the past, the history and the culture of a place defining a heritage to broadcast to the future: knowing the past and the present to act in the future. Like Joseph Paxon teaches building the Crystal Palace in 1851- the first pavilion of the Great Exhibition of the Works of Industry of All Nations-, to show is also a way to know the best abilities of a Nation, to pay attention to technological and technical innovations. From that moment on, the exhibitions became a way both to show and to exchange knowledge between countries and people, in the form of what we could call a "temporary exhibition" where showing something new and innovative. In that tradition are included the architectural projects of the middle of XX century built in Italy for exhibitions like Italia '42 in Rome, Italia '61 in Turin, the car show in Turin, the three-year exposure in Milan and so on; many initiatives to show national and international abilities and progresses in many purviews. Between the 50s and 60s Pier Luigi Nervi built in Turin important exhibition halls: The Turin Exhibition Hall (Agnelli Salon and Salon C) (1947-1949) and The Palace of Labor (1959-1961). These are big buildings to expose the innovation in the automotive sector (Fiat) in the first case and the innovation of the century of transport in the second case. These buildings, very different from each other, express the engineer's ability to shape materials, such as concrete and steel, reducing structures into essential elements that qualify the space itself without the need for decoration or added elements. The structures, in accord of the natural light definite an emotional space that allow to qualify the exhibition objects, welcomed in an embrace. The structural solutions allowed to build the Palace and the Hall in a short time using few materials thanks to the reutilization of formworks for the cast in place concrete in Palace and the use of precast concrete for the Hall. Structures composed of the repetition of single structural elements, ribs and pillars, define the entire space and at the same time represent the way to illuminate the space in a uniform way, in accordance with the temporary exhibition and the exhibits. Light and shadow decorate the space without needing anything else, in the exaltation of what is exposed but not as a cold and anonymous container, but with character and independence. The ribbed structures, designed in accordance with the laws of

Keywords: Turin, Exhibition, Pier Luigi Nervi, space, light, structure, concrete

physics, represent the true decoration of space that is defined only by these. We can define these buildings as composed only by structure and light. The architecture shows the progress and the capacity of time - like the exhibits - but always with a deep connection with the past and cultural heritage.

1. Introduction

1.1. Exhibiting what?

Expose, from latin *Exponere*, *ex-ponere*, show, take out, allow something to be seen, is usually connected to the art exhibition in a museum; art in the widest sense of the word that includes sculptures and paintings, both from the past and from the present, art exhibitions or performances that take place in a closed place like a museum. But if we consider the wide meaning of the word which is to show something out we can include more objects and more places.

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1.2. Larger architectures and greater simplification

In the architectural field and in the modern era in which Pier Luigi Nervi works, the tools available are many: on the one hand the research about new materials, in particular reinforced concrete, on the other the progress of sciences and techniques; all this gives designers greater expressive possibilities both in architectural and structural terms.

With the industrial development, steel and reinforced concrete structures spread thanks to their ability to meet the new needs of society which is in continuous and fast growth both for industrial development and for social progress: large new buildings are built such as theatres, cinemas, and stadiums to welcome a large number of people. Just think of *Le Halles* market in Paris designed to accommodate many people in order to define a different use and conception of the city.

The architecture is simplified, more and more as the buildings grow in size; the essentiality of form and space become necessary in a society where change is rapid. Nervi's architectures are born from economic needs that affect all project levels and try to solve the technical and artistic aspects with the least possible waste of energy, up to the use of prefabrication, a method of which Nervi manages to make an original use, innovative and qualifying. The principle of economy guides every choice: economy of materials (materials immediately available, simple to use and in small quantities), economy of money, economy of gestures that corresponds to the reduction of the decorative element and economy of time (speed of realization).

The development of new techniques accompanied by a modification of the society and its needs requires a reflection on the development of architecture, in fact, as Nervi observes, the large-scale works cannot in any way disregard the static requirements: structural design and planning architectural merge into one thing. Nervi suggests that in the future we will move towards a "style of truth" with the complete abandonment of every type of decoration; this does not necessarily imply an impoverishment of the architecture as, in addition to the beauty of the great works, expression of forms deriving from the static behaviour, even the minor architecture will be

able to benefit from the abandonment of useless decorations, favouring the relationships of volumes and surfaces, enriched with colours and with construction details.

The static needs of a building can be met in multiple ways, but the approach adopted leads to different results: the mere application of the formulas leads to the definition of inexpressive structures.

Otherwise, an approach that considers the physical laws and the trend of the forces can lead to the definition of expressive and aesthetically appreciable constructions. Almost as if everything that adheres to the laws of nature, even if we cannot have a direct perception of it, arouses harmony. He observes that none of us "had any sensitive knowledge of the fact that the funicular of uniformly distributed loads is a parabola, yet these newly discovered truths are immediately understood and felt as if they were born within us and for us." (Translated by the author, Nervi 1951)

2. Exhibition Architecture in Turin of Pier Luigi Nervi

Nervi won the public contract for the design and realization of the Palace of Labor in 1959 for the exhibition of 1961 in Turin to celebrate the centenary of the Unit of Italy. He had already built in Turin the Agnelli Salon (or B Salon) in 1947 and its extension in 1953 and the Salon C (1949), both for the Turin Exhibition Hall. All are big exhibition buildings, aim to show, in the first case the innovation in the automotive sector (Fiat) and in the second case the century transport innovation.

These buildings, very different from each other, express the engineer's ability to shape materials, such as concrete and steel, reducing structures into essential elements that qualify the space itself without the need for decoration or added elements. The structures, in accord of the natural light definite an emotional space that allow to qualify the exhibition objects, welcomed in an embrace.

2.1. The Palace of Labor

Nervi designed and built the Palace of Labor in Turin as a large exhibition hall for Italia '61, expressing his ability to control every aspect of construction through the design. The winning project was the result of the competition announced in July 1959 where dozen important Italian designers were invited to participate. The Hall had to be the place to welcome the international exhibition of Labor for the celebration of the first centenary of Italian Unity. The competition forecasted the design of a big building with a covered area of 25.000 square meters and an exhibition area of 44.500 square meters considering a future transformation of the building into a Center for Professional and Technical Training, to be built in ten months, foreseeing the date of the opening of the exhibition on the May 1st 1961.

The need of economy covers every aspect of the project: economy of time, economy of money, - in fact, the building was required to be inexpensive -, economy of materials and economy of space. At the same time there was the intention to build up a space of noble appearance comparable with the nobility of its aims.

Nervi's architecture, as Giulio Carlo Argan observes in 1955 on the essay "*Pier Luigi Nervi*" published by *Il Balcone*, is mainly defined by the structure in relation to space (size and proportions) and natural light. The structural invention contemplates all these aspects, representing in itself the expression of the quality of the building.

The limited time led to the brilliant final solution and inspired the engineer's ability to design space and structure. In the Palace of Labor, the structure and the architecture are composed of a series of mushroom-shaped pillars whose repetition gives rhythm and defines the space. A regular rectangular unique and unitarian space is characterized by pillars which repetition is at the base of the project that solves in that way the complexity of the request. The pillar and the covering represent one another's extension and vice versa. The pillars are shaped following the course of the forces and the result is a monumental element, with a strong character, almost a Greek column.

The pillars rhythm the space, measure it and define it, leaving the façade free. There is a pause of light between one ceiling and another. Elements in the form of tapered ribs reaches out towards the linear thin light that separates one element of the roof from the other.

The effect is of a highly expressive spatiality where the horizontality prevails over verticality, despite the great height of the building, and characterized by shadow and light that alternate in a contrasting manner. The

proportions and the monumental dimensions bring back to mind the Greek architecture, where the single element expresses the qualities of the entire composition.

Fig. 1. The Palace of labor, exterior (TSLF) and Fig. 2. Detail of the angle solution (TSLF).

Fig. 3. The Palace of Labor, exhibition of 1961 (NS) and Fig. 4. The Palace of Labor under construction (TSLF).

Fig. 5. The palace of Labor interior (TSLF), Fig. 6. Detail of the pillar (TSLF) and Fig. 7. Detail of the ribbed ceiling of the gallery (TSLF).

There is no need of nothing else, the structural solution coincides with the light solution: linear light that comes from the covering separates the elements from each other underlining their structural independence. The result is an alternation of light and shadows that emphasize the ribbed character of the ceiling that seems to pander the trend of the light on the surface.

These zenithally light, apparently few, thanks to the height of the space spread itself in the space illuminating it in a diffuse way.

It becomes a space able to receive the exposition of every type of objects that do not need a direct light, in fact, the flexibility and the indirect illumination perfectly accord to different uses and different type of exhibitions.

The structure represents at the same time an element of support and decoration defining the space itself. The structural solution allows to build the Palace up in a short time and with few materials, in fact, it was enough one formwork to replicate all pillars in reinforced concrete.

The cruciform section at the base of the pillars is connected by straight lines to a circular section at the top, the shape is designed in accord of the resisting capacity of the pillar to the bending moments caused by the wind on the glass façades. The pillars were cast on site, instead, the mushrooms were realized in a prefabricated way with a metal structure to reduce the time of constructions.

The high glass façade allows a big quantity of light to come in, but despite that, this does not generate an excessive difference in lighting or a dazzle, in fact, the light is shielded by a system that breaks light and diffuses it into the space. This system is set on the South, East and West façades, instead the northern one is free: in that way the light is perfectly balanced and controlled. Also, the perimetral gallery intercepts the light and allows it to come inside in a diffuse way. The ribbed ceiling of the gallery is decorated by the trend of strengths inside it, that solution was developed by Nervi in many buildings such as the Gatti's woolen mill. The light wet the ribbed surface in a grazing way as a Baroque architecture.

An external steel structure supports the façade decorating it and allowing the housing of the light shielding system; a projecting ceiling with a ribbed intrados is shaped to support the steel structure. So, the façade is clearly read as an element hang to the covering, underlined by the fact that it does not reach the ground, the glazed "basement" moves back defining a covered path.

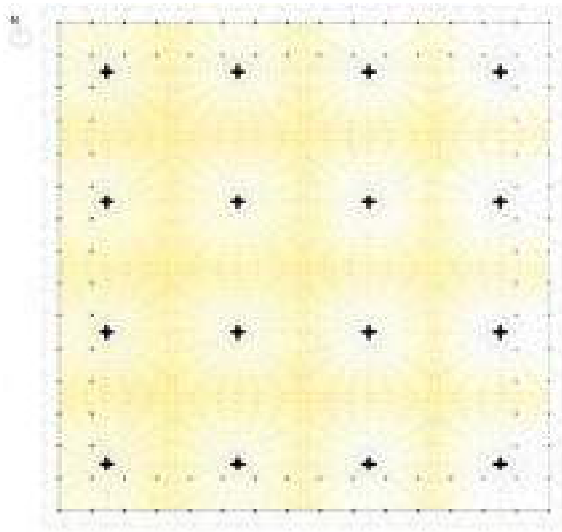


Fig. 8. Palace of Labor's plan with light study (AB) and Fig. 9. Palace of labor's section with light study (AB).

The attention given to the definition of the detail expresses an artisanal consideration to the construction even on a large scale, an expression of the Italian engineer's ability to totally control all the elements of the work.

The detail with which everything is realized contributes to the spatial quality of a building that must hold together all the aspects of the design, from the proportions, the structure, the technology, and the lighting conditions.

2.2. The Agnelli Salon

The Turin Exhibition Hall corresponds to the area occupied by the Fashion Institute designed by Ettore Sottsass and destroyed during the war. The Hall had to host the first big International Automobile Show of the postwar period in 1948, it was opened on 15 September 1948 and advertised as "the most beautiful palace Italy has ever built", in 1949 it also appears on the cover of "La technique des travaux".

It was designed as a big rectangular free hall (94,30 x 75 m) with a circular apse; between 1953 and 1954 it was expanded by five spans that permanently erased the interior garden. In the same years Nervi with Ettore Sottsass designed a further extension that provides for an arc of 100 m of light on the main front but the disappearance of Sottsass in 1953 stopped the project; meanwhile in 1949 there was added another space that is the Salon B.

As Nervi observed, there were many problems to solve, all linked together: static, constructional, and architectural problems. The aim was to design a space with aesthetic sensitivity in accordance with the technical possibilities. A big vault was designed as composed of repeated and precast reinforced concrete elements in order to cover a so big space, that solution allows to reduce costs and time of construction: “the static problem which was presented by the covering for the large hall tend me immediately think of a thin shell vault with large undulations. This offered many intrinsic technical qualities, such as maximum static efficiency and minimum use of material. It also permitted openings for windows on the side of the undulations. The brevity of time allowed for construction and the economic requirements directed me toward a solution using precast elements.” (Nervi, 1965)

The Agnelli Salon is covered by a single thin undulated vault composed of prefabricated (on site) concrete elements supported by a series of pillars arranged at regular intervals shaped and sculpted to join in a system of three-way fan (the undulated system had been recently experimented for the realization of the hemicycle pavilion of the Fiera di Milano (1946) as illumination system). The rhythm of the structural elements and the spatial directionality have as their focus the semicircular apse, covered by a semi-dome in rhomboid prefabricated elements.

The arched vault is harmoniously connected to pillars that seem to stretch out to lift the light decorated veil. A spatial compression defines an ambulatory along the longitudinal sides on two overlapping levels, almost like a church with a *matroneum*. The space presents a strong horizontality bringing back to memory a classic spatiality: everything is symmetrical, in the section the hierarchy between spaces, with compressions and expansion, scale and shape variation, is clearly established.

The large apsidal space, surrounded by a reduced measurement path recalls, in its dimensions and proportions, the great basilicas. Like for Roman architecture, space is perceived as a unit despite the fragmentary nature of the elements; the section differs, for structural reasons, but the intention is similar, that is to cover the large main space with a single element.

Fig. 10. The Agnelli Salon, exhibition (TSLF). Fig. 11. The Agnelli Salon (TSLF).

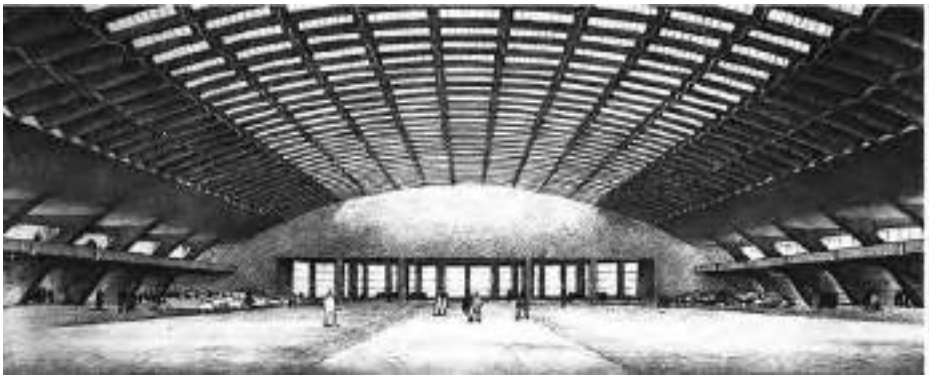


Fig. 12. Sketch of the Agnelli Salon, not realized solution (TSLF). Fig. 13. The motor show of 1956 (TSLF).

The light comes directly from the cover which, in addition to its structural function, performs the role of controlling light and defining the boundary between inside and outside. The problem of the limit, as Giulio Carlo Argan observes (cp. Argan, 1955), is identified with the problem of illumination in a phenomenological and not purely geometric or constructive conception of space.

Light defines a static space, preventing us from understanding the actual measurement of it. In fact, light is never incident, but always uniform and widespread: an almost eternal, timeless ethereal environment. Argan about this architecture states: "In the most recent works, in fact, research becomes more subtle, it truly aims at creating a more humane environmental condition by means of "covering ", giving space, not just a dimensional definition, but a vibrant atmospheric and luminous substance. In the Turin Exhibition main Hall, the vault is both a spatial term and a continuous light source, which ensures an oscillating illumination inside, whose frequency of vibration is determined by a succession of wavy fins."(Translated by the author: Argan, 1955)

The sinuous vaulted shape of the covering is underlined by the soft pattern of the ribs. The lighting of the entire environment takes place through the cover, the light filters in through the individual segments defining a regular rhythm. The sinuous sectional shape allows the light to slip over it, thus the shade decoration is softened. Uniform and diffused light that rains from the top without fully understanding the origin except for the visual relationship established with the outside through the large circular windows of the apse, in turn shielded by a projecting floor. The elegance of the intrados matches the large pillars modeled to connect with them.

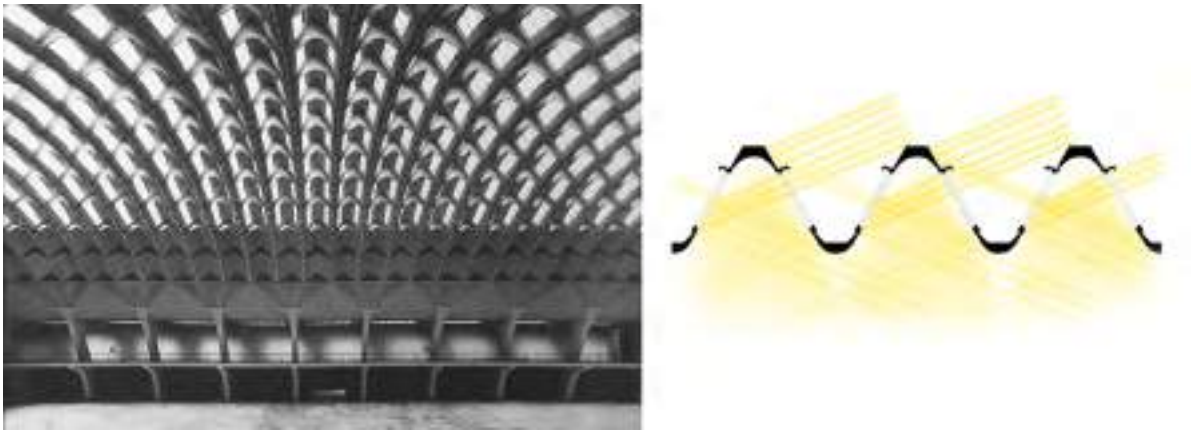


Fig. 14. The Agnelli Salon's pillar system gallery (TSLF). Fig. 15. Detail in section of the covering with the study of the light (AB)

The undulated vault represents at the same time the static, constructive, and architectural solution, in fact, thanks to the section of single elements Nervi was able to open little windows that bring zenithal light

inside the space in a diffuse way. The light ray reflects itself on the undulated surface before coming inside. A static atmosphere of calm is so obtained. The light in accord of the shape and the proportion of the space defines sensations.

Nervi about this project states: "Once all the technical and construction problems were examined and resolved and once the stresses resulting from the vault were approximately determined it was possible to pass to the second design phase, that is, to the definition and proportioning of the whole and of the parts, with the goal of achieving the greatest possible aesthetic harmony and architectural expression. The great difference between these two design phases is that the first is objective in character and answers only to the technical, while the other is completely personal, and cannot be controlled by rules or reasoning. In this case the first phase determined the general principles: an undulated thin-shell vault made up of precast elements, the supports inclined according to the resultant of the stresses in the vault; a weight limit for the elements; and a method for erecting and joining them. The second phase defined the spatial qualities, dependent on the height of the vault; the form of the undulations; the details of the diaphragms; the form and profile of the supports and of the lateral balconies (always within the limits of the static requirements); the dimensions and position of the windows in the vault; and the passage from the continuous undulated structure to the discontinuous one formed by the supports on which the vault had to rest a detail of great architectural interest." (Nervi 1965)

He underlines the importance of the relationship between these two apparently different aspects, the technical and the perceive ones that together led to a harmonic result, so the space express his power and his expressiveness and can excite.

The semicircular apse is covered by a half dome composed of precast rhomboidal elements supported by pillars on which rests a perimetral slab which absorbs the forces of the whole vault. This was built with the process experimented in Rome for the *Torre Pietra* warehouse, the aim is to decompose the structure in little precast elements and then link together in a self-supporting vault.

This was the first case of Nervi's application of the precast concrete system (ferrocement) for a so huge building, then it would become the main building technique (Rome sport palace, Rome sport Hall, Pontifical audience hall in the Vatican, Festival hall *Chianciano*, and so on).

The structure represents the decoration of the ceiling and the expressiveness of the space at the same time, there no need of further decoration, the structure solves all aspects qualifying the space in accord of the light.

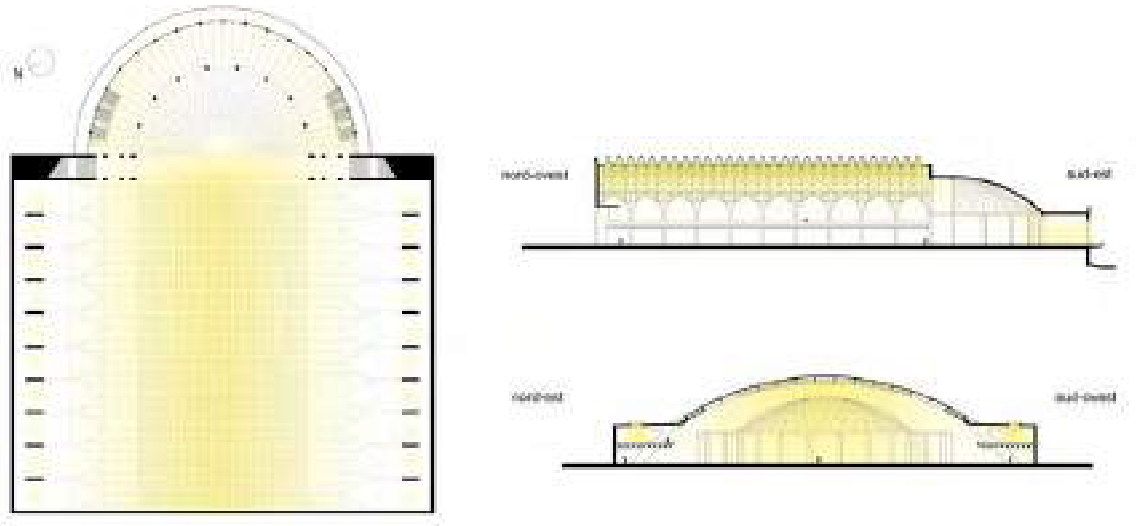
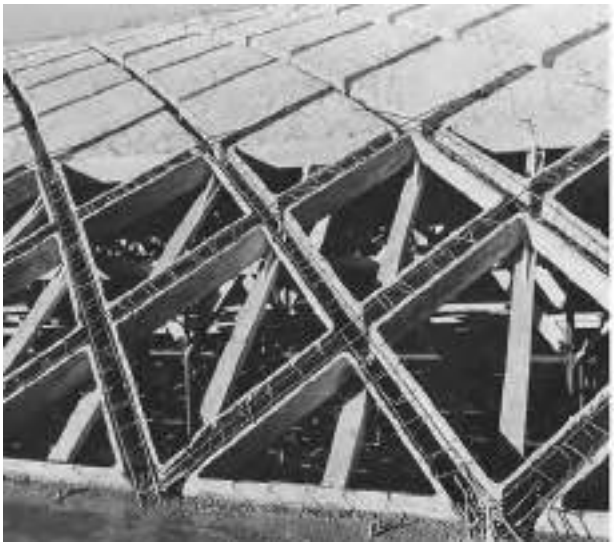


Fig. 16. The Agnelli Salon's plan as realized in 1947 with the study of the light (AB). Fig. 17. Sections with the study of the light (AB)

2.3. The Salon C

The Salon C in Torino Exhibitions, designed and built by Nervi in 1949 as an enlarge of the complex of Turin Exhibition Hall, is characterized by a linear space with a rectangular plan (50x 65 m) covered by a barrel vault with pavilion heads with prefabricated elements (similar to the Hangars of the second series built in Orvieto, Orbetello and Torre del Lago Puccini (1939/42)), supported by four inclined arches and by a perimeter path covered by a slab with wavy beams in prefabricated ferrocement. The Salon was built in few months between the closing of one exhibition during the fall and the opening of the next one in June.



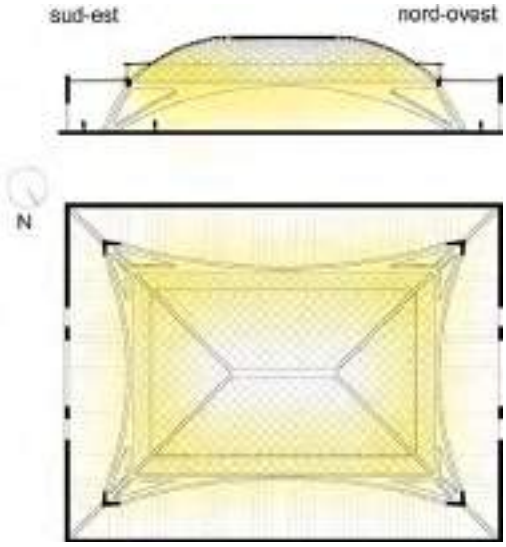


Fig. 18. The Salon C under construction, detail of the precast ceiling (TSLF). Fig. 19. Plan and section whit the study of the light (AB).

Fig. 20. The Salon C, motor show (TS). Fig. 21. The Salon C (TSLF).

Here too is used prefabricated method based on single ferrocement rhomboid elements, precast on site and then link together with a concrete casting in order to attach elements statically together. The rhomboid elements act as formwork for the ribs and, thanks to the geometric regularity of the planimetry, it was possible to use a small number of elements, repeated several times. These elements are linked to the supports by a perimetric slab such as in the apse of the Agnelli Salon. All around the main hall there is a perimetral path with a different high compared to the main hall: the decompression of the space in

section underlines the importance of the central space and emphasizes the crescendo, such as occurs in Agnelli Salon where the section shape matches the sequence of space from the entrance to the main hall, from the shadow to the light.

The relationship between the structure and the light that penetrates inside uniquely defines the space. Lighting occurs in the lower part of the vault, almost defining an "entablature" of light. The light coming from the top and being filtered by the rhomboid elements is uniform and widespread. The unique and welcoming environment takes on the giant scale both for the large, lowered arch supports and for the growing section of the vault. It is the light, as in the other projects, that defines the atmosphere.

As on many other occasions Nervi prefers to illuminate the lower part of the vault and not the central part. The dramatic nature of the space diminishes and rejoices in an almost ethereal condition of light that sculpts the light ribbed roof. This led to illuminate the space and the vault in a diffuse way underlining the structural decoration of the ceiling with need of nothing else that is structure and light in the definition of space.

3. Conclusions

Nervi considers the achievement of architectural expressiveness a natural consequence of a correct design, seeing the technical architecture and the aesthetic problem strictly connected. The method adopted by Nervi leads to the definition of forms that do not represent the presupposition or the main objective of the design, but a natural consequence of a project that seeks a phenomenological spatiality defined by the structure.

The constructive process constitutes the decisive invention of a form both from a technical and expressive point of view. The structure, and together with it the entire architecture, identifies the best possible solution in conformity with the physical laws for achieving harmony of proportions and forms. According to Nervi the main task of the designer is to give expression to the different factors of a building, he must be able to have a clear general concept of all aspects of the construction process, in the same way that a director must know the possibilities and the limits of every musical instrument. (cp. Nervi, Cosenza, Marescotti, Levi-Montalcini, Quaroni, Astengo 1955)

Structures composed by the repetition of single elements, ribs, and pillars, define the entire space and, at the same time, represent the way to illuminate the space in a uniform way, in accordance with the temporary exhibition and the exhibits. Light and shadow decorate the space without needing anything else, in the exaltation of what is exposed but not as a cold and anonymous container, but with a character and independence.

The principle of economy guides the design of Nervi for all his works together with a constant experimentation with materials and techniques driven by the interest towards knowledge and the possibility to overcome his own abilities every time. Construction is the true protagonist, which with a simplification process reduces itself to the essence, what remains is not that the structure, structure that supports, defines the form, the space, the language and the aesthetics.

The space is defined by proportions, structure, materials, and natural light. Architecture is poetic and can be defined as such only when it is able to arouse emotions, as the maximum expression of a conscious use of technology and materials: the achievement of harmony between technology and aesthetic sense is only possible if intuition guides the design, pertaining to the sphere of art, predominating over science. The goal achieved is the essential nature of the work. Essentiality that has led Nervi to an ever-greater identification of architecture with the structure itself, as an element that supports but at the same time defines the space.

As Giulio Carlo Argan in 1955 observes, all Nervi's architecture is reduced to structure and light, a structure that defines and envelops the space, translating an idea into reality. It is the relationship between structure, space and natural light that defines that harmonic balance able to arouse emotion in the same way as the great architectures of the Past. The structure with Nervi becomes itself the project, the solution to all those technical, aesthetic and perceptive aspects that characterize the best architectures.

The starting point is an idea, an idea of space able to arouse emotions as architecture is first of all poetic inspiration. The construction technique, the materials, the mathematical formulas are tools to translate all this into real construction.

It is possible to observe that in Nervi's architecture the space is often unitary whether it is linear or central and the unity is given by the repetition of the structural element which is both support and decoration; the relationship between the structure and the light, suitably calibrated, together with the wise use of materials informs the space. Matter and rhythm are closely linked to measure and proportion, instruments to which Nervi pays much attention to define the space as a whole perceptive so that it is able to arouse emotions.

The hierarchy between spaces is often denounced by the difference in section (compression and decompression) according to the geometry in plan (linear, central).

The repeated structural element underlines the geometry of the space in a harmonious balance where the technical solution and its realization vary according to the requirements in perfect harmony with the spatiality achieved. The ribbed structures, designed according to the laws of physics, represent the true decoration of space that is defined only by these. We can define the buildings as composed only by structure and light.

The architecture shows the progress and the capacity of time - like the exhibits - but always with a deep connection with the past and cultural heritage. As Moretti observes: "The moderns seem to have forgotten the laws of sequences of internal volumes. They have to reconquer space as a sensitive and living element, and not from a secure extrapolation from graphic symbols. Now we can judge from reality what mistakes modern architecture has made by ignoring the spaces in their concreteness; obviously admitting that modern architecture lives from reality and is not transferred as a fact of culture to its two-dimensional symbols, drawing and photography." (Translated by the author, Moretti 1953)

The lighting of the space through the definition of the covering as the boundary between inside and outside in Nervi's buildings takes place with two main attitudes: at the impost of the vault and of the covering itself (vault or floor); these can coexist without ever interfering with each other. The lighting at the impost of the vault, strongly linked to the Byzantine (e.g., Saint Sophia Church and Saint Irene Church in Istanbul, the monastery of Ossios Loukas in Distomo, Basilica of San Vitale in Ravenna,) and Baroque architecture (e.g. Church of San Carlo alle Quattro Fontane and Sant 'Andrea Church in Rome), bathes the entire vault in a grazing manner, enhancing the structural decoration like Baroque architecture do. Nervi, in fact, illuminating the domes at their impost, screens the light so that it never enters directly. The diffused and above all grazing light to a ribbed surface of which it is not possible to identify the light source is typical of the Baroque architecture.

The light from the covering represents instead an attitude comparable to that of the Classical architecture, just think of the Pantheon, the numerous Renaissance domes (e.g. Church of Santa Maria del Fiore in Florence, Church of Sant'Andrea in Mantova, Pazzi's Chapel in The Holy Cross in Florence, Old Sacristy in the Churc of San Lorenzo in Florence, Cathedral of Pavia), the Baroque churches of Bernini and Borromini (e.g. oratory of re magi in the Propaganda fide Palace in Rome, Curch of Sant'Ivo alla Sapienza in Rome, Collegiata of San Tommaso da Villanova in Castel gandolfo) or those of Juvarra (e.g. Basilica of Superga in Turin) and Guarini (e.g. Chapel of the Holy Shroud in Turin).

Nervi always prefers indirect lighting, even when it opens a central oculus in the dome, it does so by shielding the light and inserting an element inside which the beam breaks and is reflected (the Rome sports Hall and the Sports Palace of Rome).

The lighting condition in the definition of space represents, in history, a founding element of architecture. In the same way, in Nervi's work, lighting represents an indispensable element in design, always in close relationship with structure and space. The Exhibition Buildings in Turin demonstrate the attention given to the lighting condition of the ambiences, conceived in their three-dimensionality. The diffused and uniform light suspends the time of which it is not possible to understand the passing; the feeling is that of an ethereal architecture defined by light coverings decorated by the structure itself.

References

Nervi P.L. 1951. La proporzione nella tecnica, in. *Domus* n. 264-265, December, pp. 45-47, Editoriale Domus, Milano, Italy.

Nervi P.L. 1965. *Aesthetics and Technology in building, The Charles Elliot Norton Lectures 1961-1962*, Harvard University Press, Cambridge, UK.

Argan G. C. 1955. *Pier Luigi Nervi, architetti del movimento moderno*, Il Balcone, Milano, Italy.

Nervi P. L., Cosenza L., Marescotti F., Levi-Montalcini R., Quaroni L., Astengo G. 1955. *Architettura d'oggi*, collezione del Vieusseux, Vallecchi editore, Firenze, Italy.

Moretti L. 1953. Strutture e sequenze di spazi, in *Spazio*, n. 7, December 1952-April, Università di Roma 3, Roma, Italy.

TSLF _ Technological science library of Florence, Architecture Archive, Pier Luigi Nervi's fund

NS _ Nervi P.L., "Nuove strutture", Edizioni di Comunità, Milano, 1963, p. 134

TS _ http://www.mqcvisions.net/TorinoSparita/

AB _ Angela Benfante

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The Military Museum of the Polo di Mantenimento Pesante Nord di Piacenza

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Abstract

The Military Museum of the *Polo di Mantenimento Pesante Nord* of Piacenza is a tiny and unique reality, though complex. It consists of a collection of vehicles and instruments, typical of the arts of military and warfare production. It is a collection of military and non-military objects exhibited in the area of the so-called *Polo di Mantenimento Pesante Nord*, historically intended for the production and maintenance of strategic, tactical, and logistical equipment of the Italian Army. If you thought that this is a place mainly devoted to the means of combat designed for martial activities, you would have no less a reductive idea of this 'landmark of memory'. After the unification of Italy, the barracks and military areas of Piacenza have housed workshops and factories of armaments but have also forged men and developed scientific and technical skills, which have enriched the heritage of workers and design skills of the mechanical industry of Emilia as a whole. Not to mention that among the barracks, which were built in the second half of the XIX century, it is still possible to recognise the precious remains of the Renaissance bastion walls, which remained included in the military area. This contribution aims to describe a technological centre of excellence, still operational, with an annexed museum complex (in progress) which consists of individual and departmental weapons, factories from the early XX century, armoured vehicles, tools for the design and construction of particularly valuable and high-precision factories, as well as the remains of *Pierluigi Farnese* Castle (keystone of the XVI century fortifications of the city). The purpose of this presentation is to establish the essential principles to be inspired by when creating an exhibition of significant historical and educational value. Elements ranging from the Sangallesque bastions to ancient and modern instruments for the works of fusion and metallurgy in general are examined. Among real buildings of monumental value and miniature models, we can tell the story of the Po Valley, from Humanism to the contemporary period, with a critical and attentive look at the Industrial Revolution. We intend to carry on a deep analysis of a truly complete and unique collection of objects, which unfolds in time and space, outlining the history of the City of Piacenza. We have the opportunity to design a museum, using the spaces of existing factories, walking through the city walls, through the barracks. In practice, in order to develop the point and make it clear, a conceptual map is drawn. Not only is the museum that serves the purpose confined to a building, but it also relies on open-air places, playful areas, and points of dissemination of education and culture. The museum displays a set of living monuments, rich in historical value, is close to still active laboratories which can be used in part for the maintenance of the pieces on display. Local, military, civil and industrial history are the main themes to be analysed and included in this cultural and educational synthesis aimed at providing them with an adequate and harmonious framework. In doing that, it is possible to describe a collection of very different objects (in shape and size) and a collation of events to be duly taken care of in a large permanent exhibition all around the city. The blacksmith's hammer and pincers, the metallurgist's forge, the topographer's compass, the mechanical designer's table, the gunner's calibre, the sculptor's castings, the painter's wall decorations, up to the architect's great

Keywords: work in progress museum; culture; technology.

Sangallesque bastion. In the open air and under the metal trusses of large workshops, a few tracks and an old yellow locomotive are still there, where in the past they were used to supply materials to the workshops and the laboratories. A collection of memories, shapes, and structures to preserve, collate and restore.

1. General and historical background

The Military Pole of Piacenza was formed after the proclamation of the Unification of Italy. Historically, the city has always had a vocation as a traffic hub, on the river Po, between the Mediterranean Sea and Central Europe. A disputed place between the Seignory of Milan and the Serenissima, it rose to the rank of Duchy when, from the territory of the State of the Church, Pope Paolo III Farnese made it a feud for his son, Pierluigi, at the dawn of the 16th century.

The *urbe* surrounded by bastioned walls, a strategic stronghold in times of war and peace, welcomes a large number of convents, churches, barracks. In the 19th century, under the Kingdom of the Savoy, the good military tradition continued and strengthened.

In the heart of a region rich in factories, cradle of the manufacturing industry of the 20th century, it is also the centre of construction and maintenance of "pieces" of artillery. The construction of fire mouths and, at the same time, explosives and ammunition is preserved; the good technological and logistic school of the *Pontieri* thrives, cannons, special vehicles and tanks are maintained. After the World War II, the complex production system became a point of reference for the construction and maintenance of weapons and military vehicles.

Mechanics, draftsmen, architects, engineers, topographers, experts in fine measurements, blacksmiths, smelters, animate this place. The design of armaments, their correct conservation, and knowledge of metallurgy constitute a solid and, for many years, constantly growing heritage. Historical stratification and tradition are of fundamental importance in this context. The signs left by time are meaningful. They range from the tools of the work to the means maintained and punctually repaired and restored. Important are the buildings, too, which were designed to house laboratories and workshops. They represent telling examples of buildings from the 19th and 20th centuries, still in use, despite the fact that in the last thirty years the activity has been reduced.

2. The technological, historical and cultural heritage

The issue that arises spontaneously is whether we are faced with a centre dedicated to war industry, or whether the definition of a defence logistic pole, contains within its important data and meanings for the history of Piacenza as a whole. The latter instance leads to an exact understanding of the places under observation.

The history of the Polo di Mantenimento Pesante Nord and the apparatus of the Army Corps of Engineers is not only a chronicle of military events. It is the history of the city. It is a narration of cultural, technical, scientific, and business events. It is a social and urban heritage. Knowing how to size a fire mouth and forging its material led to a full understanding of metal modelling. Here, next to callipers and feeler gauges, there is also a description of the "lost wax" melting process.

The care of the equipment also included the intervention of master leathermakers who made the horse harness, saddles, and other pieces of equipment for regiments and military corps. Tailoring skills, for uniforms and fabrics of different uses, the artillery, with the design and production of "mascoli", hulls and bullets, form, from a chronological point of view, the first important core of the whole system. Alongside these important preparations, the hospital for the troops of the newly established Italian Army was built.

The construction was inaugurated in 1869 and bears the characteristics of modernity and rationality in its internal distribution. At the same time, it shows in the aesthetic and formal solutions of the fronts, the fundamental qualities of architectural eclecticism. In the current state of affairs, this important building body, for its attributes already in practice a museum of itself, lies unused in the building fabric of today's city.

This notation also provides a way of contemplating the built heritage of the entire facility. In a similar picture, old factories in Art Nouveau style, precious testimonies of the 20th century industrial architecture, stand out. Both the places and the objects contained there can be considered important memories. The rooms of the former porter's lodge are precious: the interior plasters are finely and imaginatively decorated according to the taste of *Belle Epoque* and stylistic historicism. The geometries outlined by the brush are a skilful mix of craftsmanship

and nascent industrialism. They have become objects to be preserved the same drawing tables of the very good technicians and designers of the Military Genius. Today this is the first true nucleus of a museum in progress, a space that is being organized as a place of memory. The military hierarchies, the staff, including some of those who have served in the factories and who now put their precious work experience at the service of the collection and exhibition of objects and monuments, are the creators of this process.

Fig. 1. Lost Wax melting procedure.

3. The constitution of the collections to be exhibited

The rooms of the original porter's lodge, covered by trusses with extensive light, offer a view of scale models of the entire military settlement. The wooden models describe the topography and history of the places. They are followed by the mechanical and optical instruments that allowed the execution of fine precision manufacturing, from the graphics to the forming of the pieces. Bullet ogives, castings or turning of gears, forging of metal components, repair and grinding of armaments, both individual and departmental. From rifles to vehicles, people tried and still try their hand at various objects, related to equipment, logistics, strategy, and tactics. Practically every field of military knowledge. In peace and war. The visitor, who by appointment, alone or in a group, can see what has been shown and described, can take a journey into the past of the art of war, to understand the modus operandi of Defence and Civil Protection of modern times. There is no lack of refined scale reconstructions of ephemeral bridges for the passage of troops, *cariaggi*, land and sea vehicles for the manoeuvre of troops and their transfers.

Fig. 2. The Bastion in the Polo di Mantenimento Pesante Nord (photo by Francesco Broglia).

. Very interesting are the vehicles and weapons, life-size, preserved, restored, or faithfully reconstructed. It emerges, in the eyes of the curious, even if profane, the folding bicycle of the World War I, on which Fanti, Bersaglieri and *Porta Ordini* pedalled. Numerous are the fire mouths and cannons, built in series, or made as prototypes. The military ground vehicles, ancient and modern, are well represented in the whole and in detail. Visible reconnaissance vehicles, transport vehicles for troops and materials, armoured vehicles, and armed loved ones. Ancient ones are restored and occasionally displayed. Modern ones are reviewed and modified. An interesting, varied, and complete overview. The military history of the last two centuries is well represented, but there is no lack of meaningful monuments of the Renaissance period. In the perimeter of the military zone, constituted since the 19th century, the remains of the Farnesian Castle have in fact remained included.

4. The Castle of Pierluigi Farnese

The remains of the Castle of Duke Pierluigi Farnese represent a real gem, for their monumental and documentary value. The work of partial restoration of these precious remains of sixteenth-century fortification is relatively recent. Starting from the 1990s, the commanders of the military pole, have contributed to highlight and safeguard the ruins of the bastioned Castrum, previously long neglected.

A singular and significant fact. In the aftermath of the liberation of Piacenza from the Austrian troops, at the height of the Wars of Independence, the fury of the population was fierce on the ancient Renaissance fortress. Pentagonal in shape, with five strong ramparts, it was attacked and soon dismembered by the people of Piacenza, who made its curtain walls salvaged bricks.

The fact that from then on it was included in a military establishment, although neglected and maimed, the ruin of the ancient fortress was not attacked by the aims of those seeking building spaces for physiological urban expansion. In the last decade of the last century, the military genius has freed the remaining buildings from the canopies that had been leaning against them and the vegetation. In this way the remains of three bastions are visible, facing outside the ancient city walls. In the visits that are allowed to citizens, enthusiasts, scholars, students and schoolchildren, the castle is an essential destination in the excursion to the museum.

In synthetic terms, although not very elegant, it serves as a content and container. The ramparts can be admired in their geometric conformation, which despite the mutilations suffered and the ravages of time, is still legible admirable. The inner chambers of countermining house a small but significant collection of replicas of tournament armour from the 16th century and reconstructive scale models of the castle.

Fig. 3. Exhibition Room (photo by Francesco Broglia).

5. A work-in-progress museum

The technological, historical, and cultural heritage is therefore very wide and varied. The problem is that it is variously distributed in workshops and barracks buildings. It is arranged according to military and industrial logistics and not according to a museum and educational exhibition. In practice, when you enter such a military establishment, which is still partly active, you can have count both of the working processes in place (with the necessary safety limits and precautions for visitors) and of important testimonies and vestiges.

The latter range in various areas, as described above. In practice you are in front of a widespread museum, an articulated route between workshops, factories, still in existence, ancient and modern military vehicles, neatly arranged in a row. A place where it is possible to observe the most modern technological applications in the field of security of a state and the provisions to be implemented in the event of natural disasters (albeit with the limitations due to the confidentiality of advanced projects and the safety of patrons), the evidence of past

conflicts. We are not faced with a place of exposure specifically designed to be such, but with an interesting and singular mixture of existing activities and places of history. As the current practical and productive functions evolve, becoming more sophisticated and less in need of manpower, spaces are freed up in factories, where finds

Fig. 4. The replica of the Bersaglieri folding bicycle (photo by Francesco Broglia).

of undoubted significance can be preserved and exhibited, testimonies of technological evolution, both of military and civil production. The *Polo di Mantenimento Pesante Nord*, still alive and up to date, as a place of revision and construction of equipment for the Army and the various Defence Weapons, therefore, also assumes the important function of a 'museum in progress'. Behind the constitution of this great machine for the exhibition of objects, artefacts and buildings, there is not the hand of a single designer. The metamorphosis in which Present and Past coexist is a harbinger of great values, both technical, scientific, and educational.

It takes place in compliance with norms and dictates that regulate a military installation, active in the social and administrative life of a modern state, at the same time open to citizens to provide evidence of what has happened in the economic and productive development of a territory.

References

Bulian, G. 1990. *Libri e mostre. Il nuovo Museo Archeologico di Roma e la mostra 'Archeologia a Roma': materia e tecnica nell'arte antica*, Roma, Terme di Diocleziano, Aprile-Dicembre 1990, in 'Bollettino d'Arte', 64, Novembre-Dicembre, Italy.

Carducci, G. 2005. Ethics, Law and Heritage, in *Icom News 3*. Available at: http://icom.museum/fileadmin/user_upload/pdf/ICOM_News/2005-3/ENG/p5_2005-3.pdf

Gentile, Eugenio. 1990. *Il castello ritrovato di Pierluigi Farnese*. TEP, Piacenza, Italy.

Howarth, F. 2012. "World Museum Leadership: ICOM or AAM?", in *Museum Management and Curatorship*. 27/2, pp.87-110, Taylor and Francis, London, UK.

ICOM *Statutes*. Available at: http://icom.museum/fileadmin/user_upload/pdf/Statuts/statutes_eng.pdf (Accessed on May 2020).

Vecchiato, V. 2018. The Ambiguities of ICOM Standards for Museum, in *Mantua Humanistic Studies*, 1, pp.123-137, Universitas Studiorum, Mantova, Italy.

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Museography and Seismic Hazard: the design project of the Majolica Room, National Museum of Bargello, Florence

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Abstract

Our heritage is as outstanding as fragile. Although there is a shared awareness about the importance of preventing and protecting the built heritage against the seismic hazard, the same attitude rarely involves the contents. Unfortunately, some studies (Podany, 2017) observe that medium-low intensity tremors represent a risk to the movable heritage. All museums, especially those located in the seismic areas, face this issue. Museum collections need to be protected, stored, and exhibited. According to the object characteristics, there might be conservative and safety actions to adopt, but rarely, the setup is also anti-seismic. Once evaluated the vulnerability of objects and settings, what are the preventive measures against these possible damages? Focusing on museography, can museum display be both safe and coherent, according to updated exhibiting criteria? Can museography integrate with seismic preventions and museum policies? How can safety solutions and exhibit design be combined in existing setups or temporary exhibitions? Considering the ever-changing museum trends and needs how do exhibit design, safety, and economic sustainability combine? These questions have been raised inside the multidisciplinary research 'RESIMUS – Resilience Museums' of the Department of Architecture (DIDA) of the University of Florence. Within the research, we developed a method of analysis to grade the vulnerability of both museum collections and setups (Viti 2018). We worked out a synthetic system of classification of objects and exhibitions that allows a qualitative and comparative evaluation of: building, setup, and object. The so-called 'RESIMUS FORM' is the combination of more models, to name a few: Italian form evaluation of the seismic risk (NTC, 2008); "Liberatore form" (Liberatore, 2000); evaluation form *musei di qualità* (quality museums) of the *Regione Toscana* (2010). The form is a simple tool ready to be applied in any museum by any staff member. It takes into consideration the average dimension and the limited resources of most of the Italian museums. It is born to be an instrument of a survey, risk evaluation, and strategic planning. We tested it for the case study of the National Museum of Bargello in Florence. As second, the RESIMUS research foresaw the development of an anti-seismic museum exhibition. According to the 'learning by doing' approach, the design project is meant to be an instrument of research (Postiglione, 2012). The paper presents part of the on-going project about the re-design of two rooms of the Bargello. The contribution illustrates the study's steps, the results coming from the RESIMUS form, the methodologies applied, and the anti-seismic design proposition. It also presents the fundamental preparatory aspects preceding the designing step: the study of the museum references, the analysis of the case studies regarding the museum design solutions, and the technical examples (cases, pedestal, mount, etc.). It deals with the narration about the ceramics on show, the technologies, and the public's experience in the museum.

Keywords: Museography; Museum Collections; Museum Design; National Museum of Bargello; Safety; Seismic Hazard; Earthquakes

1. Introduction

Any moment the earth can shake, but we do not know when or where. We do know that our heritage is as outstanding as fragile. Although there is a shared awareness about the importance of preventing and protecting the built heritage against the seismic hazard, the same attitude rarely involves the contents. Despite some studies (Podany 2017) observed as medium-low intensity tremors representing an enormous risk to the movable heritage, rarely the museum setup is also anti-seismic.

What can museums do? The museums hold extensive outstanding collections composed of several objects (by materials, dimensions, techniques, etc.). Among thousands of pieces in a museum, how do we understand which are the most vulnerable ones? Moreover, among limitless setting configurations, which are the safest under the seismic point of view? Once confirmed the vulnerability ranking of objects and settings, what are the preventive measures against damages?

The museography is the art of displaying (Newhouse, 2015). According to updated exhibiting criteria, can museum display be both safe and coherent? Can museography integrate with seismic preventions and museum policies? How can safety solutions and exhibit design be combined in existing setups (historical museum rooms, musealized setups) or in temporary exhibitions? Considering the ever-changing museum trends, the publics' multiple necessities, the internal dynamics of the museum institutions, how do exhibit design, safety, and economic sustainability combine?

The paper attempts to answer some of these questions by presenting a work in progress research developed inside the RESIMUS group of the DIDA. The paper is organized according to two main parts, the first is an introduction to the general theme of seismic prevention and safety of the collections (sections 2 and 3), and the second (sections 4, 5, 6) presents the case study and the development of the applied research Flo-RESIMUS. Section 2 presents the general context of the museum's safety against earthquakes, stressing the lack of studies in the museography field. Section 3 sums up the state-of-the-art literature about anti-seismic set designs and introduces the RESIMUS research project and the RESIMUS form. The following section (4) presents the National Museum of Bargello's case study and the research's accomplished steps. The fifth introduces the developed museographical design, applying the theoretical reasonings to a case study: two rooms of the Bargello. The conclusive part sums up considerations and findings.

2. Safety and collections: a hard path

Museum collections need to be protected, stored, and exhibited. According to the object characteristics, there might be conservative actions to adopt (temperature, light, humidity) and safety measures to apply, for example, against vandalism, theft, or accidental damages. There is a vast literature about museum conservation guidelines issued by both National and International organizations. Such documents derive from working experiences, fieldwork, and emergency moments, like the ICOM guidelines of 2005, dedicated to Iraq's heritage protection and then codified to be universal (ICOM, 2005).

Comparing and studying these documents, they rarely request or suggest anti-seismic setups. There might be a prescription about the buildings (the box), as the Italian Technical Construction Regulation – *Norme Tecniche per le Costruzioni* (NTC, 2008). The latter prescribes a set of mandatory norms to public buildings, but, as far as we know, similar prescriptions do not exist for the movable heritage.

Unfortunately, the urgency of preventive measures against earthquakes arises only when, at the list, a medium shake affects an area. In several writings, Jerry Podany has emphasized the necessity of museums and cultural institutions' commitment to conserve and expose their collections. As he noticed, even medium-low intensity tremors might represent a colossal risk to the movable heritage and to people (Podany, 2017). Some museums have applied safety measures to their collections, but this has usually happened after a disaster.

Although a vast body of literature about the study of objects' behavior during an earthquake exists in the academic field (Viti, 2018), these texts usually investigate single outstanding objects. They focus on the technological anti-seismic problems and solutions, e.g., pendulum, anti-seismic base. Their limitation of these essential studies is being mono-thematic and dedicated to single objects only.

The J. Paul Getty Museum, Los Angeles, California, was the pioneer in this field – Podany was the Head of Antiquities Conservation of the museum from 1986 to 2016. The Getty started studying anti-seismic measures and building innovative setups in the 1980s (Agbabian, 1990). Since then, together with the Getty Research Center, they exported this approach in other seismic countries. The Getty staff immediately understood the complexity of such analysis and the need for consequent practical acts. Despite thirty years of work, there are still unsolved questions, and the necessity of spreading the culture of safety among museums and cultural institutions is more urgent than ever.

Fig. 1. Archaeological Museum and Museum of Arts and Craft in Zagreb after the earthquakes of March 22, 2020 (*MUO, Museum of Arts and Craft Zagreb*).

The application of preventive measures is the most efficient method to address damages and issues. Resilience has significant resonance in managing risk, but, although mainstream and on fashion, such an approach does not always find a concrete application in the cultural heritage field. The Sendai Framework for Disaster Risk Reduction 2015-2030 (Clarke et al. 2018) is a key document in risk management and recovery. Several other documents (ICOMOS 2015, HFA 2013) suggest planned actions for preventing and recovering cultural heritage, and several countries commit the application. The often-missing transition from purpose to practice emphasizes the complexity of the argument and the lack of a shared culture on cultural heritage prevention. The acknowledgment is part of the problem.

The lack of knowledge about what an institution can do, and the possible applicable measures imply concrete actions. Anti-seismic devices often limit the advanced technological solutions, like expensive engineering operations on singular objects or interventions on the entire buildings. Unfortunately, most museums and cultural institutions have a limited budget and the need to prioritize the expenses. They cannot afford expensive single solutions. It has been proved that even simple actions may be sufficient to prevent uncountable losses – with all due distinctions (Podany, 2017).

3. The Flo-RESIMUS project

In general, museums hold extensive outstanding collections composed of different typologies of objects (by materials, dimensions, techniques, etc.) that can be presented in limitless settings. Among thousands of different pieces in a museum, how do we understand the most vulnerable ones? Moreover, among unlimited setting configurations, which are the safest under the seismic point of view?

Some authors tried to answer these questions. As said, Agbabian and al. (1990) propose one synthetic classification model, based on the possible configuration of the exhibition design and the objects' position. The

classification structure has been resumed and boosted by Podany in its field test, while Liberatore (2000), Augusti and Ciampoli (1992), Ertürk and Sungay (2004) work on Agbabian similar classification to find a method to easily classified the level of fragility of the museum objects and settings. The proposed methodologies are too simplistic, limited to the single object analyses, or dedicated to the experts.

There is a necessity of developing an instrument that can be effectively and efficiently applied by not experts of the engineering field to obtain a quick seismic risk assessment, but, first, a shared awareness about the importance of seismic prevention for museum collections is needed.

Once evaluated the ranking of objects and settings' vulnerability, what are the preventive measures against damages? Museography is a complex discipline. It is the art of displaying and not a random shelf arrangement. According to updated exhibiting criteria, can museum display be both safe and coherent? Can museography integrate with seismic prevention and museum policies? How do safety solutions and exhibit design be combined in existing setups (historical museum rooms, musealized setups) or temporary exhibitions? Considering the ever-changing museum trends, the publics' multiple necessities, the museum institutions' internal dynamics, how do exhibit design, safety, and economic sustainability combine?

The project 'RESIMUS – Resilience Museums,' of the Department of Architecture (DIDA) of the University of Florence, tries to address these needs and answer these questions through theoretical and applied research.

On one side, RESIMUS is developing a method of analysis to grade the vulnerability of both museum collections and setups (Viti 2018). It proposes a synthetic system of classification of objects and exhibitions that allows a qualitative and comparative evaluation of building, setup, and object. The so-called 'RESIMUS FORM' (RF) is the combination of many models, to name a few: Italian form evaluation of the seismic risk (NTC 2008); Liberatore form (Liberatore 2000); evaluation form *musei di qualità* (quality museums) of the Tuscany Region (2010). Considering the average dimension and the limited resources of most of the Italian museums, it is plausible that such museums do not have specialized staff able to assess their collections' seismic safety level. The goal is to issue an effective and flexible instrument that can be easily used by any member of any staff of any museum. The RF can serve as an instrument for multiple purposes: survey, risk evaluation, and strategic planning. The outcomes are the rating of the objects' risks, the selected settings, and a general survey of that museum. The operation should provide useful information to the study of the resilience of the setting 'museum' of that city (Viti 2018). In general, all these actions should be part of the risk reduction plan (Sendai, 2015).

To this day, the RF is a demo of the analysis approach. It has been tested first at the National Museum of the Bargello (Mattoni and Tanganelli, 2018). Compared to other examples and references, the RF is a qualitative instrument of analysis, introduces new examination elements, and amplifies the inquiry context to the entire exhibition building. Such approach has two primary outcomes: 1) description of the museum setting's situation to a precise date – being useful to develop management risk and recovery plans; 2) through qualitative analysis, museographical description of the room settings.

The form is composed of three parts: 1) General report of the building and the museum context; 2) Room Form, a qualitative report of a chosen room of the museum; 3) Object form, a qualitative report of one object and its display kept in the already analyzed room (Room Form). The forms give, as a result, the level of vulnerability of the objects and their settings. The results from form 3 (Object form) rank the safest and the riskiest objects on show of one room. If grouped by rooms, the results determine the level of vulnerability of each analyzed room. Although such results come from an exterior survey, the upshots have the credit of emphasizing the collection's vulnerability and of making aware the museum of its current situation (Cerri and Collotti, 2019). For instance, speculating about the diffuse and correct application of the form by a consistent group of Florentine museums, the sum of the results would trace and rank the museums' vulnerability of the *Città Metropolitana di Firenze* (Florence Metropolitan City).

Other aspects of the research are the application of professional instruments and specific methodologies. There are two complementary pursued analyses: single in-depth analyses and museum design development. According to the RF results, the numerical analyses applied to significant artworks can be pursued, whether on the most vulnerable or the most significant object from the geometrical or masses perspective. The seismic analyses are based on the rigid block with Finite Element Method (FEM) procedures and are applied to 3D models acquired during 3D scanning campaigns (Viti, 2018). This phase might also comprehend mechanical tests on materials and replicas. The second aspect is the museographical study, realized by studying the

references and the existing museum settings (Cerri and Collotti, 2019). Once acquired the relevant information related to the seismic vulnerability, the museum, in collaboration with the RESIMUS team, might consider planning the design project of some settings or the redesign of selected rooms. The final design will combine anti-seismic solutions, museographical coherent design, and museum strategic addresses. According to the' learning by doing' approach, the design project is meant to be an instrument of research (Postiglione, 2012).

The project is the tool to address the issues we introduced in this section. The multidisciplinary project and the involvement of several branches of knowledge demonstrate that a successful design must benefit from the different professionals' contributions: curators, museographers, engineers, technicians, etc. The project RESIMUS introduces a methodology to explore the potentiality of the museum space. It combines safety analysis, recommendations, and solutions (anti-seismic devices). Also, it demonstrates that safety, aesthetics, and museum narrative can provide a concrete answer to urgent requests (safety of collections, limited budget, and adequate quality level of the exhibitions).

4. The Flo-RESIMUS project

4.1. The Bargello in a nutshell

The National Museum of Bargello is one of the most important Florentine museums. It is located in the city centre and dedicated to Medieval and Renaissance art. Usually, it is visited by more than 200 thousand people each year.

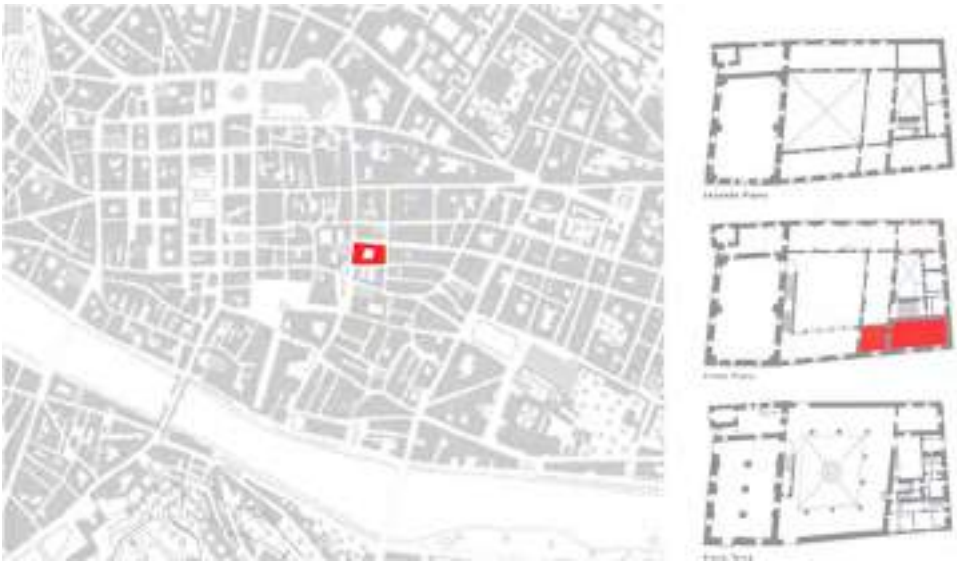

Fig. 2. Position and levels of the museum.

According to tradition, the Bargello Palace was designed around 1250 by Arnolfo di Cambio's master Lapo di Cambio (Paolozzi Strozzi, 2014). Through the years, the building underwent extensions and modifications. It was the headquarters and residence of the *Podestà* (chief magistrate) first, and prison then. In 1857, the jail was transferred to the *Murate* district, the palace was cleared and destined to become a museum. The building endured heavy transformations and restorations according to the then Neo-gothic fashion. On June 22, 1865, by royal decree, it was established as Italy's first National museum. The museum is now considered one of the most important statuary Italian museums. Michelangelo, Donatello, Cellini, Della Robbia's works are here, and it is well-known for its outstanding fine arts and coins collections. The scientific museum program (and the related distribution of the collections) went through some changes during the time due to both curatorial choices and extreme natural events, like the flood of 1966.

The building occupies an entire parcel and stands on Piazza San Firenze, via del Proconsolo, via Ghibellina,

and via dell'acqua. The current interior and exterior aspects derive from the nineteenth-century refurbishment that gave to the interiors the fake allure of the ideal original palace. Though the building end-use was a museum, the goal of the refurbishment project was to remind, as much as possible, an idealistic medieval setting.

The internal space develops around the central courtyard, and several addictions are easily recognizable. The vertical museum distribution has been obtained by modifying the portion of the east side of the building connecting the three floors of the museum (there is also another vertical connection serving the staff area). Despite some necessary uploads, the building has been almost unchanged since nowadays. The oldest unit contains the entrance (on via del Proconsolo) and the main, and larger, rooms of the museum: at the ground floor the so-called Michelangelo's Room, containing the Renaissance sculpture collection, and the Donatello's Room at the first floor, with the masterpieces created by Donatello and his contemporary colleagues. The courtyard is an exhibition space too. Big marble masterpieces are allocated here, while on its vertical surfaces, there are the stone emblems of the chief magistrates that had inhabited the palace. The other spaces on the ground floor are devoted to technical uses or temporary exhibitions. From the courtyard, one can access the first floor also through the monumental staircases, entering the Verone. This level hosts seven other exhibition rooms, including the palace chapel. On the second level, there are seven other rooms. The current museum organization (the museological program) follows thematic criteria, e.g., authors, materials, historical periods, etc. The visiting path is free, and the visitors have no suggestion in following a precise pathway. In 2015, the museum edited a special guide dedicated to the museum masterpieces, must-see suggestions to facilitate the visit (Paolozzi Strozzi 2015).

At the moment, the museum does not have external deposits. The collections, more than 10.000 pieces, are all kept in the same structure. Since 2014 (D.L. 106/2014), the museum is part of the group of museums called *Musei del Bargello* (Bargello's Museums). It includes: Medici's Chapels, *Orsanmichele*, *Casa Martelli*, *Palazzo Davanzati*. The director is currently Paola D'Agostino.

1.1. *The analysis*

In the next few years, the National Museum of Bargello is going to start a progressive refurbishment of several rooms of the museum. During the meetings about the RESIMUS project, we were asked to dedicate the research to the Majolica Room. To the completion of the research, we agreed to include in the project also the so-called Sala del Trecento (Fourteenth Century Room) because it can be considered as the antechamber of the Majolica room. Following the RESIMUS methodology, as a first step, we applied the RF. The outcomes show a general good situation from a safety point of view. The Majolica room, located on the first floor, has one access, two blind walls, and one with two windows. The exhibition system is constituted by a series of display cabinets (from the '70s), made of glass, mirror, and anodized aluminium, containing various ceramic objects, and five big ceramic tondos, hung to the walls. The Trecento Room is a passing-through room with no blind walls: three contain passages (doors), and the fourth has one window. Here, the collections are variably arranged in the space: on some shelves, hung on the walls, placed on historical pieces of furniture or on bases.

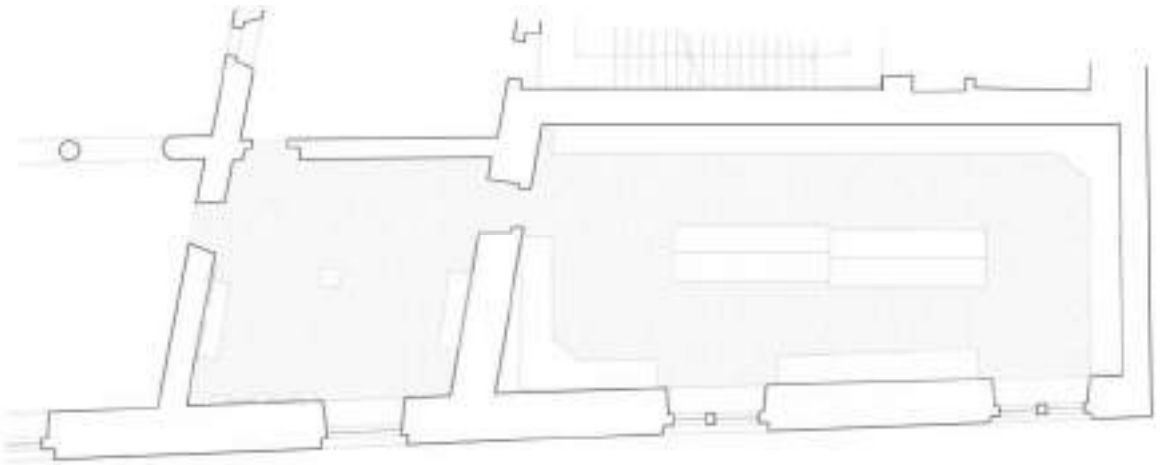

Fig. 3. Current organization of the rooms.

In the case of the Majolica Room, the analysis shows that the main criticality is about the furniture: the shapes (of the cabinet, in particular in the correspondence of the angles), the fixing (the cabinets are not anchored to walls or floor), the materials (the shelves are glass sheet placed on fours metal vertexes), and the interior organization (types of the pedestal, mounts, disposal). In the case of the Trecento Room, the vulnerability of the setting up and of objects are mainly linked to inadequate mounts or choice of the display solutions (simple hangs, fleet mounts, disputable shelves).

Fig.4. The *Trecento* room.

Observing the actual exhibition from an architectural design perspective, the Majolica Room presents a recurrent solution: a big cabinet with several shelves containing a high number of pieces. It refers to an encyclopaedic approach, exposing a lot of objects according to given criteria.

The current disposal dates back to the '80s, and the organization follows the chronological and geographic system. Such a path is not visibly marked for a non-expert visitor.

The *Trecento* Room has a less clear order and a most recent arrangement. This mixes sacral and secular objects, types of artifacts, furniture, sculptures, architectural fragments, frames. About the lighting, both rooms have well-calibrated artificial light. These rooms benefit from the natural one, but there is no shadowing system, and the risks are the dazzle effects.

Fig.5. The Majolica room.

The museum has no big communication spaces. Little stands held short general explications, while the captions are essential and placed near to the referred pieces. The Majolica's cabins along the walls have a mirror as a back. If, on the one hand, the mirror has the benefit of reflecting the back of the ceramics, from the other, it creates an odd combination of reflexes that might disturb the visitors.

The current structure, although with removable horizontal shelves, has a strict and rigid grid and does not allow different configurations. The mounts are made of different materials (metal or plastic) and have several shapes, some are customized for specific ceramics, and others are standard. These mounts hold open shapes, while basin and vases lean directly on the panes of glass.

2. **The design**

2.1. *Before the design: the references*

Besides the analysis, an important step is studying the references, a standard procedure in the designing process. The Flo-RESIMUS research compares and studies some museographical examples adopting anti-seismic devices or other compatible valid solutions.

Among many, the chosen cases are the Getty Museum, Los Angeles California USA, the Museo Chileno de arte precolombino, Santiago de Chile, Chile, and the Munda – *Museo Nazionale d'Abruzzo*, L'Aquila, Italy. Other well-known examples of settings and museums are not part of the study because of the inconsistency with this research's criteria. It is the case of new settings concern the arrangement of big objects only, such as Michelangelo's *Pietà Rondanini* at the *Castello Sforzesco*, Milan, Italy (Cerri & Collotti 2019) and the *Bronzi di Riace* at the MarRC – National Archeological Museum of Reggio Calabria, Reggio Calabria, Italy. The cases of the Museum of New Zealand Te Papa Tongarewa, Wellington, New Zealand and National Museum of Western Art, Tokyo, Japan, because the entire buildings are isolated.

About the exhibition of the ceramic objects, we made a comparison among different exhibit solutions. It helped us enduring several ways of exposing ceramics (and comparable objects) and understanding if and how the issues of safety are solved. The investigation pursues the different museographical approaches (arrangement of the objects, materials, light, arrangement of the communication part, graphics), the fashion in the exhibit design, the adopted technical solutions. The analysis confirms that there is an endless way of exposing and recurrent exhibit patterns and typologies of mounts.

2.2. *Request from the museum and the museographical analysis*

During the museum staff meetings, we discussed the pro and cons of the current situations, the curatorial program, the requests for new settings, and the future museum goals. The appointed curator, Marino Marini, underlined the inefficiency of the cases. He stresses that to open them, they need at least two people and that the dust, abundant in the centre of Florence, filters inside the cases. That implies a high-priced cost of the cleaning services.

Besides, he pointed out the general lack of storage spaces. Limited to the ceramics, he foresaw the possibility of placing some of them in a small internal deposit.

The elements pointed out by Marini align with our museographical survey. The showcases are inefficient from a maintenance and technical point of view. The combination of golden anodized steel, mirror, and glass might confuse and distract the visitors, creating reflexes, glares, stereoscopic effects. The embedded lighting system (neon light) is not cost-effective and does not enhance the objects. There are also ergonomic and accessibility issues. For example, the cases' dimension is such that exposing volume is not completely visible by everybody.

About the setting and the public reception, the room is dedicated to ceramics experts or enthusiastic. There are some introductory panels with few paragraphs about the room and the exposed collections. The labels are synthetic. The detailed information is in the guides on sale at the bookshop, located at the entrance. In the Majolica room, the linear and repetitive arrangement of the objects create a monotonous pattern. There are not calculated emphasis or selected objects catching the visitor's attention (e.g., the masterpieces, a kid's corner, the focus on unique objects). As said, the arrangement follows a chronological and geographical order, but the explanations are missing. It is also not immediately perceivable the route to carry out, clockwise or counter clockwise. The chronological sequence is not marked, as well as the geographic provenance (production place).

A general weakness of the museum is the lack of a digital database (online and offline). Recently, it started conversing its paper catalog into digital-only.

2.3. *A working progress design solution*

The development of the design project considers several aspects, such as: RF results, safety measures to adopt, museum necessities, available anti-seismic technologies, and design analysis. The new setting does not subvert the current configuration. The design is respectful of the place, does not cover the neo-medieval refurbishment, and is not in contrast with the museum's general set up. Also, the exhibition design is not the protagonist of the rooms. It is instead the tool with which the objects are enhanced and showed to the public. The two rooms work together, as an introductory hall and as a theme room the second. Traditional exhibition and digital tools integrate into a constructive dialogue. The seismic safety devices are, let say, invisible, being an integral part of the exhibit solution. Two main parts compose the Trecento room. The area, closed to the window, accommodates the sculptures, the altarpieces, and the paintings. The passing way area hosts a slim display cabinet as an introduction to the next room. This host archaic ceramics from Tuscany (1300). The cases virtually continue in the Majolica room. The project for this room foresees a long and high showcase developing on the longer wall.

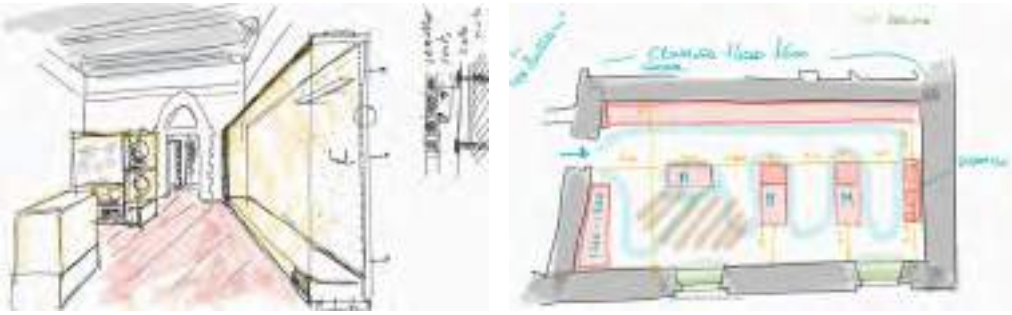

Fig. 6. Study sketches of the Majolica room.

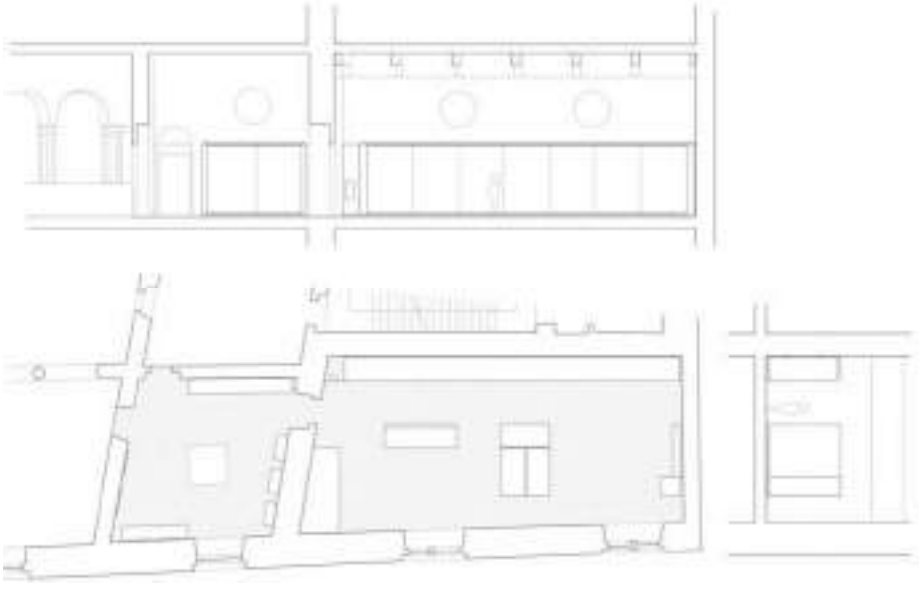

Fig. 7. Plan of the design proposal.

This part hosts part of the collections organized by year and origin. A multimedia wall, anchored at the bottom of the room, hosts some objects, digital screens, and traditional explanations. The multimedia is thought to those who do not know the ceramics' pre-industrial production or want to deepen their knowledge (production, forms, passages, decorations, colours). The window side hosts a bench containing movable seats. Three showcases hosting the Medici collection mark the centre. These cases are fixed to the walls and to the floor. Specific mounts

secure the pieces. The design proposes then two novelties plus one goal: first, a children's corners, this occasion might be the opportunity to experiment this thematic spot; second, the inclusion of the digital technology in the exhibition design, where digital technology is intended as a tool to deepen certain aspects, update the contents, propose a different curatorial interpretation, browse the collection. The goal is to make these rooms, and hopefully the whole museum, an exhibition for all.

2.4. *The project in 5 keywords*

2.4.1 Technology

The showcases are taken from the Goppion catalogue. Goppion Technology is an Italian world leader company in the field of museum display technology. For the sake of the research, designing a new typology of the case would not have been a substantial contribution. Modifying existing models and testing specific mount solutions appear more meaningful to the goal of the research. The research has a real implication, meaning building new tailor-made showcases would have been insanely expensive and hardly realizable. In this case, the essential aspect is the anchor of the cases, to the floor, in the case of the freestanding element, to both wall and floor, in the case of those placed to the wall, and the mounts.

2.4.2 Mounts

The topic of the mounts is a strategic point. There are a series of different solutions allowing the safety of the objects. Depending on the kind of arrangement, vertical or horizontal surface, the solutions might variate. In this design project, the open forms (plates) and little objects are mostly shown hanging on the vertical surfaces to enlarge the exhibition space. Closed forms (vases and basins) are placed on horizontal surfaces or suspended using different mounts. The Getty experience teaches us that the mounts have to have specific safety forms. Such prevents the falling of the mount from the anchoring point or of the objects. Although similar, these ceramics have different shapes and details. To be safe, each of them needs its specific mounts.

The examples of the Victoria & Albert Museum, London, the Metropolitan Museum, New York City, and the Brooklyn Museum, New York City, show as these configurations allow a wide variety of presentations. These give us the opportunity of playing with the collection. To realize the cases, Goppion already has a compatible solution in its catalogue. The chosen model has a back that permits the allocations of mounts, shelves, and descriptive panels. Such a solution allows the free arrangements and modification of the pieces' configuration (CNR 2016).

Fig. 8. Example of the current exhibition system used in the Majolica room (G. Cerri) and a reference solution, the National Museum of the American Indian, NYC, US. (Goppion S.p.A.).

2.4.3 Graphic design and communication

The proposal includes a new communication apparatus that would lead the visitors through the two rooms. The graphic is coherent with the rooms' general layout and in line with the museum's graphic identity. The text and the graphic do not overwhelm the objects but are supportive. The labels are minimal. In certain parts, they are close to the objects, and in others, are grouped in summary panels.

The goal is to have simple, easily removable, and replaceable labels. Particular objects, the masterpieces, or the must-sees, have longer descriptions, explaining why they are that important. The general graphic follows the curatorial plan and the colours of the new exhibition design vary inside a shade of neutral tones. Such choice enhances the colours of the ceramics, standing up in the background. The masterpieces' corners have different colours or graphics (Da Milano and Sciacchitano, 2015). The catching solution helps and guides the visitors. The arrangement of the mounts and the internal bases is not fixed. Thanks to this exhibition system, the curator might change the order and the disposition at any time. That also allows the possibility of rearranging the objects (during restorations, loans, rotation) with a small expenditure. According to this project, the "educational" aspects materialize in the multimedia wall. Such a solution needs to be preceded, though, by the digitalization of the collections. Here, new technologies, traditional solutions, and showcases work together.

2.4.4 Lighting, natural and artificial

The lighting project maintains the most recent interventions. The eight led spots hanged to the chains are moved and redirected. The new showcases embed different lights, emphasizing the contents, and the curtains shade the natural light coming from the big windows. Such a solution diminishes the effects of the reflections on the glasses, the dazzle, and dark-light effects.

2.4.5 Accessibility

The position of the cases allows the passage of wheelchairs and strollers. The object's arrangement inside the showcases follows the prescriptions suggested by the document Accessible Exhibition Design (Smithsonian Museum, 2016). The colours, the lettering, and the element of wayfinding have to be understood by most people. The written text is bilingual, Italian, and English. The label design is set to host material legibly for all visitors, so to be ready to have available label information in alternative formats (e.g., Braille, audio, LIS) for people who cannot read print.

3. Conclusion

The paper presents the on-going research project Flo-RESIMUS, showing a real application of the RESIMUS method to a case study. The goals of the paper might sum up in three points. It highlights:

- the necessity of a shared awareness about the culture of seismic prevention;
- the importance of preventive studies and the mixing knowledge to provide an inclusive standard site-specific procedure;
- the necessity of a collaboration among professionals and academics to develop a complex and complete museum and cultural project.

The paper tries to answer open questions through a learning-by-doing approach. The answer is the museum design project. In general, the research is given by the combination of several fields of knowledge. The results are that the safety of the objects might be accomplished using simple but not apparent expedients. To do so, museography and anti-seismic technology have to work jointly. One of the goals of the research is to design a coherent exhibition project with a harmonic combination of all the elements: disposal of objects and showcases, the natural and artificial light, the curatorial program, the public and educational program, the use of the spaces, the communication system, the graphic, the accessibility.

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References

Agbabian M.S., Masri S.F., Nigbor R.L., 1990. *Evaluation of Seismic Mitigation Measures for Art Objects*, Los Angeles: Getty Conservation Institute, USA.

Augusti G., Ciampoli M., Airoldi L., 1992. Mitigation of Seismic Risk for Museum Contents an Introductory Investigation, 10th World Conference on Earthquake Engineering, A. A. Balkema, Rotterdam, pp. 5995-6000, Madrid, Spain.

Cerri G., Collotti F., 2019. If safety is not enough. a multidisciplinary research on seismic prevention of museum collection: the museographical analysis. In Proceedings of the 7th ECCOMAS Thematic Conference on Computational Methods in Structural Dynamics and Earthquake Engineering, Crete, Greece.

Cerri G., Pirazzoli G., Tanganelli M., Verdiani G., Rotunno T., Pintucchi B., Viti S., 2018. Seismic Assessment of Artefacts: The Case of Juno's Fountain of The National Museum of Bargello. IOP Conf. Ser.: Mater. Sci. Eng. 364 012057.

CNR and Goppion, 2016. *Scienza delle vetrine*, CNR edizioni, Roma, Italy.

Clarke L, Blanchard K., Maini R., Radu A., Eltinay N., Zaidi Z., Murray V., 2018. Knowing What We Know – Reflections on the Development of Technical Guidance for Loss Data for the Sendai Framework for Disaster Risk Reduction. PLOS Currents Disasters. Aug 2.

Da Milano C., Sciacchitano E., 2015. *Linee guida per la comunicazione nei musei: segnaletica interna, didascalie e pannelli.* MIBACT, Roma, Italy.

Ertürk N., Sungay B., 2004. Seismic Conservation of Historical and Cultural Treasures of a World City: Sizing the Need and Formulating an Action Plan for the Museums of Istanbul, Turkey, unpublished report, Boğaziçi University, Kandilli Observatory and Earthquake Institute, Disaster Preparedness Education Program, Yıldız Technical University, Faculty of Art and Design, Museum Studies Graduate Program.

HFA 2013. Synthesis report on consultation on a post-2015 framework on disaster risk reduction. International Strategy for Disaster Reduction, United Nation, Geneva, Switzerland.

ICOM 2005. R*unning a Museum: A Practical Handbook.* Available at http://www.icomdeutschland.de/client/media/198/running_a_museum.pdf (Accessed: June 4, 2020).

ICOMOS 2014. Heritage at Risk: World Report 2011/2013 on Monuments and Sites in Danger, In Machat, Petzet, Ziesemer (eds.), *International Council on Monuments and Sites*, Hendrik Bassler.

Liberatore D., 2000. *Vulnerabilità dei beni archeologici e degli oggetti esibiti nei musei*. CNR-Gruppo Nazionale per la Difesa dai Terremoti, Roma, Italy.

Mattoni C., Tanganelli M., 2018. Approcci speditivi per la determinazione della vulnerabilità sismica. In Viti (ed), *Resimus. Un progetto rivolto alla vulnerabilità sismica delle opere museali*. DIDApress, Firenze, Italy.

Newhouse, V., 2015. *Art and Power of Placement.* The Monacelli Press, New York, USA.

NTC 2008, Norme Tecniche per le Costruzioni, D.m. ministero delle Infrastrutture e Trasporti, Roma, Italy.

Paolozzi Strozzi B. 2014. Museo Nazionale del Bargello. Official Guide. Giunti, Firenze, Italy.

Podany J. C., 1991. Safeguarding a Collection and Building From Natural Hazards, American Institute for Conservation of Historic & Artistic Works Workshop, Washington D.C., USA.

Podany J. C., 2017. When Galleries Shake: Earthquake Damage Mitigation for Museum Collections. J. Paul Getty Trust, Los Angeles, USA.

Regione Toscana. Legge Regionale 25 febbraio 2010, n.21, Testo unico delle disposizioni in materia di beni, istituti e attività culturali. Available at: http://raccoltanormativa.consiglio.regione.toscana.it/articolo?urndoc=urn:nir:regione.toscana:legge:2010-02-25;21 (Accessed: March 2021).

Global Agreement, 2015. *The Sendai Framework for disaster risk reduction 2015-2030*, United Nations International Strategy for Disaster reduction, 1st ed., Geneva, Switzerland.

Smithsonian Museum, 2016. *Accessible Exhibition Design*. https://www.sifacilities.si.edu/ae_center/pdf/Accessible-Exhibition-Design.pdf (Accessed: June 4, 2020).

Viti S. (ed.) 2018. *Resimus. Un progetto rivolto alla vulnerabilità sismica delle opere museali*, DIDApress, Firenze, Italy.

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Rebuilding the ruins. Mediterranean open-air museums

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Abstract

The paper aims at studying the relationship between architecture and archeology, in the field of open-air museums' design in archeological sites. The issue of the heritage musealization and its implications on the design methodology are analyzed by comparing two examples, realized in different periods at the opposite sides of the Mediterranean world, but expressing two similar compositional approaches in using the ruins as an essential part of the new architecture.

The first one is the archeological museum of Karatepe, located near Adana (Turkey) and designed by Turgut Cansever between 1957 and 1961. This structure has been the first archeological open-air museum in Turkey, demanded by the famous archeologist Halet Çambel to host the ruins of 9th-century BC Hittite fortification, in particular those of two monumental gates. The architect aims to realize a permanent building separated from the ancient walls, but able to reintegrate them into the landscape. Therefore, he designs a modern system of shelters, composed of two U-shape roofs and two linear ones, which develops in high the ruins' floor plan, giving an exact interpretation of the dimensions and niches of the ancient gate. The building structure is highly innovative for that time: thin pillars arise from the ruins and support impressive reinforced concrete roofs. The light filters and spreads from a set of wooden slats, so that sharp shadows on the remains are avoided. The architecture is fragmented, nevertheless, the whole system, made of roofs, archeological remains and nature, is conceived as a unit. Thanks to the architectural reinterpretation of the ancient ruins, we can understand the past monumentality of the gate and its antique role in the landscape's composition.

The second case study is the musealization of Praça Nova archeological site at São Jorge Castle in Lisbona (Portugal), realized by João Luís Carrilho da Graça between 2008 and 2010. The site consists of a stratification of Phoenician, Roman and Arab settlements, discovered during the 1990s in the courtyard of a 16th-century royal palace. The architectural shapes and volumes are designed by Carrilho da Graça to give a formal definition of the archeological ensemble and, at the same time, to identify each historical layer. The whole area is delimited by a corten-steel wall, from which a volume arises to host the remains of a prehistoric settlement. A dark movable structure protects the 15th-century mosaics, but the more interesting intervention is the rebuilding of the 11th-century Arab houses: white suspended volumes seem to rise from the ruins, while the floor plan of the ancient houses is readable on the roof structure made of wood and polycarbonate, conceived to share uniformly the light inside the buildings. The two architectural samples differ in intention and conception; nevertheless, both are designed to give a modern interpretation of the ancient ruins and to redefine them. The new arising volumes are thought, in both cases, to rebuild the ancient form and to make the archeological ground plan identifiable, even at great distances, so that also the landscape is recomposed.

Keywords: Open-air museums; archeological sites; heritage musealization; Turgut Cansever; João Luís Carrilho da Graça.

1. Rebuilding the ruins: a Mediterranean issue

The paper aims at studying the relationship between architecture and archeology, in the field of the open-air museums' design in archeological sites. The issue of the heritage musealization and its implications on the design methodology are analyzed by comparing two examples, the Archeological Museum of Karatepe (Turkey) by Turgut Cansever and the Archeological Site Center of Praça Nova in Lisbona (Portugal) by João Luís Carrilho da Graça. Although realized in different time periods, at the opposite sides of the Mediterranean world, the two works express similar compositional approaches in using the ruins as an essential part of the new architecture.

Building with the archeological remains is a recurring theme in both Mediterranean shores, but mostly in Europe, where the notion of cultural heritage is born: starting from the Athens Charter of 1931, several principles for conservation and restoration have been developed. Architects have always played an important role in creating an increased awareness in the society, by giving the possibility to visitors to experience the tangible cultural heritage and, indirectly, also the intangible one, with different exhibition methods.

On the other hand, architects from all over the world have always been fascinated by the Mediterranean archeology, which is considered an essential instrument of education for the architect's work. Ruins, indeed, can be used as a tool to develop the design process and, in some cases, a poetic of the fragment. As Aldo Rossi states, architecture value lies in the possibility of recognizing images, which resist time, in contrast to material deterioration. In this sense, a fragment does not imply a unique global image, but can refer to different ancestral, recognizable ones (Rossi, 1989). Therefore, a fragment can be repeated and interpreted to give shape to architecture: this compositional tool recalls every time different images, but comparable to various cultures.

2. The Archeological Museum of Karatepe by Turgut Cansever

In 1946 the prominent Turkish archeologist Halet Çambel discovered in Karatepe, near Adana, the ruins of a 9th-century BC Hittite fortification. Çambel firmly objected to transferring elsewhere the remains, in particular those of two monumental gates, and demanded to preserve them and the bas-reliefs *in situ*, in order to not destroy the integrity of the monument with the environment.

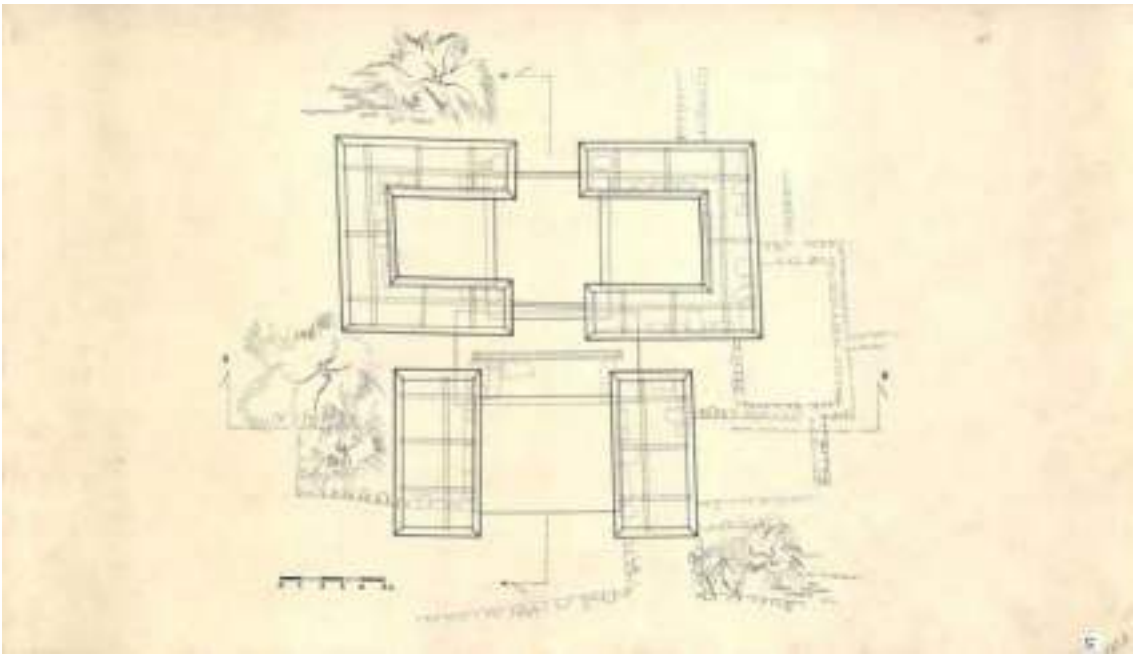

Fig. 1. Karatepe open-air museum: roof plan.

The architectural result would be the first archeological open-air museum in Turkey.

After a preliminary project drafted by Franco Minissi, in 1957 the Turkish architect Turgut Cansever was commissioned to design the museum. The architect's attitude was that of reinterpreting the ancient ruins with a modern idea, realizing a permanent building separated from the ancient walls, but able to reintegrate them into the landscape. Therefore, he designed a modern system of shelters, composed of two U-shape roofs and two linear ones, which developed in high the ruins' floor plan, giving an exact interpretation of the dimensions and niches of the ancient gate.

The exposed concrete structure was highly innovative for that time and was developed with the support of the engineer Vural Cinemre: thin pillars arise from the ruins and support impressive reinforced concrete roofs, whose perimeter precisely follows the ancient gate's planimetric directions. With the aim to minimize the necessities of maintenance and restoration, the engineers realized with success, for the first time in Turkey, a high-quality exposed concrete structure.

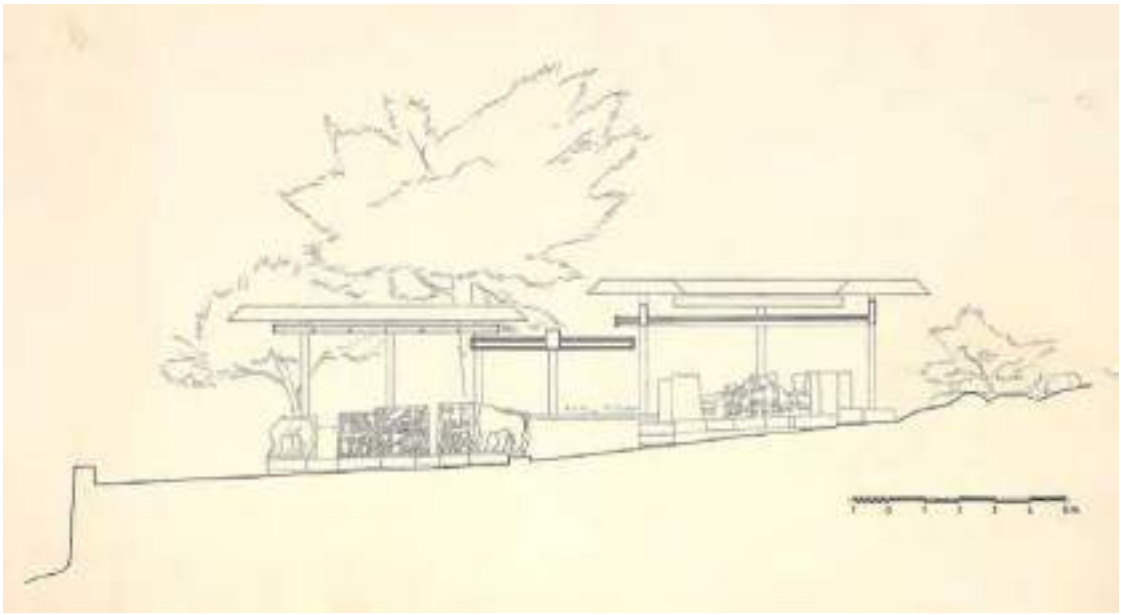

Fig. 2. Karatepe open-air museum: cross-section.

The light filters and spreads from two big skylights, placed between the linear roofs and the U-shaped ones. They are mede of two iron structures, to which glass sheets and sets of wooden slats are hung, so that sharp shadows on the remains are avoided. The drainage system (drainpipes and gutters) is completely hidden inside the pillars and between the iron structures and the wooden slats, while the rainwater is collected underground (Çambel, 2003).

The entire architecture is composed of fragments, which interpret archeological parts; nevertheless, the whole system, made of roofs, ruins and nature, is conceived as a unit (Cansever, 1981). The design aims at reading the ancient remains and restoring the original volumes, in order to bring to light the past monumentality of the gate and its antique role in the landscape's composition.

In contrast with the antique monument's massiveness, the horizontal roofs seem to spread over the archeological remains (Cansever, 1981). From the photographs at the time, it is possible to find a morphological analogy with the Turkish housing type, theme dear to Cansever: the ruins' perimeter wall, as the garden wall of a traditional Turkish house, is surmounted by the jutting tectonic structure, open toward the landscape.

The realization was completed in 1961 and included a guesthouse, built with a similar structural system and founded on the rock. The building hosted the rooms for the archeological researchers working on the site and a small library-museum.

Fig. 3. Karatepe open-air museum: the museum during construction.

Fig. 4. Karatepe open-air museum: the roofs in relation to the ancient wall.

3. The Archeological Site Center of Praça Nova by João Luís Carrilho da Graça

The second case study is located at São Jorge Castle in Lisbona. The fortress, which arises on a hill near the river Tago's estuary, was founded in the Islamic period, in the 11th century, while during the 16th was transformed into the royal palace. It was classified as a national monument in 1910, but the restoration works, directed by the *Direção Geral dos Edifícios e Monumentos Nacionais* (General Directorate for National Buildings and Monuments), started only in 1938. The intervention followed Viollet Le-Duc's doctrine, but gave the castle a conformation that it never had before. The restoration had a political value, in line with the regime's propagandistic intent to make the monument a symbol of the Portuguese nation.

In the 1990s, during the excavations for realizing a car park, a stratification of Phoenician, Roman and Arab settlements has been discovered in the castle's courtyard. The most important remains were a set of structures

dating back to the Iron Age, two Islamic houses and a paved surface belonging to the Bishop's Palace, and afterward to the Santiago Counts' Palace (Nobre Neto da Silva, 2014).

Accordingly to the relevance of the remains, in order to maintain the integrity of the system, it was decided to realize a musealization *in situ*. Two exhibition spaces were built: the Museum Center by Victor Mestre and Sophia Aleixo (2007-2008) and the Archeological Site Center by João Luís Carrilho da Graça (2008-2010).

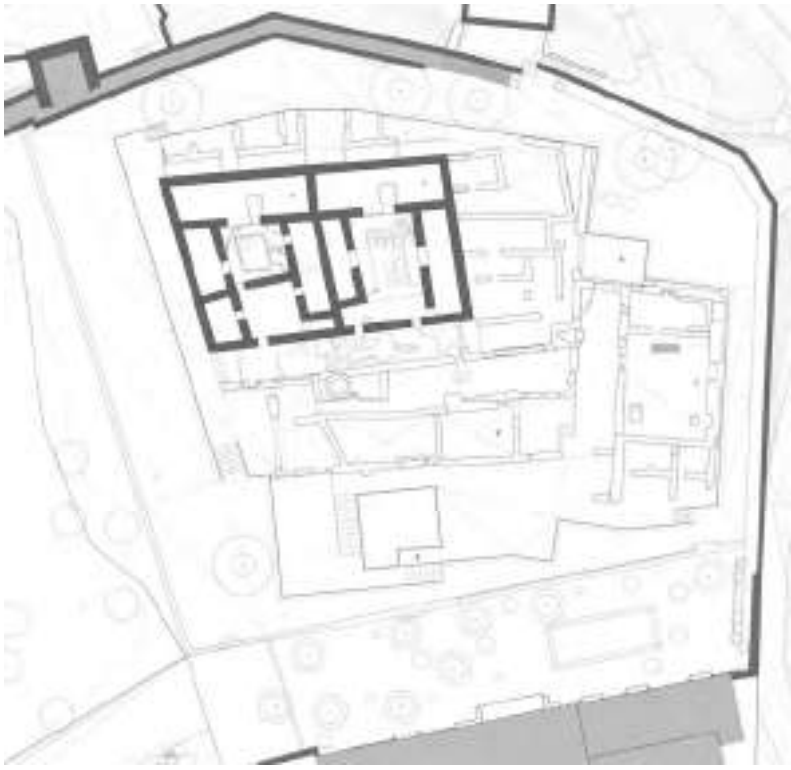

Fig. 5. Karatepe open-air museum: the museum in the landscape.

Fig. 6. Praça Nova open-air museum: project plan.

This last project, awarded with the Piranesi Prix de Rome in 2010, was designed in collaboration with the landscape architect João Gomes da Silva, with the aim to give a formal definition to the archeological ensemble and, at the same time, to identify each of the three historical layers. As for the first step, the whole archeological site has been delimited by a Corten-steel wall, to define a topographical area. An independent volume, crossed by horizontal slots, takes shape from these walls with a spiral form, which leads visitors at a lower level, towards the remains of the Iron Age settlement (Bucci, 2010).

Fig. 7. Praça Nova open-air museum: view of the project, between the Islamic houses and the metal volume.
Fig. 8. Praça Nova open-air museum: overall view of the project, towards the Islamic houses.

The second design operation was the realization of an elevated surrounding platform outside the border walls, aimed to define an intermediate space of relationship between the archeological site, the castle and the close Santa Cruz Church. The access to the ruins' ground level is marked by some limestone elements, which reveal the connection with the gravel paths.

Nevertheless, the more interesting intervention is the rebuilding of the 11th-century Arab houses: white abstracted suspended volumes seem to rise from the ruins, revealing the original conformation of the housing type, arranged around a courtyard. The ancient houses' floor plans are readable on the roof, made of polycarbonate screens protected by a wooden structure, which shares uniformly the light inside the buildings.

The seeming lightness of the structure, made of Knauf Aquapanel slabs supported by steel profiles, is expressed by just six support points, located where the ancient foundations are interrupted, so that they never touch the ruins. During the night, the artificial light underlines the detachment between the ancient foundations and the new white partitions, to create a surprising scenic effect and, at the same time, to highlight the separation between old and new (Bucci, 2010).

Finally, a dark movable structure protects the 15th-century mosaics of the Santiago Counts' Palace (former Bishop's Palace) and displays them by a reversed perspective on a mirrored surface located on its lower part.

4. Inhabiting the ruins: compared approaches

The two architectural samples differ in intention and conception; nevertheless, both are designed to give a modern interpretation of the ancient ruins and to redefine them. Cansever's suspended roofs and Carrilho da

Graça's arising volumes are thought to rebuild the ancient form and to make the archeological ground plan identifiable, even at great distances. Therefore, both architectures have a landscape and territorial value, considering the site as a natural and anthropic system to be preserved and, at the same time, to be completed. Carrilho da Graça prefers to speak of territory, rather than of landscape, because this term implies an anthropic influence in transforming the topography. In the territory, the traces of the ancient routes and settlements, based upon the topographical conformation, are still alive.

Fig. 9. Praça Nova open-air museum: view from above of the Islamic houses by night.

Another common theme is the clear distinction between preexistence and contemporaneity. However, the architects work with two different attitudes. In Adana, the modern structure is not conceived as separate from the ancient one, even using a different language; indeed, the concrete shelters are founded on the remains and their conformation is not ethereal: the imposing roofs seem to oversee the hill. Architecture results from revealing its constructive principles, expressed by wise use of materials.

For Cansever, the distinction between old and new is not significant, as well as the separation between conservation and invention, because the main responsibilities of the architect are those of solving the dichotomies and contradictions between past and present. He states:

"The hierarchy that arises from the evaluative relationship between the traditional and the contemporary, which are affected by man's ontological constraints and existential needs, will be the guideline for preserving the traditional through a reconciliation of the past, the present and the future.

The attitude of change for the sake of change and the separation of conservation from creation should be discarded.

The fundamental principle in carrying out this task will be "not to change until the old can be replaced by something better" (Cansever, 1977).

Otherwise, for Carrilho da Graça the added elements are totally independent and autonomous in language and character, even if designed on the basis of the existing ones. The evident separation between ancient (permanent) and new (reversible) is the way to achieve balance in the composition. In this case too, the

uniformity between architecture and constructive technique is important, but is aimed at searching for an abstraction, able to restore the memory of the past (Nobre Neto da Silva, 2014).

Praça Nova intervention is completely respectful of the preexistence, which remains intact and authentic, in order to show its vicissitudes. On the other hand, the new architecture claims its independence, becoming itself the message that attests to the site's history, in a wide sense.

In conclusion, we can assert that both the musealization operations are based on the conception of inhabiting the ruins, in terms of holding. Mediterranean housing types are used to establish a dialogue with the heritage in a wide sense and to find a relation with the present time. Types developed throughout history and the world, thus their transposition in time and space has defined languages and elements common to different Mediterranean cultures. In this sense, these architectures allow visitors to a broader understanding of specific site and spaces.

Acknowledgements

The research around the work of Turgut Cansever has been developed and illustrated thanks to the helpfulness of the Cansever family, in particular that of Emine Öğün Cansever.

References

Bucci, F., 2010. Recupero del sito archeologico al Castello di San Jorge, Lisbona. Un involucro sospeso sui resti che lo modellano, in *Casabella* n. 794, pp.9-15, Arnoldo Mondadori Editore, Milano, Italy.

Çambel, H., Özyar, A., 2003. *Karatepe-Aslantaş. Azatiwataya*, Verlag Philipp von Zabern, Mainz am Rhein, Germany.

Cansever, T., 1977. The city center of Istanbul: its past and its future problem, in *Urban conservation in Europe and America: planning, conflict and participation in the Inner City Rome*, 1975, Conference proceedings, Appleyard, D. (Ed.), pp.91-100, Tipografia Olimpica, Roma, Italy.

Cansever, T., 1981. *Thoughts and architecture*, Türk Tarih Kurumu Basımevi, Istanbul, Turkey.

Nobre Neto da Silva, R., 2014. *Monumentos e museografia. Dois espaços museológicos no Castelo de São Jorge,* em Lisboa, Master's degree dissertation, Instituto Superior Técnico, Lisbon, Portugal.

Rossi, A., 1989. Le distanze invisibili, in *L'architettura italiana oggi: racconto di una generazione*, Ciucci, G. (Ed.)., pp.237-246, Laterza, Bari.

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The gipso|TECA of the University of Perugia: conversion of a heritage building in a plaster cast gallery

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Abstract

The topic of the present contribution is the architectural heritages reusing for exhibition buildings taking into account the up-to-date requirements for the preservation, the enhancement and the protection of art goods. In particular, the architectural-structural reconfiguration of a heritage building into "gipso|TECA", the new plaster cast gallery of the University of Perugia, is reported. The latter building is part of the architectural aggregate of *Palazzo Murena* designed by Luigi Vanvitelli and completed by his pupil Carlo Murena in 1762, a former monastic complex and current headquarters of the aforementioned University and of its administrative offices. A preliminary in-depth historical and iconographical investigation, gathered by a survey, revealed the antecedence of such structure with respect to the context in which is located. Currently the building hosts the University Bursar's offices, but it appears mainly in disuse, and it is characterized by a high seismic vulnerability. The mandatory purpose is to reinforce this ancient masonry building, while developing a complementary flexible and contemporary museum space proceeding in the perspective of "build in the built". On this, an integrated design approach is proposed aiming at the creation of a "casket" in which exhibit and preserve the academic art collection that is devoid, at the moment, of an iconic seat able to fit its quality.

1. Introduction

Due to the recent earthquakes that affected the central Italy, in particular the Umbria region, the University of Perugia has activated a research program aimed at assessing the seismic vulnerability of the historic buildings owned and managed by itself. This activity has also involved the architectural complex composed by *Palazzo Murena* (former monastery of the Olivetans), the church of the University (ex Oliventans' church) and the building which, at the present time, is the seat of the Bursar's offices of the University of Perugia. In a previous contribution (Liberotti et al., 2020), the seismic safety of *Palazzo Murena*, current headquarters of the University of Perugia and of its administrative offices, was assessed.

Instead, the topic of this contribution is the building that houses the Bursar's offices of the University of Perugia, for which an in-depth historical and iconographic research, experimental investigation campaigns and structural monitoring related to an assessment of seismic vulnerability have been made. A design proposal of architectural and structural reconfiguration is presented. The binding aim is to reduce the seismic vulnerability,

Keywords:Architectural heritage, Seismic vulnerability, Structural strengthening, Build in the built, Museum accessibility, Art goods safeguard.

prefiguring, according to the principles of "building in the built", an iconic and contemporary museum space, designed to host the collection of plaster casts of the University of Perugia. The result is an architecture that is as integrated from a functional point of view, with the pre-existing testimonies, as at the same time, autonomous on a figurative level: able to play an emblematic cultural role in the interest of students and citizens.

1.1. The plaster cast galleries and the plaster cast collection of the University of Perugia

Although the practice of plaster casts, mostly formed on bronze and marble originals, has been widespread since the classical age (in Athens for educational purposes and in Rome for decorative ones), the plaster cast gallery, intended as a teaching room dedicated to the study of statues and the exercise of figure drawing, is a purely Renaissance invention, which has its roots in the Italy of the 16th century. At first when the practice of plaster casts became a daily activity in the workshops of the wealthiest artists and later when the first Academies of Drawing were established (Florence in 1562, Perugia in 1573 and Rome in 1577) (Cassese, 2013). But the presence of a specialized classroom for the exercise of figure drawing remains an exception. The proliferation of plaster cast galleries, in fact, is a direct consequence of the Antonio Canova's cultural policy who, in the capacity of plenipotentiary minister of Pope Pio VII, contributes decisively to the implementation of the collections of plaster casts of the Academies present in the Pontifical territory, aimed at orienting the trends of the territories under their influence. Starting with Umbria in general, which Canova attends assiduously being the owner of a summer residence in Sangemini, and Perugia in particular, where Canova is a member emeritus of the Academy of Fine Arts (Iannaco, 2009). It is no coincidence that the Umbrian capital still boasts three collections owned by the main institutes of higher education (Academy of Fine Arts "Pietro Vannucci", University for Foreigners, University of Perugia) and two plaster cast galleries, set up in the former convent of San Francesco al Prato, where the collection of the Academy (which has grown over the centuries around the four casts of Michelangelo imported by Vincenzo Danti) (Boco, 2014) and in *Palazzo Pontani*, where is kept the collection of the University of Perugia (formed on Greek-Roman works and organized as scientific cabinet by Filippo Magi between 1960 and 1975) (Sciaramenti, 2019). But, unlike the plaster cast gallery of the Academy of Fine Arts "Pietro Vannucci", renovated according to a project drawn up by Fabio Mongelli, following the damage suffered during the earthquake events of 1997, the plaster cast gallery of the University of Perugia, although presenting pieces recently subjected to a wise restoration, hasn't an exhibition set up context appropriate to its patrimonial value, both in terms of accessibility and dimensional features. A real shame considering that, in the age of Artentainment, the copies of copies are rated almost as original artifacts.

2. Cognitive activity

Historical masonry buildings are always characterized by architectural and structural peculiarities that make complex both the assessment of seismic vulnerability and the design of interventions aimed at their conservation and reuse. Therefore, the need to adopt an interdisciplinary approach based on historical research and architectural surveys emerges.

2.1. Palazzo Murena

Designed by Luigi Vanvitelli in 1739 as the seat of the Oliventans' religious order (monastery of *Monte Morcino Nuovo*), the architectural complex of *Palazzo Murena* is situated on the northwest side of the old town of Perugia, in particular in correspondence of the ancient "contrada de' Pasteni", which has always represented the best exposed slope, from a climatic point of view, of the district called Conca: an area characterized since ancient times by the alternation of surfaces for cultivation and burial, which betrays the first signs of urbanization at the end of the 13th century (Casagrande, 1983). The site (Fig. 1), as declared by Luigi Vanvitelli in one of his memorials, has been chosen "per esser grande e libero e suppongo arioso in cui si potrà fare una chiesa molto onesta, la quale penserei di figura regolare con sua cuppola o catino sopra […] chiostro […] bello e spatioso" (Chiacchella, 1983). From a typological point of view, the architectural complex looks like a quadrangular fortification with a central courtyard, articulated northwards in the linear building of the Olivetans' church

(equipped with a sacristy and a novitiate), designed by Luigi Vanvitelli in 1739, and southwards in the "U-shaped" building of the Olivetans' monastery, also designed by the same architect, but completed by his pupil Carlo Murena, who in fact assumed the role of director of works, from whom the palace inherited the current name (Minieri Riccio, 1880; Mariano, 2000; Carbonara Pompei, 2008), (Fig. 2). However, Vanvitelli's original authorship is proven by numerous historical and archival sources, in which the biography written by the nephew of the same name, in the early 19th century, stands out. It includes, among the works carried out by the architect, the project of the church and the monastery, but also and, above all, the autograph drawings preserved in the archive of the Royal Palace Museum of Caserta (Gianfrotta, 2000). The construction works, started in 1740 and completed in 1762, caused the upheaval of the pre-existing urban fabric, engaging roads, and buildings, and also gave to the city a monumental architectural complex, which dominated the naturalistic area of the *Conca* opposing its stereometric compactness to the picturesque fragmentation of the old town.

(a) (b)

Fig. 1. (a) The *Conca* district; (b) The architecture complex of *Palazzo Murena*.

It is not a chance that the local historian Luigi Bonazzi harshly criticized the archaic magniloquence of this new architecture, defining it as "una sorta di Alhambra", and only justifying its existence in the perspective that

Fig. 2. Picture postcard of Perugia's view in the 1950; in the centre stands out *Palazzo Murena.*

in 1810, following the Napoleonic suppression of religious orders, it would be confiscated from the Olivetans and assigned to the University of Perugia (Bonazzi, 1879). Then the academic moved there, freeing the historical one in *Piazza del Sopramuro* and later, with the Study Regulations issued in 1824 by Leo XII, the University of Perugia became state owned and consequently, in 1860, ownership of the entire architectural complex passed to the Italian state property.

This made possible to elect the architectural complex as the seat of the headquarters and of the administrative offices of the University of Perugia, laying the foundations for the intense building programme promoted by the Rector Giuseppe Ermini and designed by Giuseppe Nicolosi during the 1960s and 1970s (Belardi, 2008), which replaced the existing green areas and transformed the Conca's area into a real university campus.

2.2. The Bursary

The rigorous orthogonal layout that marks the monastery of *Monte Morcino Nuovo*, as designed by Luigi Vanvitelli and built by Carlo Murena, is contradicted by the exceptionality of a small building, located on the northeast side, which is characterized by a different planimetric arrangement, attributable to the different old road network, and by a various partition of the interior spaces, referable to the several function. It is no coincidence that this building, in the original project of Luigi Vanvitelli kept at the State Archives of Perugia[1], is painted in grey and is marked by the caption "ospizio", legitimizing the hypothesis that it was a noteworthy building, as implicitly proven by the fact that it has not been demolished, but it has been incorporated "tout court" in the new architectural complex and it still boasts vaulted rooms (Fig. 3). Nevertheless, the document reveals other two valuable information: originally the building was located along a naturalistic slope (as well as it betrays the purpose of erecting a retaining wall to "tenere il terreno tagliato" belonging to the camp above of the St. Benedict's nuns) and presented only three floors (the fourth level is the result of a recent elevation) (Fig. 4).

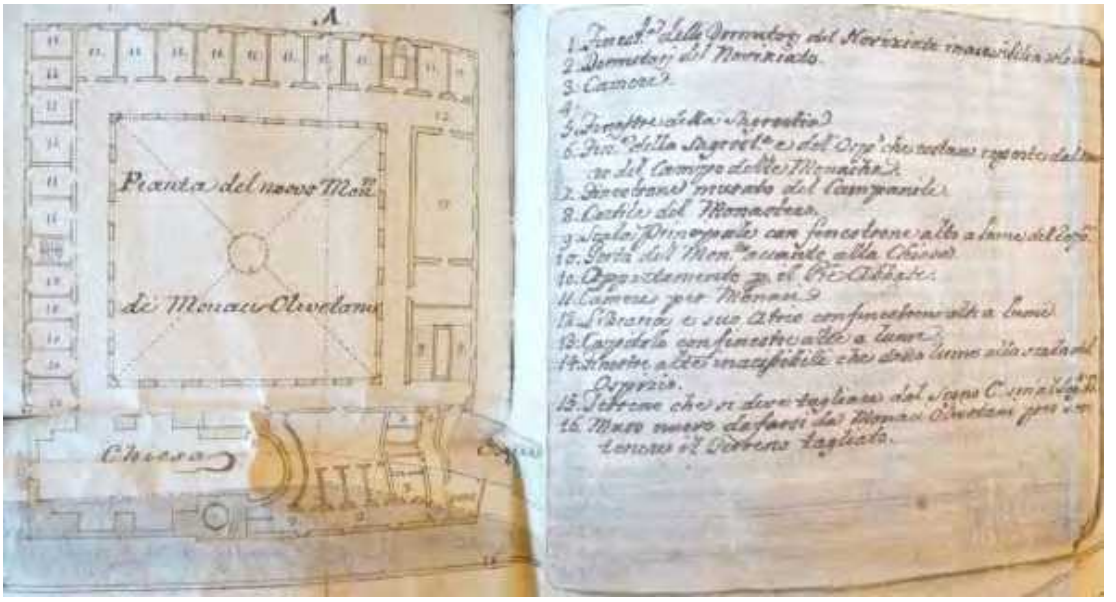


Fig. 3. Autograph plan and description of the monastery of *Monte Morcino Nuovo* from Luigi Vanvitelli. The pre-existing hospice and the wall of the camp of the St. Benedict's nuns are visible, (State Archives of Perugia, 1739).

[1] Tarducci M., *Evoluzione storica e stratigrafica di Palazzo Murena*, research carried out as part of the teaching of "Architettura e Composizione 1" of the Degree Course in Building Engineering and Architecture (Professor Paolo Belardi), a.a. 2016/2017, Archives of the Department of Civil and Environmental Engineering of the University of Perugia.

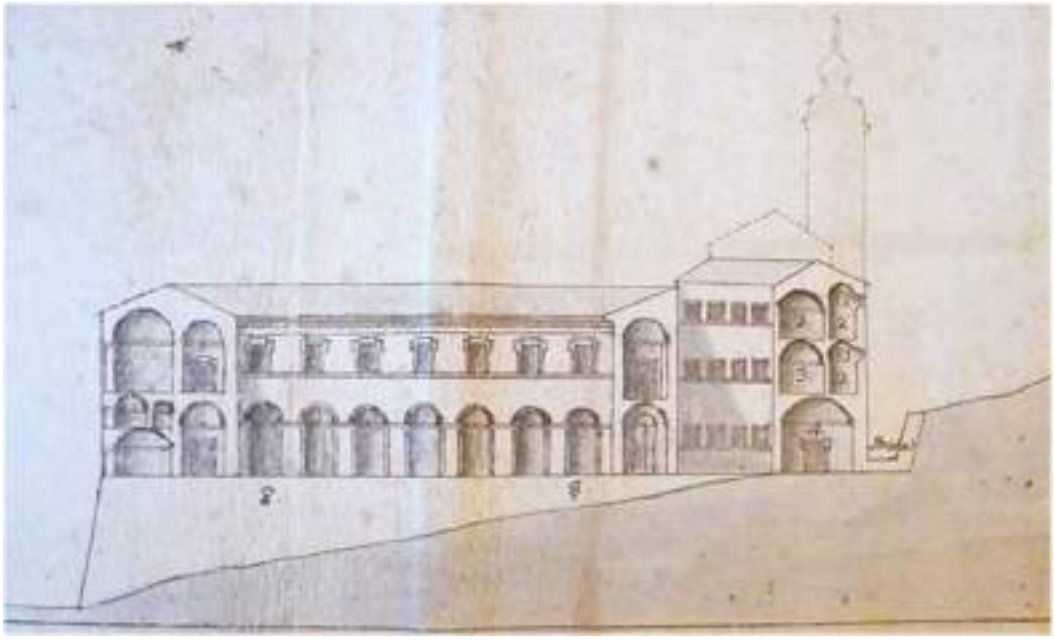
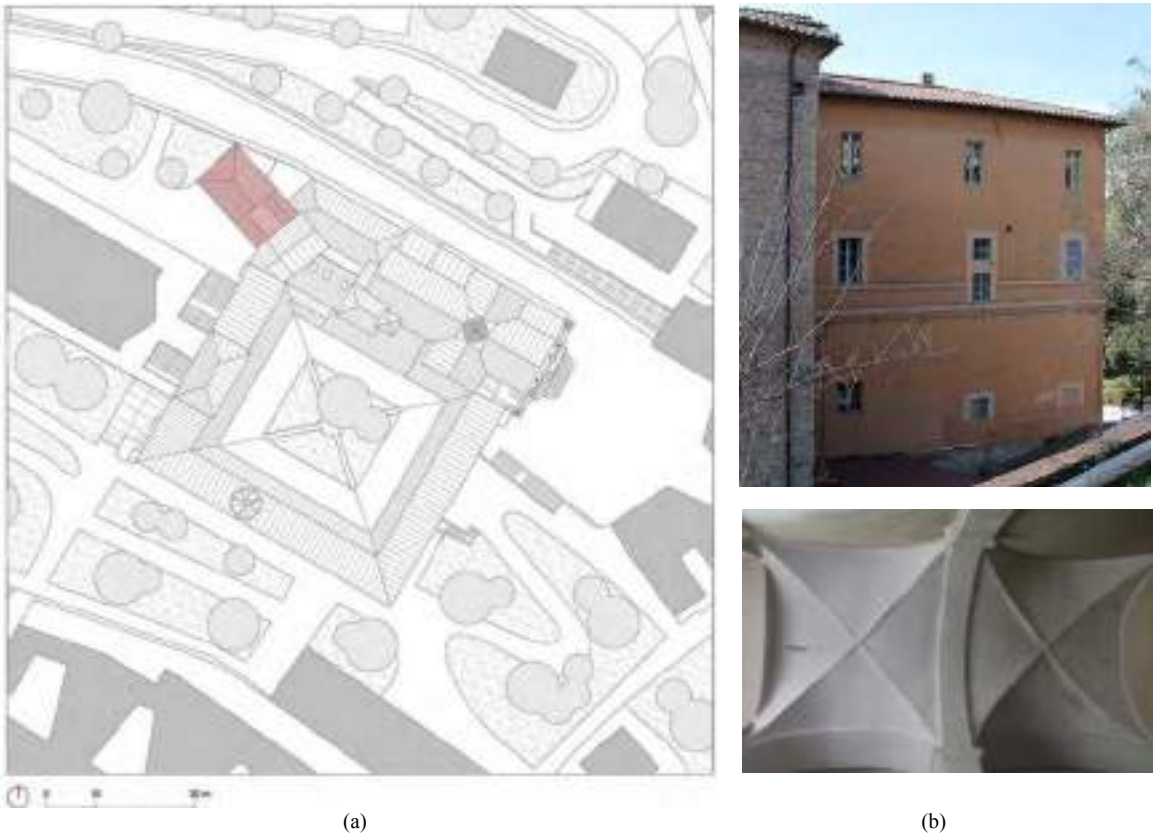
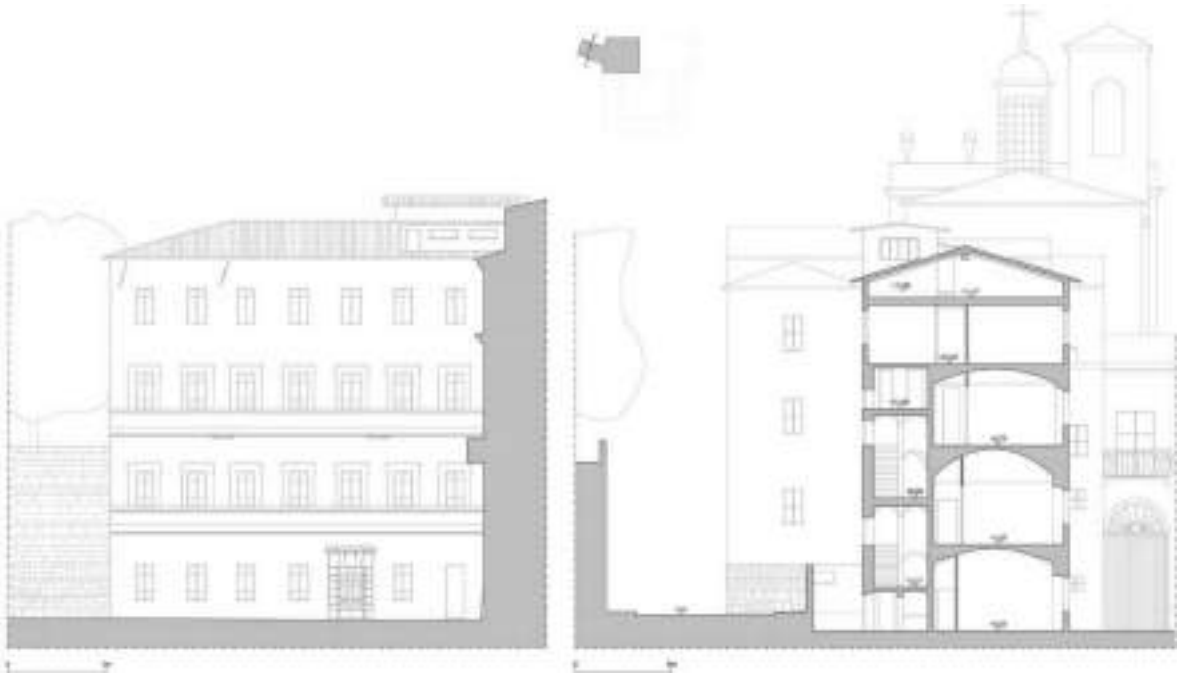


Fig. 4. Original design drawing of the monastery of *Monte Morcino Nuovo* from Luigi Vanvitelli and the wall of the camp of the St. Benedict's nuns. On the right the cross-section of the hospice (State Archives of Perugia, 1739).



(a) (b)

Fig. 5. (a) Plan with the seat of the Bursar's offices of the University of Perugia (highlighted in red); (b) Photographic survey of the Bursar's offices of the University of Perugia.



(a) (b)

Fig. 6. Extract of the elevations and sections drawn up during the survey activities: (a) Southwest elevation; (b) Cross-section.

Nonetheless, the consultation of the yearbooks of the University of Perugia also revealed that the building had many functions over the century. In fact, before becoming the seat of the Bursar's offices of the University of Perugia, it was used as religious hospice and then its premises were used as the seat of the Institute of Physics; in the recent past it hosted the Accounting Office of the University of Perugia and the Carabinieri Station Command. It is precisely because of this functional plurality, at times concomitant, that the building has been subject over time to a progressive fractionation of the interior spaces, until such circumstances led to a progressively loss of those typological and figurative values that, on the other hand, have been highlighted by a recent master thesis in Building Engineering-Architecture (Sorignani, 2018), in which an in-depth archival research and an accurate architectural survey have been carried out: those two activities are ritual when intervening on the historical heritage, but on this occasion, proved to be so useful to lead the design choices (Fig. 5, 6, 7).

The research, in fact, showed that originally the building was on three levels and was organized around three cloisters (now reduced to two courtyards). In addition, from the architectural survey, it has emerged that the variety of visible ceilings, ranging from brick vaults to plasterboard false ceilings, and the irregular elevation profile of the floor slabs attributable to the need to connect uneven and functionally heterogeneous rooms, are the result of a construction process that lasted almost seven hundred years.

3. Actual state of the building

The extensive historical-iconographic research permitted to correlate the observations deriving from the survey with the series of transformations that, over the centuries, have involved the construction; in addition, such activities permitted to ratify the antecedence of the Bursar’s offices building in relation to the architectural complex designed by Luigi Vanvitelli. Therefore, an experimental campaign was carried out, in partnership with the Technical Office of the University of Perugia, in order to increase the level of knowledge concerning such ancient masonry architecture also in relation to the interaction and overlapping with the contextual buildings.

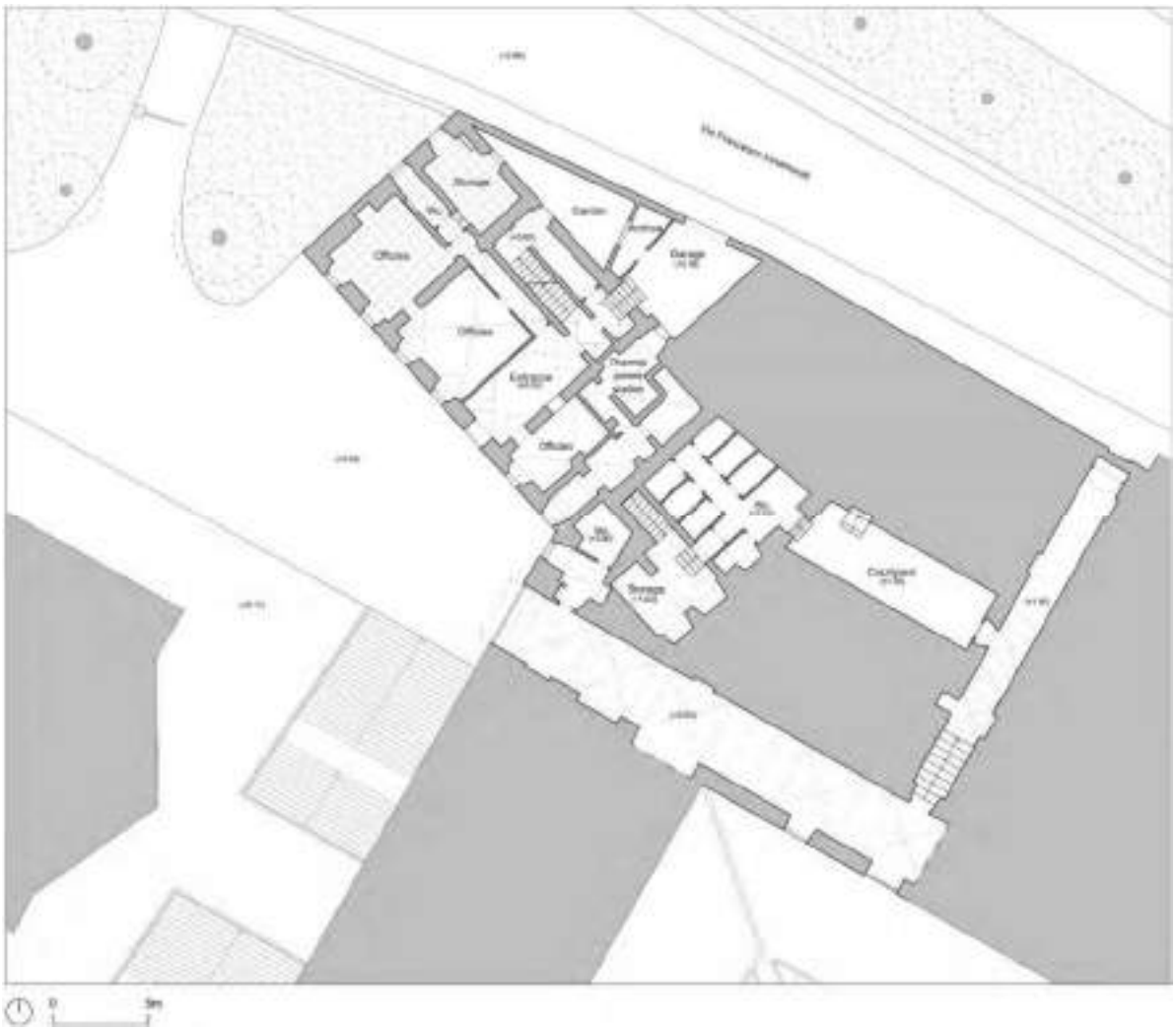


Fig. 7. Survey of the ground floor plan of the seat of the Bursar's offices of the University of Perugia.

3.1. Experimental test campaigns

To recall, several experimental tests and instrumental investigations were conducted:

- visual inspections over the masonries;
- videoendoscopic investigations on load-bearing walls and vaults;
- single and double flat-jack tests;
- tests on mortar samples;
- geophysical tests with georadar.

The visual inspections carried out after removal low end plaster portions, together with the endoscopies, the tests on mortar samples and the ones with flat jacks allowed to identify the masonry type and its quality. In particular, two masonry typologies have been observed and classified according to the NTC (2018) and the Circ. No7 (2019):

- masonry in solid brick and lime mortar;
- masonry in rough-hewn stone elements (found only in few portions of the building).

The test with flat and double jacks, performed on the ground floor, led to the definition of the mechanical parameters for the most widespread wall type, Tab. 1.

Parameters	N/cm^2
f_m	266.6
E	346

Table 1. Experimental outcomes for solid brick and lime mortar masonry: with f_m the average compression strength and E the Young's modulus.

In addition, series of endoscopic tests has been carried out in order to identify the geometric characteristics and constructive features of the masonry vaults. Specifically, the tests marked as *V11* and *V12* concerned the ceiling of two rooms on the first floor while the *V9* and *V10* were carried out on the respectively floors on the second level. The *V11* and *V10* tests were performed at the intrados and at the extrados of the same vault providing information on the thickness of the vault and indication about the width of the filling:

- thickness of the layer composed of brick and mortar equal to *14 cm*;
- thickness of the filling greater than *7 cm*.

The tests *V12* and *V9*, on the other hand, were performed at the intrados and at the extrados of the large vault covering a courtroom, the Dessau hall. The *V12* test, eccentric with respect to the cornerstone, gave results useful for the identification of the masonry thickness while the *V9* showed the extent of the filling (Fig. 8):

- thickness of the layer composed of brick and mortar equal to *14 cm*;
- thickness of the filling equal to *4 cm.*

3.2. Structural peculiarities

The Bursary building presents numerous peculiar quirks in relation to its volumetric development such as rather articulated load-bearing structure, floor plans varying from level to level, etc. This heritage edifice stands as a cluster of vary masonry vaults combining different floor's heights; as stated during the survey the architectural value of the central masonry body of the building arises.

(a) (b)

Fig. 8. Videoendoscopy *V11* – from intrados: (a) View at *15 cm* from the start of the drill, filling in unbound material; (b) Image at *5 cm* from the start of the drill, brick and mortar elements.

The experimental activities have shown several structural lacks marked as a possible risk factors affecting the seismic safety of the building and deriving from different temporal backgrounds:

- Presence on the level of the second floor of "in falso" masonry, bearing walls built without a direct load path to the ground and weighing on the underlying brick vaults;

- masonry walls of modest thickness with load-bearing function in relation to the upper vaults;
- presence of a widespread crack pattern with local collapse on the third floor;
- the roof, although presenting a concrete ring-beam capable of conveying the load almost exclusively on the perimeter walls, represents an extremely rigid and heavy plane, resulting burdensome for the lower structures which instead are more flexible;
- the crawl space, used as an archive, entails the concentration of considerable loads;
- excess of non-load bearing wall causing increasing in the seismic mass of the structures arranged, in addition, without a specific functional and distributive purpose.

Based on the tests carried out over the years and on the basis of the knowledge obtained during the geometric survey phase, LC (Level of Knowledge) has been identified and the respective confidence factors have been defined as described below.

4. Vulnerability analysis

4.1. Numerical modeling

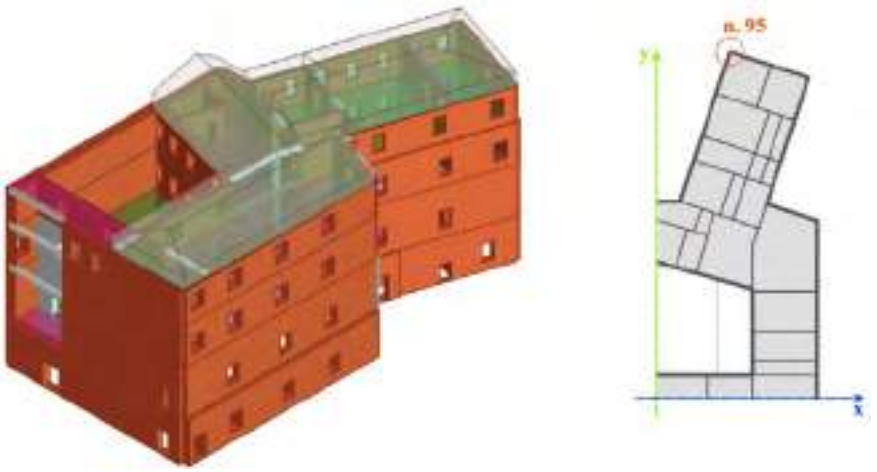
In order to evaluate the safety of the structure in presence of seismic actions a numerical model has been created and, as required by the Italian Building Code (NTC 2018, Circ. No7 2019) a global seismic analysis has been carried out. Such simulation involves the entire construction and engages the walls mainly in their plane; the local mechanisms affect single males or limited portions of masonry and derive from the lack of connections between the walls and the slabs. The model was implemented out by means of the *3Muri* software, which employs the *Frame by Macro-Element method* and allows to conduct non-linear static pushover analysis on the 3D structure, (Fig. 9).

The investigations conducted can be classified as "extensive and exhaustive in-situ verifications", in relation to the analysis of construction details, and "extended in-situ investigations" with respect to the materials' properties. Therefore, it has been possible to adopt the LC equal to *2* for both the identified wall types, corresponding to a *Confidence Factor (FC)* equal to *1.2*. With the aim to conduct structural evaluations on the safe side, the masonries' design values have been determined according to the Italian Building code instead than taking it directly from the experimental outcomes. On this for both wall types, the average mechanical parameters values have been extracted from Tab. C8.5.I of the Circ. No7 (2019) and have been divided to *1.2* (*FC*). Furthermore, the flexural and shear stiffness of the masonry elements has been reduced by *50%* to consider the penalizing effects tied to the cracking pattern; such design values of the mechanical parameters are shown in Tab. 2.

As mentioned, the investigations carried out also made it possible to identify four main types of brick vaults: cloister vaults, cross vaults, barrel vaults and barrel vaults with cloister heads. The video endoscopic tests showed a stratigraphy, proceeding from the intrados to the extrados, consisting of plaster, solid brick, filling material, screed, and floorings. Based on the results of these investigations, the structural permanent loads (*G1*) have been attributed for each vault typology in the subsequent numerical analysis, Tab. 3; indifferently for all vaults a non-structural permanent load (*G2*) equal to *2,50 kN/m* ^{2} has been ascribed.

Masonry type	FC	Red. Factor	$f_{m,d}$	$\tau_{0,d}$	E	G	w
Masonry in rough-hewn stone elements	1,2	50%	250	4,3	615	205	20
Masonry in solid brick and lime mortar	1,2	50%	320	7,6	750	250	18

Table 2. Design parameters related to the walls identified for the non-linear analysis with: $f_{m,d}$ the compression strength *[N/cm^2]*; $\tau_{0,d}$the shear strength in absence of normal stresses*[N/cm^2]*; *E* the modulus of elasticity *[N/mm^2]*; *G* the tangential elasticity modulus *[N/mm^2]*; and w the specific weight *[kN/m3].*



(a) (b)

Fig. 9. Numerical modelling: (a) View of the 3D model; (b) Location of the reference node on the upper floor, X and Y are the seismic direction with respect to which the simulation was performed.

	T1	T2	T3	T4
G1	6,23 kN/m^2	8,36 kN/m^2	10,94 kN/m^2	10,50 kN/m^2

Table 3. Values of the structural permanent loads (*G1*) applied to each masonry vault for the numerical analysis with: *T1* the cross vaults; *T2* barrel vaults simple and with cloister heads; *T3*barrel vault with cloister heads –Dessau hall; *T4* cloister vaults

In compliance with its public function the building has been rated in Class III (NTC 2018, Circ. No7 2019) in compliance with its public function; in this framework, the following values of the variable loads were considered in the calculation model:

- Offices open to the public (Cat. B2): *3.00 kN/m^2*;
- Common stairs, conference rooms (Cat. C2): *4.00 kN /m^2*;
- Libraries, archives (Cat. E1): *6.00 kN/m^2*;
- Roofs and attics accessible for maintenance only (Cat. H1): *5.0 kN/m^2*.

The action of the wind, being modest compared to the one of the earthquake, was neglected in the calculation. The action of snow esteemed on the roof is equal to *1.30 kN/m^2*. In relation to the seismic actions, the spectrum employed is the one elaborated selected from the NTC (2018), to the parameters related to the city of Perugia and to the placement of the building, as it is more precautionary than the one gathered by the micro-zoning studies. The simulations have been run with respect to the two seismic directions and the outcomes of such pushover analysis are compared to the location of a reference node; on this sensitivity analyses (Pagnini et al. 2011) were conducted aiming at proper representation of the structure's actual seismic behaviour, Fig. 9b.

4.2. Seismic vulnerability assessment

In this contribution, according to the NTC (2018), the results of the pushover analysis are evaluated by means of the α_{SLX} coefficient, defined as:

$$\alpha_{SLX} = \frac{PGA_{CLX}}{PGA_{DLX}} \tag{1}$$

where for the considered design combinations PGA_{CLX} is the limit capacity acceleration, or the maximum entity of the actions, that the structure is capable to sustain and PGA_{DLX} is the spectral demand acceleration for each limit state, or the reference value of the acceleration of the seismic action. The subscript *X* is indicating the considered limit state: *C* for the collapse limit state, *V* for the life-saving limit state, *D* for the damage limit state and *O* for the operational limit state. A value of α_{SLX} equal or greater than *1* indicates a successful simulation and the seismic capacity of the building is assumed to be the minimum one obtained from such analyses.

The presence in the numerical results of some values of the ratio α_{SLV} lower than *0.6*, as was the case for the Bursary building, reveals that the construction must be counted among those constructions at seismic risk and would require interventions of strengthening.

Taking note of the previously observed safety shortcomings of the building, confirmed by the outcomes of the non-linear analysis, an improvement plan must be designed with a multidisciplinary approach aimed at the harmonization of the structural improvement longings with the architectural and cultural value of such strategic asset for the University of Perugia. Build in the built environment is an innovative design culture aimed at giving surplus value to contexts to be enhanced and reshaped as drivers for social and economic regeneration, rather than realize new buildings. From this design approach an ambiguous camouflage, for whom the intervention is visible only due to the roof, emerges through the emptying of the existing spaces and the reconstruction of a new inner spatiality. Such a strategy, aimed to reconvert the building, was seen as a common ground between architecture, structural engineering and museographic features in order to promote the individuality of the edifice and the distinctive experience that the plaster cast gallery can offer.

5. Architectural-structural reconversion in gipso|TECA

5.1. Build in the built

At the moment, in Italy, there is no more relevant architectural topic than the one of "build in the built" (Zucchi, 2014; Girasante and Potenza, 2016; Parlato, 2018); because it is precisely by omitting such approach that our cities have lost meaningfulness, increasingly becoming devoid of those stratifications that have always marked them and in some way qualified them even on a planetary level. On the other hand, it is clear that "build on the built" does not mean merely aligning the building heritage with the new functions of the digital age, just as it does not mean adapting the ancient structures to the performance imposed by the up-to date Building Codes (NTC 2018, Circ. No7 2019) aimed at guaranteeing the safety (anti-seismic, fireproof, etc.). Such design strategy allows to dignify social awareness, in terms of environmental sustainability, as a tangible (and visible) landmark. In other words, it means minimizing the consumption of environmental resources and historical memory, avoiding both the anthropization of new areas and the erasure of anthropogenic pre-existences. Especially, "build in the built" does not mean renouncing to architecture, because it is exactly from the comparison between the new and the old that the expressive strength of the one and the other is emphasized (Latina, 2019). This is true both for conservative interventions, in which prevails the safeguard of the features and the formal matrixes of buildings, and for innovative interventions, in which the experimentation of new technologies and new languages predominates (Pellegrini, 2018).

5.2. Design approach to the structural strengthening

In order to increase the seismic safety of the building an improvement plan should include: consolidation of the foundations, strengthening of the masonries in particular the "in falso" walls, retrofitting of the horizontal slabs and masonry vaults, the remaking of the roof's structure in favor of a lighter solution and the reinforcements of the stairwells. This kind of scheme, if approached in the ordinary path, results expensive and demands a long-lasting construction site without ensuring a new function suitable for the prestige of the construction.

In the present case study, the conceiving of such design actions is contingent upon the devising of proper strategies aimed at the long term goal of the safeguard of the Bursary's architectural value with respect also to

its feasible socio-cultural role regarding the University and the city of Perugia. In this framework, a project of structural-architectural reconfiguration proposing the subtraction as a modality of transformation and reuse of the construction lending to the intended use of academic plaster cast gallery and is presented (Chametzky, 2001; Tosi Pamphili, 2013). The central masonry core of the building, rated during the surveys as its rarest architectural feature, deserves to be maintained and promoted as well as the outer masonry casing; the renunciation to the adjacent existing volumes guarantees instead significant benefits by allowing the creation of large open spaces and improving the accessibility of the new museum spaces. The plan foresees to demolish those masonry elements proceeding from the top to bottom of the building by means of the technique called "top down". Those two internal emptying operations cause the removal also of the horizontal connections with the façade maintaining instead those in the wall intersections, therefore the installation of temporary shoring is required in order to prop up the façade (Lucchini et al., 2014).

To restore the box-behaviour to the masonry building, a new load-bearing structure made of mixed steel-concrete columns and steel beams is inserted with the aim to create a mesh, structurally anchored to the outer masonries and to the core's walls, designed according to the up-to date seismic requirements. In one of resulting compartment, the bigger one, moreover, it is planned to place hidden steel beams along its perimeter so as to create a sort of steel hoops. In addition, these new structural elements which runs through the entire building will hold up the structural and mechanical vertical connections, some parasite architectures and contain part of the new technological systems; the full-height voids give a glimpse along the various floors of the "core" interconnected with each other through walkways.

The modern building is thus closed inside this architectural mask which retains the four original façades that will be suitably restored even applying high-performance systems for doors, windows and shutters with thin fixtures interpreted as an integrated part of design plan an able to emphasis the basic architectural shape of the ancient masonry façades. As concerning the new roof, lighter than the actual one, is characterized by a steel truss made up of bolted L-profiles coated in larch strips; the beams rest directly on the existing masonries and is connected to them thanks to plates and transversal connectors that cross the walls. The introduction of the aforementioned new structural elements allows a reorganization of the building without portioning the inner spaces and avoiding the construction of additional volumes: a mandatory condition designed to emphasis the open, public nature of the gallery in order to promote moreover the interaction between visitors in a sort of open laboratory. Together these elements combine to create a museum without "boundaries", characterized by a significance and malleability of museum space, which in this way is always open to change; the importance of such aspect has been stressed out by the current public health emergency, whom is transforming the nations' intellectual perspective about the reciprocal relationship and interactions between construed space and curatorship, or in other words, between museum buildings, exhibitions, visitors and exposed art goods.

The museum offers two entrances and itinerary options: the visitor can either access by the main entrance at the lower level or climb a set of stairs from the headquarters of the University of Perugia to arrive in the central lobby at a higher level. Both of these levels give access to the gallery main spaces. In addition, this configuration allows for different components of the museum to operate independently. It is considered that restoring a homogeneous function for whole the building can safeguard this architectural artefact against the negligence also estimating lower costs compared to traditional interventions.

5.3. Architectural-functional arrangement of the expositive spaces

Precisely because the office of the Bursary of the University of Perugia is not marked by a distinctive use, but is divided into several uneven functions, it presents a cluttered internal subdivision, which mortifies its historical value and compromises its representative potential. Hence the reasons for a design proposal that is not only interdisciplinary, because it aims to integrate the need for seismic adaptation with the distributive reorganization in the sign of architectural re-composition, but it's also courageous, because it aims to transform the building into the plaster cast gallery of the University of Perugia through the technique of emptying/incorporation (Ungers, 1981) (Fig. 10).

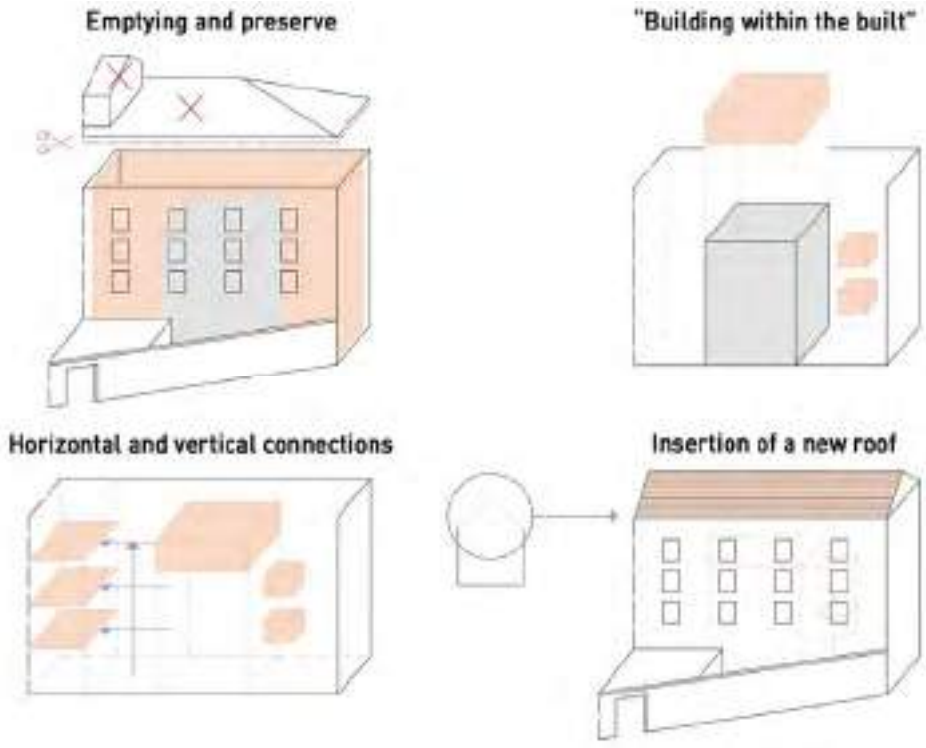
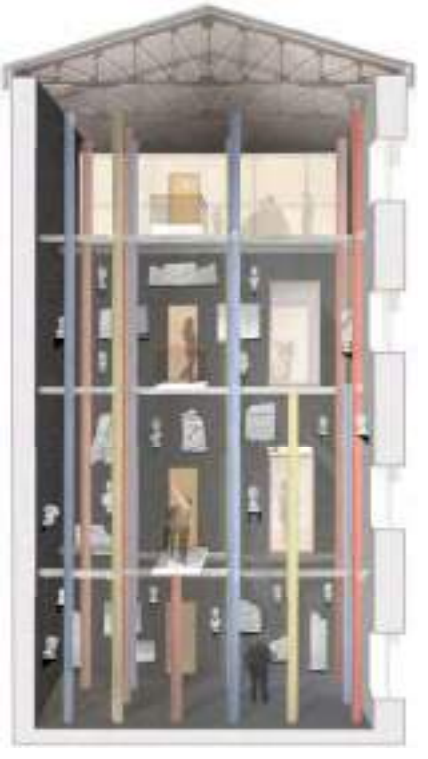


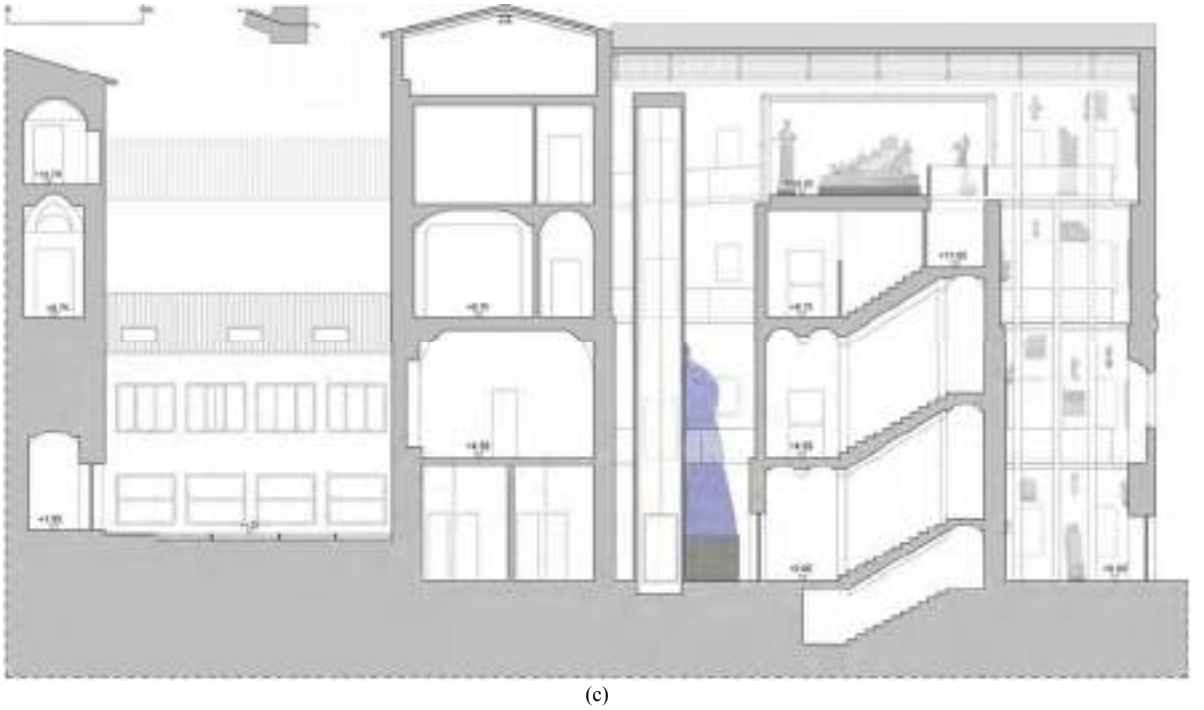
Fig. 10. Concept with meta-projectual phases.

The designed plan, in fact, in addition to provide for the conservation of the external walls, entrusting them with the role of shell, and of the central core, enhancing the historical styles, prefigures a next-gen. museum structure, dedicated to the multimedia practice of figure drawing (Belardi and Menchetelli 2018). A museum space directly accessible from the gardens of *Palazzo Murena* by means of an astonishing hall (higher than *20 m*, dotted by a forest of polychrome columns and conceived as a *wunderkammer*), and organized around the pre-existing central nucleus in which the reception (on the ground floor) and the exhibition rooms (which are deployed in its overlapping floors) are arranged (Fig. 11a).
The latter main galleries in turn are facing the double-height entrance vestibule by means of solid glass volumes suspended on the void; through which can be admired, between the pillars, the jutting out parietal statues (Fig. 11b). The museum itinerary culminates in a volume (over the upper level of the masonry nucleus) designated by textile walls that allowing the visitors to glimpse the shadow silhouette of the statues from the outside. While an articulated system of aerial pedestrian paths, guarantees the connection of the pin-core of the plaster cast gallery with the interiors of *Palazzo Murena* (containing an art studio, conservation and restoration labs, temporary exhibition spaces, and education areas). Such hall emphasizes with its typological variety the figurative and dimensional exceptionality of the *Ercole Farnese*: a spectacular replication of the plaster cast preserved at the Academy of Fine Arts "Pietro Vannucci", made of plastic material by 3D printing and marked by a chromatic treatment programmatically provocative (Fig. 11c). Just as programmatically provocative is the new wooden roof of the building, conceived as a viral element and which, guaranteeing immediate recognition, contributes decisively also to the conversion of the building into gipso|TECA (Sorignani, 2018). This spatial-structural interpretation can have a decisive impact also on the user's perception of the constructed architectural space.
Then the visitor will find himself first engaged by an immersive space, between coloured pillars and plaster steles, and then, once inside the core of gallery, he will benefit from the view of the plaster statues arranged, in the different floors, in order to guarantee their total visibility and an adequate permeability of the museum spaces. These are the essential prerequisites for a plaster cast gallery in order to organise periodically life drawing courses and various educational activities. The gipso|TECA is so connoted, both formally and substantially, in the university and city cultural pole.

(a)



(b)



(c)

Fig. 11. Projectual proposal: (a) Plan of the second floor; (b) Rendering of the atrium dotted with the forest of columns; (c) Cross-section.

6. Conclusions

The Bursar's offices of the University of Perugia present an orientation unrelated if compared to all other building of the architectural complex of *Palazzo Murena* in which is placed, a former monastic complex designed by Luigi Vanvitelli and actual headquarters of the University of Perugia. Such topic brought to conduct in depth historical and iconographical research which have led to assert that anciently this building covered the role of canon senile hospice, later it has been included in the former monastery and in modern times it become the University Bursar's offices. Progressively several experimental and instrumental tests have been conducted, along with survey campaigns, in order to increase the level of knowledge associated with this construction. The obtained data have been used to create a numerical model aimed at the evaluation of the actual global seismic behaviour of this heritage building; the outcomes of such analysis permitted to rate the Bursar's offices in safety level that deserves to be improved.

Recognizing the architectural quality of some elements of the building a plan has been designed in order to look at the structural deficiencies in the wider perspective of making a plaster cast gallery out of the building. The plan foresees the creation of a box in the box, keeping the wall outer case and the inner masonry core, who presents lots of valuable masonry vaults. To reshape the interior arrangement, some pre-existing walls and horizontal slabs were demolished. Behind the heavy mass of the historic façade, a new museum space develops thanks to a steel structure, placed in the rooms of new creation, collaborating with the existing masonries, and intended to provide for the seismic requirements. The museum layout hosts the new functions including a linear exhibition that runs along the building's development, by means of suspended pedestrian walkways, and many galleries inside the central core. Such spaces offer different flexible environments suitable to set up the plurality of plaster casts; at the same time lighting, display and air conditioning systems are carefully integrated to create the appropriate display and conservation conditions. The exhibition includes Italian and international historic documents, original drawings and models, fragments of documentaries and films, and photographs displayed to cast light on the plaster casts' crafts and culture. On this, insights and a close-up look at 3D printing and modelling for the carving and the protection of art goods are also featured. In addition, the museum includes accessible laboratories with a view to broadcast the activities conducted in them: to support the traditional moulding and maintenance work, a 3D archive of the art collection is in turn updated, using survey instruments like the laser scanner, and enhancing the possibilities of monitoring, refurbishment, and preservation.

The users can discover the museum space through interaction, participation, and accessibility. The building, with its new function and appearance, will restore to the plaster casts collection an emblematic cultural role in the interests of students and citizens of Perugia besides holding the out-of-town people's appeal.

Acknowledgments

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References

Belardi, P. (Ed.), 2008. Giuseppe Nicolosi (1901-1981) architettura università città, Proceedings of *Giuseppe Nicolosi (1901-1981) architettura università città*, (Perugia, 19 October 2006). Libria, Melfi, Italy.

Belardi, P., Menchetelli, V., 2018. 4DGypsoteca. Un'architettura multimediale per la didattica del disegno, in "*Ambienti digitali per l'educazione all'arte e al patrimonio"*. In: Luigini, A., Panciroli, C. (Ed.). pp. 35–50, Franco Angeli, Milano, Italy.

Boco, F., 2014. Gipsoteca, in "MUSA. Museo dell'Accademia Perugia", in: Boco, F. (Ed.). *EFFE*, pp. 42–43, Fabrizio Fabbri Editore, Perugia.

Bonazzi, L., 1879. *Storia di Perugia dalle origini al 1860*, Boncompagni, Perugia, Italy.

Carbonara Pompei, S., 2008. *Al crepuscolo del barocco. L'attività romana dell'architetto Carlo Murena (1713-1764)*, p. 36Viella, Roma.

Casagrande, G., 1983. La Conca di S. Lorenzo, in *Un quartiere e la sua storia: La Conca di Perugia. Itinerario per una conoscenza e una proposta*. pp. 229–237, Guerra, Perugia, Italy.

Cassese, G., 2013. Accademie di Belle Arti: identità, patrimonio e futuro dell'Italia, in *Accademie Patrimoni di Belle Arti,* In: Cassese, G. (Ed.). pp. 15–43, Gangemi Editore, Roma, Italy.

Chametzky, P., 2001. Rebuilding the Nation: Norman Foster's Reichstag Renovation and Daniel Libeskind's Jewish Museum Berlin, in *Centropa a journal of central European architecture and related arts*, 1 (3), pp. 245–264, The University of Aberdeen, UK.

Chiacchella, R., 1983. La Città «moderna» e la dilatazione delle funzioni urbane del quartiere della Conca, in *Un quartiere e la sua storia: La Conca di Perugia. Itinerario per una conoscenza e una proposta,* Guerra, Perugia, Italy.

Circ. No7 (2019), *Circolare del Ministero delle infrastrutture e dei trasporti 21 gennaio 2019, n. 7 C.S.LL.PP.,* Istruzioni per l'applicazione dell'«"Aggiornamento delle "Norme tecniche per le costruzioni"» di cui al decreto ministeriale 17 gennaio 2018., Supplemento ordinario alla "Gazzetta Ufficiale" n. 35 del 11 febbraio 2019 - Serie generale, Ministero delle Infrastrutture e dei Trasporti; Roma, Italy.

Gianfrotta, A., 2000. *Manoscritti di Luigi Vanvitelli nell'archivio della Reggia di Caserta 1752-1773*, Pubblicazioni degli archivi di Stato. Ministero per i beni e le attività culturali, Ufficio centrale per i beni archivistici, ISBN 88-7125-174, Roma, Italy.

Girasante, F., Potenza, D., 2016. *Costruire sul costruito*. Sala Editori, Pescara, Italy.

Iannaco, L., 2009. *Antonio Canova in Umbria: "le possessioni di S. Gemini"*, Futura Edizioni, Perugia, Italy.

Latina, V., 2019. TTT' le tre "T" del riuso, in *Area*, 166, pp. 4–8, New Business Media Srl, Milano, Italy.

Liberotti, R., Cluni, F., Gusella, V., 2020. *Vulnerability and seismic improvement of architectural heritage: the case of Palazzo Murena. Earthquakes and Structures*, in press.

Lucchini, A., Mazzucchelli, E., Mangialardo, S., Persello, M., 2014. *Façadism and CLT Technology: an innovative system for masonry construction refurbishment*. 40th IAHS World Congress on Housing, At Funchal, 10.13140/2.1.3510.8163, Madeira, Portugal.

Mariano, F., 2000. Vanvitelli nelle Marche ed in Umbria, in "*Luigi Vanvitelli e la sua cerchia*". In: De Seta, C. (Ed.). Catalogo della mostra (Caserta, Palazzo Reale, 16 dicembre 2000-16 marzo 2001), pp. 79–83. Electa Napoli, Napoli, Italy.

Minieri Riccio, C., 1880. *Recensione a D. Salzaro «Poche parole dette sul sepolcro di Luigi Vanvitelli»*. Archivio Storico delle Province Napoletane, V, p. 196, Italy.

NTC (2018), *Decreto Ministeriale 14 Gennaio 2018, Aggiornamento delle «Norme tecniche per le costruzioni.»,* Supplemento ordinario alla "Gazzetta Ufficiale, n. 42 del 20 febbraio 2018 - Serie generale, Ministero delle Infrastrutture e dei Trasporti; Roma, Italy.

Pagnini, L.C., Vincente, R., Lagomarsino, S., Varum, H., 2011. A mechanical model for the seismic vulnerability assessment of old masonry buildings, in *Earthquake and Structures*, 2 (1), pp. 25–42. https://doi.org/10.12989/eas.2011.2.1.025, Techno Press, Korea.

Parlato, S., 2018. *Riabitare la città. Costruire sopra e dentro l'esistente*, Franco Angeli, Milano, Italy.

Pellegrini, P. C., 2018. *Manuale del riuso architettonico. Analisi ed interventi contemporanei per il recupero degli edifici,* Dario Flaccovio Editore, Palermo, Italy.

Sciaramenti, B., 2019. Gipsoteca Greca e Romana, in *Naturalia e artificialia,* Galassi, C. (Ed.). Musei, raccolte e collezioni dell'Università degli Studi di Perugia. pp. 92–106, Aguaplano Libri, Perugia, Italy.

Sorignani, C., 2018. *UNI|TECA Progetto architettonico di trasformazione in Gipsoteca dell'edificio sede dell'ufficio Economato dell'Università degli Studi di Perugia*, Master thesis. Supervisors: prof. Belardi, P., prof. Gusella, V., University of Perugia, A.A. 2017-2018, Perugia, Italy.

Tosi Pamphili, C., 2013. H&M a Roma. Sotto la cupola di Fuksas, in *Artribune*. www.artribune.com, Italy.

Ungers, O. M., 1981. La bambola nella bambola. L'incorporazione come tema di architettura, in *Lotus International* 32, pp. 14–23, Electa, Bari, Italy.

Zucchi, C., 2014. Innesti: il nuovo come metamorfosi. Bassoli, N. (Ed.). Marsilio, Venezia, Italy.

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The impact of museum design on visit experience from an environmental psychology perspective

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Abstract

Re-examining museum and exhibition spaces from the perspective of Environmental Psychology requires a profound critique of the current fashion of thinking, designing and telling the story of museums. When the individual is considered at the core of the museum visit, it is possible to evaluate his experience not only in those aspects related to learning and entertainment, but also in relation to the impact that design choices have in modulating their perception, behavior and satisfaction. Environmental psychology, as a study of person-environment dynamics, constitutes a privileged theoretical framework for understanding the interaction between museum environments and lifestyles, visitors' interests and motivations. This allows one to better understand how visitors perceive, process, respond and interact with the stimuli in the exhibition environment. The changes that marked the evolution of museums since the end of the nineteenth century have recently led to the enhancement of the experience of visitors. The importance of the emotional, behavioral and cognitive dimensions, and the way in which visitors take possession of the museum space to meet personal and learning goals, have greater recognition nowadays. The growing need to promote artistic, historical, and cultural resources, together with a renewed way of understanding art as a consumer good and a source of stimulating personal experiences, strengthened the role of museums as one of the cornerstones of cities' cultural infrastructure, with a profound impact on the way exhibition spaces are designed. Over the past 150 years, exhibition design has shifted from non-technologically mediated visual experiences to interpretative and experiential forms, which increasingly recognize the role of design. More precisely, exhibition design as a way of intentionally organizing the visitor's experience, began to receive specific attention in the 1960s. However, it is only since the beginning of this century that the character of a museum's physical space has been specifically studied and recognized in its effect of modulating visitors' experience. Research in this field has typically related specific features of the setting - such as layout, signage, intensity and type of lighting, colours - to self-report measures, such as, satisfaction. When looking at the perception of an exhibition context (the main aspects that a designer can control), the research papers on environmental assessment highlighted the importance of variables related to the information provided, the navigability and the environmental consistency. It emerged that a moderate level of sensory stimulation combined with a sense of autonomy and control over the environment are associated with a more satisfying visit experience.

Keywords: environmental psychology, museum, exhibition design, visitor experience, atmospherics, restorativeness, museum fatigue.

Exhibition design can influence the visitors' flow, the number and quality of social interactions, the attention and the emotional response. More specifically, design can positively influence affectivity and thus foster discovery, exploration, and learning, while the emotions induced by works of art, associated with cognitive responses, shape the aesthetic experience.
A further environmental feature linked to museum spaces is restorativeness: the ability of environments to "regenerate" the individual from a condition of stress and cognitive fatigue. Museum design can also be effectively designed to reduce "museum fatigue", a phenomenon widely observed and documented, whether in relation to a single exhibition area or an entire museum, which leads visitors to progressively devote less time and attention to what is displayed.

1. Introduction

Environmental psychology (Steg & de Groot, 2019), a field of study looking into interactions between people and the environment, offers a theoretical framework understanding the correlations linking contemporary exhibition spaces to the behavior, motivations, and interests of its visitors. Many research papers on museum visitors – internationally known as Visitor studies – while not explicitly identifying with environmental psychology, take advantage of similar approaches and procedures (Bitgood, 2002, 2011; Ng, 2003). Research in both areas may be helpful to better understand the changes museums have undertaken since the end of XVIII century, and offer a clearer picture of how visitors perceive, process and respond to the exhibition space (Bitgood, 2011; Falk & Dierking, 2000). On this perspective, considering the visitor as the main fulcrum of the visit is crucial to assess his experience in relation to the design choices influencing the perception, learning and enjoyment related aspects.

Environmental psychology may offer interesting guidance on obtaining a vibrant experience comprising of maximum learning, engagement and rational circulation from a visit to a museum (Costa, 2013) and, at the same time, profound criticism to the current habits in thinking, designing and narrating cultural spaces. Studies on exhibition settings, to a large extent, focuses on visitors' behavior or learning, in connection with the capability of museums to satisfy predetermined educational tasks. Just recently visitors' experience has been conceptualized in broader terms recognizing the importance of emotional dimensions, in addition to behavioral and cognitive ones, and the way visitors take possession of museum space to fulfill individual learning objectives (Tizi & Pazzaglia, 2018).

In the last 150 years museum design theory has gradually moved from not technologically mediated visual methods, to interpretative and experiential styles, enhancing the importance of design. Exhibition design as an intentional method to organize users' experience in a museum space begun to have some attention in the early '60 of the last century (Miles *et al.*, 1988), whereas it is only from the beginning of this century that the qualities of the physical space in a museum have been specifically studied and recognized in their effect of modulating the visitor experience (Dernie, 2006; Falk & Dierking, 2000; Macdonald, 2007; Ng, 2003; Rounds, 2004). Studies on this topic have usually linked peculiar spatial features – layout, wayfinding, intensity and type of lighting, colours – to general self-report evaluations, such as satisfaction feeling.

2. The socio-cultural role of museums

The International Council of Museums defines museums as "a non-profit, permanent institution in the service of society and its development, open to the public, which acquires, conserves, researches, communicates and exhibits the tangible and intangible heritage of humanity and its environment for the purposes of education, study and enjoyment" (ICOM, 2007).

From "place sacred to the Muses", where collections of books and works of art were housed, over the centuries, the museum gradually adapted its nature, until, at the end of the XVIII century, it developed some of the features it still remains. Museum architecture, in the same period, taking up Greek and Roman styles, characterized these buildings as modern temples which provided sacredness to the works preserved, responding to a celebratory function, standing as a symbol of the Country and its cultural identity (Gilli & Rozzi, 2013).

At the beginning of XX sec. the institution of Modern Movement had a considerable influence on exhibition design. It was in Germany in the early 1930s that, through Bauhaus projects, attention began to be paid to the visitors' flow, to the sequential organization of spaces, to graphic design. Otto Neurath, founder of Social and

Economic Museum in Vienna in 1925, recognized the public educational potential in exhibitions and the importance of audience in the process (Kraeutler, 2008). In United States as well, the mass consumption culture of the twentieth century carried out a significant influence on exhibition design. In 1946 Rene D'Harnoncourt designed the exhibition "Arts of the South Seas", at the Museum of Modern Art (MoMA) in New York, using light and colour to create suggestive effects, transforming the exhibition into an art form and open to interpretation (Foster, 2012). In conjunction with these changes in design practices, exhibitions increasingly became the means by which art is experienced rather than simply the place where it is cataloged (Lampugnani, 2011). In these years minimalist design rises up with the idea of white cube, which rapidly becomes the archetype of the art gallery. Its aim is to leave the artworks as the main focus, letting the space disappearing in the background (Giebelhausen, 2011). However, scientific museums (e.g. natural history and science museums), the white cube's counterpart, developed the black box paradigm, intentionally obscuring the outside world and placing the visitor in an artificial space designed with particular emphasis to the scenography of the installations (Dernie, 2006; Toon, 2005). In both cases - the white and black box - visitor experience is placed at the core of the design.

In the 90s of last century, new museums were built all over the world at a surprising rate, with a 483% growth in invested capital (Tilden, 2004). The growing urge, perhaps due to a renewed nationalism following the end of the Cold War, to enhance artistic, historical and cultural resources, as well as a different way of thinking about art as a commodity, confirmed museums as one of the main asset of the city's cultural scene, affecting the way museum consultants program, manage and design exhibition space (Tizi & Pazzaglia, 2018).

From historical to contemporary buildings, museum architecture shifted from showing to telling and from classification to narration (Hillier & Tzortzi, 2011). In this transformation process, the physical context of the museum also changed. Museums, especially larger ones, are important tourist destinations and monumental representations of the sense of place and cultural identity of an area (Kirshenblatt-Gimblett, 1998; Stylianou-Lambert, 2011).

Fig. 1. Museum of Old and New Art (MoNa), Hobart (Australia). Exterior. Photo Credit: Mona/Jesse Hunniford. Image courtesy of MoNa.

The Solomon R. Guggenheim Museum in New York, masterpiece by architect Frank Lloyd Wright and one of the most recognizable examples of architecture of XX century, the Louvre Pyramid in Paris, conceived by architect Ieoh Ming Pei and inaugurated amid controversy and resistance in 1988, represent two buildings that quickly established themselves as urban landmark with a great visual and emotional impact.

In more recent times, cities since then ignored by tourist flows have, in some cases, become known and sought-after destinations following the creation of a museum, becoming their catalyst and symbol in the collective imagination. The most significant example internationally is represented by the Guggenheim Museum in Bilbao, a contemporary art museum inaugurated in 1997 and designed by the architect Frank O. Gehry. Here, the ambition was to create transformation through an activating urban epicentre, as with the Sydney Opera House. The building, soon considered an icon of the period, gave its name to the "Bilbao effect", a phenomenon for which cultural investments, materialized in an iconic building, would be able to revive the economy of cities and/or regions (Baniotopoulou, 2001; Franklin, 2016; Plaza, 2006; 2007; Plaza et al., 2009). The Museum of Old and New Art (MoNa), Hobarth, Tasmania (fig. 1), acclaimed in 2011 as the most important cultural event space since the opening of the Sydney Opera House, introduced substantial changes to visitors' experiences, generating a significant cultural flowering in Hobart that reaches a level of urban and regional regeneration, supported by tourism, like in Bilbao (Franklin & Papastegiadis, 2017). The Louvre-Lens Museum, inaugurated in 2012 as a branch of the main museum and built on the site of an old coal mine can be considered an additional positive test of the Bilbao effect.

These dynamics highlight how a new museum typology is emerging, where the building - as important as the works of art inside and a work of art itself - is configured as the pivotal way for a city to represent itself to the world. At the same time it is also a tool for advertising and raising funds, not only for the museum, but also for the urban context (Lindsay, 2013). After that, other cities tried to replicate the same effect unsuccessfully or with minor results (e.g. Glasgow, Varsavia, Göteborg, Las Vegas), indication that more investigations are needed not to oversimplify the phenomenon.

These changes to the spatiality of museums determine different ways of exhibiting the works, requiring new strategies and exhibition techniques.

3. Perception models and environmental preference

To understand the relationship between human perception of a museum setting and visitors' experience is primarily important to globally understand how environments are perceived. The most significant visual environmental characteristics, especially for indoor spaces, are described in terms of space, functions, lighting and colour (Lin, 2004). Having said that, single elements by themselves are not sufficient to influence what is perceived, but how they are arranged and grouped.

The principle of Gestalt theory on grouping and hierarchies between objects continue to influence researchers on spatial assessment and visual perception process in a broader sense (Wagemans *et al.*, 2012). This reinforces the idea of studying environments as holistic entities (Goulding, 2000).

Human evolution has been shaped by interactions with the environment and people have been conditioned to adapt quickly and explore environments for their value as a source of information. Therefore, it is reasonable to hypothesize that many aspects of environmental assessment may have an evolutionary basis (Crouch, 2013). Consequently, environmental preferences are an essential aspect of understanding environment-behavior dynamics (Kaplan, 1972; 1987; 1988). Environmental aesthetics studies have investigated human responses to a series of natural or built environmental stimuli. Environmental preference is the result of incredibly fast cognitive processes that integrate considerations such as protection, accessibility and learning possibilities into a single affective judgment (Kaplan, 1988).

Kaplan (1987; 1988) identified four predictive factors for environmental preference, all inherent in the information that a scene can offer: coherence, legibility, complexity and mystery. The relationship between preference and the perceived value of complexity and mystery is non-linear. This means that those environments capable of offering sufficient exploration potential, and being understandable enough to be navigated without exceeding the finite amount of information that the human brain is able to process simultaneously are preferred (Kaplan, 1988; Ng, 2003).

The evolutionary concept of protection is also considered in the "Prospect and Refuge" theory developed by Appleton (1988), according to which the preferred environments are those which allow a complete perception of the scene (perspective), but which are not so exposed as to be vulnerable to attack (refuge). In particular, the protective dimension is the most important factor for all animals' preference of an environment (Stamps, 2007). Considering more specific environmental attributes, the Permeability Theory (Stamps, 2007; 2005) states that the environment influences the sense of protection by limiting perception or movement. Visual permeability is a strong predictor of the perception of spaciousness, while locomotor permeability is connected to the perception of security.

In museum environments, a moderate level of sensory stimulation and a sense of autonomy and control on the environment are associated with a more satisfying experience (Rui Olds, 1994). When visiting a museum, one way to satisfy visitors' need for information is to provide adequate signage and present the exhibits in a logical and thematically coherent way (Goulding, 2000) (fig. 2). The need for security can be translated as the need to feel at ease in a museum space. Considering the general needs of security and information from the public in the museum context, Rui Olds (1994) proposed four main characteristics of the ideal museum:

1. Movement: the freedom to explore the environment in a self-determined way.
2. Comfort: a varied atmosphere (in the scale, finishes, lighting, textures) and a moderate level of stimulation of all the senses.
3. Competence: neat and marked spaces, which allow visitors to find their paths easily.
4. Control: not feeling exposed but protected from unexpected encounters.

Whenever one factor is limited the value of the other factors should be increased. When all four needs are balanced, the visitors feel renewed and the space truly lives.

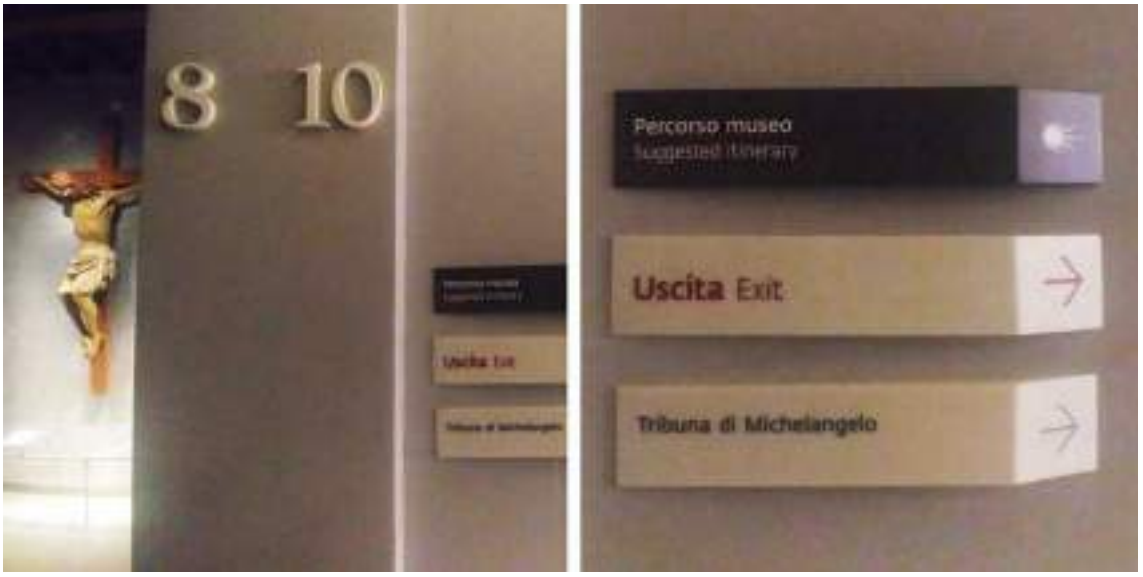

Fig. 2. Museo dell'Opera del Duomo, Florence (Italy). Design by Natalini Architetti, Guicciardini e Magni Architetti. Example of misleading information: the numbering of the rooms does not follow a logical order. The graphic design of the suggested itinerary seems to indicate going back.

4. Exhibition design and visitors' experience

Exhibitions are a fundamental aspect of the public image of museums and the main means by which museums communicate with their public. The evaluation of the effectiveness of the exhibits began to be investigated in the 1960s, revealing how the key challenge was to capture the mutable attention of visitors (Bitgood, 2013; Shettel *et al.*, 1968; Yalowitz & Bronnenkant, 2009). Exhibition design is becoming increasingly popular as an

important component of museum policies to engage the public (Burton *et al.*, 2009). From a historical perspective, the installations can also be seen as products of their time and as an expression of the ideas of their creators (Moser, 2010). Over time, the exhibitions have evolved to include a wider range of media, creating overlaps with art, advertising, architecture and graphic design (Dernie, 2006; Lorenc *et al.*, 2010).

In the experience economy, the transition from products to experiences represents a conceptual change that emphasizes the user experience (Ritchie *et al.*, 2011; Pine & Gilmore, 1999). Consistently with this trend, museums reconsider the experience they can offer visitors, becoming active producers of culture rather than passive custodians of it (Kirchberg & Tröndle, 2012; Smith, 2011). In the exhibition and museum context, the term experience can be considered the output of a process of mutual interaction between the visitor and their environment (McCarthy & Ciolfi, 2008), in which, using theater as a metaphor, the exhibition design is the scenography (Nelson, 2009; Zomerdijk & Voss, 2009; Yellis, 2010). The characterisation of a museum's physical space is essential to emotionally engage the viewer and, therefore, to create an experience that is associated with a rich and positive memory (Dernie, 2006; Macdonald, 2007) (fig. 3).

Studying visitor behavior by monitoring routes and times - an approach pioneered by the work of Robinson and Melton in several US museums in the 1920s and 1930s (Melton, 1935; Robinson, 1928) - is still essential today to evaluate the success of an exhibition, considering the time spent as a prerequisite for learning (Serrell, 1988; Yalowitz & Bronnenkant, 2009). The average time spent in most exhibitions, regardless of their size, is less than 20 minutes; typically, visitors stop at about a third of the available items (Serrell, 1998).

Fig. 3. Museum of Old and New Art (MoNa), Hobart (Australia). Siloam, MoNa's new underground tunnel extension. Photo Credit: Mona/Jesse Hunniford. Image courtesy of MoNa.

Design tools such as orientation maps, scenography, choice points, influence the orientation and path of visitors, the number of items observed, the way visitors interpret the curatorial message (Bitgood, 2011; Goulding, 2000; Macdonald, 2002; Spock, 2006). In several museums, difficulties in orientation can be a (unexpected) consequence of the design, which can lead to the exhaustion of cognitive resources in understanding how and where to move rather than involving the contents (Bitgood, 2003). Spatial configurations or objects that attract attention can help visitors navigate complex spaces, in particular broad areas or environments with multiple paths (Klein, 1993). In the absence of visual clues, visitors tend to traverse spaces according to straight trajectories and rarely go back, although in a wide corridor they could zigzag to see what

is displayed on both walls (Bitgood, 2006; Bourdeau & Chebat, 2001; Klein, 1993; Melton, 1935; Robinson, 1928; Witcomb, 2003).

For the Attention Value Model (Bitgood, 2006; 2011; 2013) visitor behavior is the consequence of a continuous and often subconscious cost-benefit analysis. The central element is the visitor's attention, being transient and more directly influenced - with respect to interest - by environmental and situational factors. The perceived cost may vary from visitor to visitor, but is also influenced by the way the exhibition is designed. For example, the probability of a text panel being read depends not only on the visitor's willing to read, but also on the length of the text and its layout. This model explains why visitors choose the straightest route within the exhibitions, making detours only when they perceive the benefits (e.g. seeing an interesting art piece more closely).

Visitors tend to look for environments suited to their physical, physiological and psychological characteristics (Ng, 2003; Rounds, 2004) and are attracted to those exhibitions that offer the greatest concordance with their needs and objectives, responding negatively to the environments that confuse and frustrate them (Pekarik & Schreiber, 2012; Rui Olds, 1994).

By providing a better understanding of the way the exhibition environment is perceived, it is possible to design set-ups that can improve the visitor experience. For example, exhibition design can influence visitors' traffic pattern flow (Klein, 1993; Peponis *et al.*, 2004), quality and frequency of socialization (Choi, 1999; Hillier & Tzortzi, 2011), attention (Bitgood & Patterson, 1993), visitor movements and their physiological responses (Tröndle & Tschacher, 2012), affective responses (Packer, 2006; 2008). Specifically, design may positively influence affectivity and therefore favor a mental attitude to discovery, exploration and consequently, learning (Forrest, 2014), while, at once, emotions aroused by artworks (Berlyne, 1971; Russell, 1980) shape the aesthetic experience of visitors (Mastandrea, 2014). Affectiveness also seems important in creating a general mental image when visiting a museum (Scott, 2009). Furthermore, museum design may be successfully applied to reduce "museum fatigue" causing a decrease in total amount of time in museum and attention to artworks (Bitgood, 2009a; 2009b; 2011).

The results of numerous studies support the evidence that the "atmospheric" dimensions of a museum experience (including light, colour, layout, signage, etc.) - on a par with the specific contents and individual factors relating to visitors' knowledge (Mastandrea, 2014; Smith & Smith, 2006) - play a fundamental role in determining the visiting experience (Bonn *et al.*, 2007; Packer, 2008; Roppola, 2012; Schorch, 2013).

Fig. 4. German Ivory Museum, Erbach (Germany). Design by Licht Kunst Licht, Sichau & Walter Architekten BDA. Photo Credit: Sichau & Walter Architekten (2017). Image courtesy of German Ivory Museum. Light and color, as atmospheric variables, define the visit path, with a strong impact on the overall visit experience.

In particular, light and colour (fig. 4) have mutual influence and are key factors in determining the general perception of an exhibition space (Boyce, 2004; Bonn *et al.*, 2007; Kottasz, 2006; Merwin *et al.*, 2007; Peponis *et al.* , 2004; Roppola, 2012; Singh, 2006; Vogels, 2008). However, the copious studies which investigated light and colour have produced complex and sometimes conflicting results. Colour is able to influence the perception of size, crowding, temperature and time (Yüksel, 2009; Mahnke & Mahnke, 1987). Different types of lighting can influence perception in different ways. For example, indirect peripheral lighting helps to create a sense of spaciousness; uneven lighting can increase complexity and create focal points (Custers *et al.*, 2010; Flynn, 1988).

5. The perceived atmosphere of an exhibition

The term atmospherics was used for the first time to describe the design of sales environments and defined as the conscious way of designing space to induce certain effects on buyers (Kotler, 1974).

The atmospherics concept, as an area of environmental psychology related to marketing, highlights how research in this sector can also be applied to the museum context to broaden the understanding of the quality of the visit experience (Chang & Horng, 2010; Forrest, 2013; Lin, 2004). The influence of this "silent language" occurs through sensory and emotional mechanisms, with behavioral outcomes that often occur at unconscious levels (Kotler, 1974; Turley & Milliman, 2000).

The Stimulus-Organism-Response (S-O-R) approach, derived from environmental psychology, constitutes the most influencial theoretical framework to qualify customer responses to the environment (Mehrabian & Russell, 1974). Although this paradigm has been criticized because it considers a one-way environment-behavior relationship and neglects the users' objectives and motivations, it continues to be the most commonly used in research on atmospherics (Liu & Jang, 2009; Massara *et al.*, 2010). The S-O-R approach claims that sensory inputs from the environment combine with personality factors, causing an internal emotional reaction, which will be followed by an action.

Similarly to what happens in sales environments, within an exhibition space the perceived atmosphere constitutes an important dimension of the experience and overall it can be considered an additional means of communication (Forrest, 2014). Marketing research in the cultural field demonstrated the importance of the environment and of "atmospheric" variables in relation to visitors' overall perceptions of museums, their affective state and their intentions (Bonn *et al.*, 2007; Kottasz, 2006; Roppola, 2012; Schorch, 2013).

Recently, the Italian version (PAI-VI; Tizi *et al.*, 2019) of an English instrument called Perceived Atmosphere Instrument (PAI; Forrest, 2014) has been published. This is designed specifically to collect an assessment of atmospheric variables (Kotler, 1974) in art exhibitions and museums. The instrument, calibrated to distinguish exhibitions characterized by different design elements (e.g. layout, navigability, exhibition display, lighting, colour), allows to identify relationships between the physical museum setting (*Vibrancy*, *Spatiality*, *Order*) and the purely psychological variables, such as satisfaction with the visit, emotional experience, cognitive interest and fatigue, and perceived restorativeness. Visitors get the various components of the atmosphere related to the settings and translate them into the evaluation terms of the general experience, on a cognitive and emotional level (Tizi *et al.*, 2019). The perceived atmosphere is also connected to the factors of environmental restorativeness, confirming the regenerative effect of visiting museums and art exhibitions (e.g. Mastandrea *et al.*, 2019), and, at the same time, linking the restorative effect to the physical characteristics of the installation.

Knowledge of factors as Vibrancy, Spatiality and Order can be a guiding element in the design phase. For example, when the idea is to create environments that are perceived as tense and dramatic, the characteristics linked to low Spatiality values and high Vibrancy values should be used. On the opposite, when the designer would like to offer a regenerating space, like in museums' lobbies or in areas where many people gather, low values of Vibrancy and high ones of Spatiality are needed. Environments characterized by low Vibrancy and low Spatiality may be unattractive, but this configuration can constitute an intentional strategy to discourage visitors to stop in certain areas, such as access corridors. In addition, the PAI-VI can be used as a verification tool to assess the perceived atmosphere of an exhibition by visitors, providing information on the impact of the set-up and how the exhibition design has contributed to conveying the curatorial message, making the visit is a satisfying experience, both in terms of learning and fun, with a likely economic and image return for the exhibition body (Tizi *et al.*, 2019).

6. Regenerative aspects of museum environments

An interesting environmental quality in the context of art exhibitions and museums is restorativeness, which means the ability of an environment to "regenerate" the individual from conditions of stress and cognitive fatigue (fig. 5).

Fig. 5. Odunpazarı Modern Museum, Eskişehir (Turkey). Design by Kengo Kuma. Photo Credit: Studio NAARO. Image courtesy of Odunpazarı Modern Museum. The combination of art, light and natural materials creates a space with a strong restorative impact, within which visitors can freely move.

Restoration can be defined as “the process of renewing physical, psychological and social capabilities diminished in ongoing efforts to meet adaptive demands” (Hartig, 2004, p. 2).

Environmental regeneration studies refer to two main evolutionary theories, one focused on the restoration of positive affective states (Stress-Recovery Theory; Ulrich, 1983), the other on cognitive ones, in particular on the restoration of attention functions fatigued by intense and prolonged cognitive efforts (Attention-Restoration Theory; Kaplan & Kaplan, 1989).

According to Kaplan (1995), regenerative environments are characterized by determined properties. The first, called Being-away, implies the feeling of being separate and apart from one’s usual thoughts and concerns. The second, Extent, refers to an environment that encourages to be totally immersed and engaged through its familiarity and coherence. The third one, the most important, is Fascination, a dimension of involuntary, spontaneous or even passive attention, aroused by environmental characteristics. This doesn’t require cognitive effort and, consequently, allows a dynamic recovery of direct or voluntary attention. The last one, Compatibility, is about feeling congruence between the environment and people's goals and inclinations.

Restoration is a process that is usually prompted by natural environments (on which most research studies focused), typically perceived and experienced as more regenerating than urban environments (Hartig & Staats, 2003). Mere exposure to nature, however, is not a prerequisite for regeneration. Furthermore, favorable conditions for regeneration do not necessarily appear only in nature (Collado *et al.*, 2017). Multiple contexts without significant natural features, such as museums (Clow & Fredhoi, 2006; Höge, 2003; Mastandrea *et al.*, 2019; Packer, 2008; Packer & Bond, 2010; Staats, 2012), monasteries (Ouellette, Kaplan, & Kaplan, 2005), squares (Abdulkarim & Nasar, 2014), can be regenerating.

Two elements seem to contribute significantly to the regenerative potential of museum context: feeling comfortable or at ease in the setting, and being able to find one's way around (Kaplan, Bardwell, & Slakter, 1993). Research has shown that comfort and wayfinding apply to different types of museums (including art museums, history museums, gardens, and zoos) and can equally offer visitors regenerating experiences (Ballantyne, Packer, & Hughes, 2008; Bennett & Swasey, 1996; Pals, Steg, Siero, & van der Zee, 2009). Comfort and wayfinding (fig. 5) would therefore constitute two characteristics transversal to these types, connected to the perception of regeneration.

Frequent or repeat visitors are more likely to seek regenerating experiences (Kaplan, Bardwell, & Slakter, 1993; Ouellette *et al.*, 2005), for which museum environments seem to offer an alternative to natural ones, since people not used to going to museums may feel uncomfortable when inexperience inhibits their exploration and learning ability (Hood, 1993). To increase the likelihood that first-time and infrequent visitors feel a regenerating experience, environmental conditions can be promoted: moving independently in an unfamiliar environment, having seats and rest areas, having optimal levels of lighting, temperature and noise (Packer & Bond, 2010).

7. The museum fatigue

The concept of "museum fatigue" was described for the first time in 1916 by Gilman. It was defined "as a physical tiredness that comes from seeing exhibitions", considering, however, only physical factors (Robinson, 1928). Fatigue was presumed to be the cause of a consistently observed phenomenon: visitors progressively devoted less time and attention to what is exposed. Melton (1935) suggested considering the number of visited exhibits as an additional variables. Subsequent studies included environmental factors relating to the museum itself. This phenomenon can be observed with respect to a single area within a museum to the visit of an entire museum (Bitgood, 2009a; 2009b). Visitors can experience physical fatigue, for example, by walking inside a museum and mental fatigue when trying to maintain a high level of attention for a long period of time (Jeong & Lee, 2006) (fig. 6).

Davey (2005), based on the results of previous studies, proposed an updated definition of museum fatigue highlighting the interaction between visitor and environment:

"a collection of phenomena that represent predictable decreases in visitor interest and selectivity either during entire visits, within smaller areas (such as exhibit galleries), or across a few successive exhibits. These decreases are likely to be attributed to a combination of visitor factors (such as cognitive processing, physical fatigue, and individual characteristics), factors in the environment (such as exhibit architecture and the museum setting), and interaction between them." (p. 20)

While the phenomenon is widely accepted and cited in the literature, there is a lack of clarity about what museum fatigue constitutes precisely and what causes it (Bitgood, 2009a), and it seems that there are still several aspects to investigate (Kim , Dillon, & Song, 2018). Indeed, physical and mental exhaustion are only two factors that can explain museum fatigue.

In a 2009 review, Bitgood (2009a, p. 95) hypothesised alternative explanatory concepts, and their causes:

- *Satiation*: exposure to homogenous objects with little emotional or intellectual stimulation; boredom;
- *Stress*: physical and mental pressure associated with distracting or unwanted frustrations, etc.;
- *Information overload*: inability to process inputs because too many are presented at once or inputs are presented too quickly over time;

Fig. 6. Museum of Classical Art, Sapienza University of Rome, Rome (Italy). Lack of seats, inadequate paths and lighting, no captions contribute strongly to museum fatigue.

- *Competition*: presentation of multiple objects simultaneously resulting in either distraction or more selective attention to fewer objects;
- *Limited attention capacity*: depletion of cognitive energy from mental exertion; assumes finite amount of the resource, much like a gasoline tank;
- *Decision making processes*: visitors choose to attend less because the value (utility/costs) are decreased or because visitors choose to avoid state of exhaustion or because time pressure result in greater selectivity as the visit progresses.

Museum fatigue influences the extent to which visitors interact with exhibitions, with an impact on learning, which appears to be correlated with viewing time (Davey, 2005). The architecture of the museum and the design of the exhibition significantly influence the interest of visitors, and therefore the time spent in. This could help explain why the interest of visitors varies between different exhibition areas (Johnston, 1998).

The main design key features are: isolation, size, contrast with setting background, sensory features (sound, smell, or touch), lighting, and line-of-sight placement (Davey, 2005). Furthermore, some other aspects influence the aesthetic preferences of visitors for their ability to facilitate cognitive processing: among these, amount of information, symmetry, the presence of vertical and horizontal patterns, and figure-ground contrast (Reber, Schwarz, & Winkielman, 2004). Bitgood (2011), as well, suggested strategies that can reduce fatigue:

- Provide devices to focus attention: brochures and handheld maps can help visitors decide what to pay attention to and what to see;
- Minimize physical and mental effort: organizing exhibitions so that there are spaces for physical and mental rest;
- Facilitate orientation: providing clear signage and organizing decision points so that visitors do not feel overwhelmed by multiple choice;

- Minimize the workload: ensuring that the content of the displays is divided into small and clear segments, and that there is an immediately evident relationship between labels and objects;
- Raise questions in visitors: stimulating visitors' curiosity, asking question in labels and correct misconceptions;
- Encourage breaks: integrate bars and relaxation areas in the path to allow visitors to regenerate before facing another gallery.

Some of these issues have also been covered by other scholars. For example, the theme of relaxation areas has been particularly studied because visiting them positively influences satisfaction and perceived affective qualities towards the museum (Cancellieri *et al.*, 2018). Furthermore, they could maximize the regenerating effects if directly connected to external natural spaces (Jeong & Lee, 2006). Concerning wayfinding, organizing the exhibition spaces so that visitors can quickly and autonomously retrieve information and, therefore, decide what to see and how to move within the museum context, could help make the visit experience more engaging, reducing fatigue (Forrest, 2014). The implications of these themes could be of support to designers who deal with museums (Kim, Dillon, & Song, 2018) since the main reason why visitors stop visiting a museum halfway is the fatigue (fig. 7).

Fig. 7. Kimbell Art Museum, Fort Worth (Texas). Design by Renzo Piano. Photo Credit: Nic Lehoux. Image courtesy of Kimbell Art Museum. Museum fatigue can be effectively counteracted by planning rest areas along the exhibition route with comfortable seats and, where possible, a restorative view.

8. Conclusion

Museums are changing. We are experiencing a shift of interest from the function of a museum being solely of exhibit-informational nature to a second being of a constructive-expressive nature (Panciroli *et al.*, 2017); a shift from being object-centered institutions towards visitor-centered institutions (Hein, 2000); a shift from the

aesthetic value of museum artifacts to the historical information they encompass and the ideas they foster, leading museums to focus on telling stories about the objects, and enabling visitors to construct semantic meaning around them (Sylaiou *et al.*, 2010). Moreover, the shift in the perception of the museum, both for curators/museologists and for the visitors, in two main directions: toward stability (especially of content and of communicated messages), and toward flexibility (Pescarin, 2014). Visiting a museum, and, critically, re-visiting a museum, requires the museum to offer constantly new, attractive but serious exhibits, that might provide a combination of stable, fast and flexible contents (*Ibidem*).

Environmental psychology has provided design guidance that can make the visiting experience more engaging and satisfying, and can help to deeper understand the impact of exhibition design on it. Psychology in general also had a significant influence on how we think today about museum and visitors, proposing a more holistic view of the visiting experience (Recupero *et al.*, 2019).

The exhibition environment is a very significant factor for the satisfaction of visitors in a museum. According to research by Jeong and Lee (2006), the following five variables should be considered more carefully than any other when designing a museum: the method of exhibition; the contents of exhibition; the visual and locomotor accessibility; the illumination; the rest areas.

The most relevant data is the visitors' responses to visual and locomotor accessibility. Indeed, visitors move inside the space to see the exhibits up close, so an effective visual accessibility will stimulate their curiosity to explore the museum, inducing spontaneous movements and probably a satisfying experience. In an open traffic system, too many options could be confusing. Conversely, in a closed system, visitors could easily get bored. So within a museum, the most effective strategy could be to guide and stimulate - through appropriate design choices - the movements of visitors through the spatial characteristics, modulating the visual and locomotor accessibility to the different exhibition areas (Choi, 2001).

Managing visitor attention is a central challenge in the field of exhibition design (Bitgood, 2003). Signage and other visual cues can help visitors assess from afar what the different areas of an exhibition are and how they are conceptually linked, so that they can consciously choose where to direct their attention. A widely used signage can be very helpful for those people often looking for signs of orientation, but it is not a barrier for those visitors who seek more casual routes. Wide and continuous views can help navigate the environment and stay in visual contact with other people.

Everything that is displayed should be labeled clearly, logically and easily identifiable, to prevent visitors from losing interest. Where possible, visitors should be given the opportunity to approach objects and view them from various angles (Forrest, 2014).

As for illumination, abrupt transitions between bright and dark spaces should be avoided and the object should be well lit, regardless of the general lighting of the space.

Color can be used effectively to reinforce the interpretative content of an exhibition and to highlight its organization. Slight differences in color, however, may not be perceived, especially in darker environments.

In general terms, the preferred exhibition environments are those that are perceived as lively: rich in sensory, three-dimensional, colorful, dynamic stimuli. These characteristics must be balanced by a sense of global order, which allows visitors to quickly get an idea of the space in which they are located (*Ibidem*).

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References

Abdulkarim, D., & Nasar, J., 2014. Are livable elements also restorative?, in *Journal of Environmental Psychology*, *38*, pp.29-38, Elsevier, Amsterdam, The Netherlands.

Appleton, J., 1988. Prospects and refuges revisited, in *Environmental aesthetics: Theory, research and applications*, 3, J. Nasar (Ed.), pp. 27-44), Cambridge University Press, Cambridge, UK.

Ballantyne, R., Packer, J., & Hughes, K., 2008. Environmental awareness, interests and motives of Botanic Gardens visitors: Implications for interpretive practice, in *Tourism Management*, *29*(3), pp.439-444, Elsevier, Amsterdam, The Netherlands.

Baniotopoulou, E., 2001. Art for whose sake? Modern art museums and their role in transforming societies: The case of the Guggenheim Bilbao, in *Journal of Conservation and Museum Studies*, *7*, pp.1-15, Institute of Archaeology, UCL, London, UK.

Barlı, Ö., Aktan, M., Bilgili, B., & Dane, Ş., 2012. Lighting, indoor color, buying behaviour and time spent in a store, in *Color Research & Application*, *37*(6), pp.465-468, Wiley Online Library, New York, USA.

Bennett, E. S., & Swasey, J. E., 1996. Perceived stress reduction in urban public gardens, in *HortTechnology*, *6*(2), pp.125-128, American Society for Horticultural Science, Alexandria, USA.

Berlyne, D. E., 1971. *Aesthetics and psychobiology*, Appleton-Century-Crofts, New York, USA.

Bitgood, S., 2002. Environmental psychology in museums, zoos, and other exhibition centers, in *Handbook of environmental psychology*, R. B. Bechtel & A. Churchman (Eds.), pp.461-480, John Wiley & Sons, New York, USA. .

Bitgood, S., 2003. Visitor orientation: When are museums similar to casinos? *Visitor Studies Today*, *VI*(I), pp.10-12, Taylor and Francis, London, UK.

Bitgood, S., 2006. An analysis of visitor circulation: Movement patterns and the general value principle, in *Curator:The Museum Journal*, *49*(4), pp.463-475, California Academy of Sciences, USA.

Bitgood, S., 2009a. Museum fatigue: A critical review. *Visitor Studies*, *12*(2), pp.93-111, Taylor and Francis, London, UK.

Bitgood, S., 2009b. When is "museum fatigue" not fatigue? *Curator: The Museum Journal*, *52*(2), pp.193-202, California Academy of Sciences, USA.

Bitgood, S., 2011. *Social design in museums: The psychology of visitor studies*. Collected Essays (Vol. 1), MuseumsEtc. Edinburgh, UK.

Bitgood, S., 2013. *Attention and value: Keys to understanding museum visitors*, Left Coast Press, Walnut Creek, Usa.

Bitgood, S., & Patterson, D. D., 1993. The effects of gallery changes on visitor reading and object viewing time. *Environment and Behavior*, *25*(6), pp.761-781, SAGE Publications, Newbury Park, USA.

Bonn, M. A., Joseph-Mathews, S. M., Dai, M., Hayes, S., & Cave, J., 2007. Heritage/cultural attraction atmospherics: Creating the right environment for the heritage/cultural visitor. *Journal of Travel Research*, 45(3), pp.345-354, SAGE Publications, Newbury Park, USA.

Boyce, P., 2004. Lighting research for interiors: The beginning of the end or the end of the beginning. *Lighting Research and Technology*, *36*(4), pp.283-294, SAGE Publications, Newbury Park, USA.

Bourdeau, L., & Chebat, J.-C., 2001. An empirical study of the effects of the design of the display galleries of an art gallery on the movement of visitors. *Museum Management and Curatorship*, *19*(1), pp.63-73, Routledge, UK.

Burton, C., Louviere, J., & Young, L., 2009. Retaining the visitor, enhancing the experience: Identifying attributes of choice in repeat museum visitation. *International Journal of Nonprofit and Voluntary Sector Marketing*, *34* (December 2008), pp.21-34, Wiley, Hoboken, USA.

Chang, T.-Y., & Horng, S.-C., 2010. Conceptualizing and measuring experience quality: The customer's perspective, in *The Service Industries Journal*, *30*(14), pp.2401-2419, Taylor and Francis, London, UK.

Choi, Y. K., 1999. The morphology of exploration and encounter in museum layouts, in *Environment and Planning B: Planning and Design*, *26*, pp.241-250, SAGE Publications, Newbury Park, USA.

Choi, Y. K., 2001. The spatial structure of movement in museum layouts, in *Journal of the Architectural Institute of Korea (Planning & Design)*, *17*(3), pp.31-8, Korea Institute of Science and Technology Information, Daejeon, Korea.

Clow, A., & Fredhoi, C., 2006. Normalisation of salivary cortisol levels and self-report stress by a brief lunchtime visit to an art gallery by London City workers, in *Journal of Holistic Healthcare*, *3*(2), pp.29-32, BHMA, UK.

Collado, S., Staats, H., Corraliza J. A., & Hartig T., 2017. Restorative environments and health, *Handbook of environmental psychology and quality of life research*, G. Fleury-Bahi, E. Pol, & O. Navarro O. (Eds.), pp. 127-148, Springer, Berlin, Germany.

Costa, M., 2013. *Psicologia ambientale e architettonica* (2nd Ed.), Franco Angeli, Milano, Italy.

Crouch, G. I., 2013. Homo sapiens on vacation: What can we learn from Darwin?, in *Journal of Travel Research*, *52*(5), pp.575-590, SAGE Publications, Newbury Park, USA.

Custers, P., de Kort, Y., IJsselsteijn, W., & de Kruiff, M., 2010. Lighting in retail environments: Atmosphere perception in the real world, in *Lighting Research and Technology*, *42*(3), pp.331-343, SAGE Publications, Newbury Park, USA.

Davey, G., 2005. What is museum fatigue?, in *Visitor Studies Today*, *8*(3), pp.17-21, Visitor Studies Association, Albany, USA.

Dernie, D., 2006. *Exhibition design,* Laurence King Publishing Ltd., London, UK.

Falk, J. H., & Dierking, L. D., 2000. *Learning from museums: Visitor experiences and the making of meaning*, AltaMira Press, Walnut Creek, USA.

Flynn, J. E., 1988. Lighting-design decisions as interventions in human visual space, in *Environmental aesthetics: Theory, research and applications*, J. L. Nasar (Ed.), pp. 156-161, Cambridge University Press, Cambridge,UK.

Foster, R. J., 2012. Art/artefact/commodity: Installation design and the exhibition of Oceanic things at two New York museums in the 1940s, in *The Australian Journal of Anthropology*, *23*(2), pp.129-157, John Wiley & Sons, New York, USA.

Forrest, R., 2013. Museum atmospherics: The role of the exhibition environment in the visitor experience, in *Visitor Studies*, *16*(2), pp.201-216, Visitor Studies Association, Albany, USA.

Forrest, R., 2014. *Design factors in the museum visitor experience* (PhD thesis, The University of Queensland, Business School), accessed May 25, 2019, at https://espace.library.uq.edu.au/view/UQ:348658

Franklin, A., 2016. Journeys to the Guggenheim Museum Bilbao: Towards a revised Bilbao Effect, in *Annals of Tourism Research*, *59*, 79-92, Elsevier, Amsterdam, The Netherlands.

Franklin, A. & Papastegiadis, N., 2017. Engaging with the anti-museum? Visitors to the Museum of Old and New Art. *Journal of Sociology*, *53*(1), SAGE Publications, Newbury Park, USA.

Ganucci Cancellieri, U., Manca, S., Laurano, F., Molinario, E., Talamo, A., Recupero, A., & Bonaiuto, M., 2018, in *Visitors'* satisfaction and perceived affective qualities towards museums: The impact of recreational areas. *Rassegna di Psicologia*, *XXXV*, *1*, pp.5-18, Carocci, Roma, Italy.

Giebelhausen, M., 2011. Museum architecture: A brief history. In S. Macdonald (Ed.), *A companion to museum studies*, pp.223-244, Routledge, UK.

Gilli, F., & Rozzi F. M., 2013. *Smart museum. La psicologia della fruizione artistica*, Franco Angeli, Milano, Italy.

Gilman, B., 1916. Museum Fatigue. *Scientific Monthly*, *12*, pp.67-74, James McKeen Cattell, USA.

Goulding, C., 2000. The museum environment and the visitor experience. *European Journal of Marketing*, *34*(3), pp.261-278. Emerald Publishing, Bingley, UK.

Hartig, T., 2004. Toward understanding the restorative environment as a health resource, in *Open space-People space: An international conference on inclusive environments*,

Hartig, T., & Staats, H., 2003. Guest editors' introduction: Restorative environments, in *Journal of Environmental Psychology*, *23*, pp.103-107, Elsevier, Amsterdam, The Netherlands.

Hein, H. S., 2000. *The museum in transition*, Smithsonian Institution Press, Washington DC, USA.

Hillier, B., & Tzortzi, K., 2011. Space syntax: The language of museum space, in *A companion to museum studies*, S. Macdonald (Ed.), pp. 282-301, Wiley Blackwell, Hoboken, USA.

Höge, H., 2003. A museum experience: Empathy and cognitive restoration, in *Empirical Studies of the Arts*, *21*(2), pp.155-164, .

Hood, M. G., 1993. Comfort and caring: Two essential environmental factors. *Environment and Behavior*, *25*, pp.710-724, SAGE Publications, Newbury Park, USA.

ICOM, 2007. *Museum definition*, accessed February 10, 2020, at http://icom.museum/en/activities/standards-guidelines/museum-definition/

Jeong, J.-H., & Lee, K.-H., 2006. The physical environment in museums and its effects on visitors' satisfaction, in *Building and Environment*, 41, pp.963-969, Elsevier, Amsterdam, The Netherlands.

Johnston, R., 1998. Exogenous factors and visitor behaviour: A regression analysis of exhibit viewing time, in *Environment and Behaviour*, *30*(3), pp.322-347, SAGE Publications, Newbury Park, USA.

Kaplan, S., 1972. The challenge of environmental psychology: A proposal for a new functionalism, in *The American Psychologist*, *27*(2), pp.140-3, American Psychological Association, Washington DC, USA.

Kaplan, S., 1987. Aesthetics, affect, and cognition: Environmental preference from an evolutionary perspective, in *Environment and Behavior*, *19*(1), pp.3-32, SAGE Publications, Newbury Park, USA.

Kaplan, S., 1988. Perceptions and landscape: Conceptions and misconceptions, in *Environmental aesthetics: Theory, research and applications*, 11, J. Nasar (Ed.), pp. 45-55, Cambridge, UK.

Kaplan, S., 1995. The restorative benefits of nature: Toward an integrative framework. *Journal of Environmental Psychology*, *15*, pp.169-182, Elsevier, Amsterdam, The Netherlands.

Kaplan, S., Bardwell, L. V., & Slakter, D. B., 1993. The museum as restorative environment, in *Environment and Behavior*, *25*(6), pp.725-742, SAGE Publications, Newbury Park, USA.

Kaplan, S., & Kaplan, R., 1989. *The experience of nature: A psychological perspective*, Cambridge University Press, Cambridge, UK.

Kim, M., Dillon, J., & Song, J., 2018. The factors and features of museum fatigue in science centres felt by Korean students, in *Research in Science Education*, 07.03.2018, pp.1-18, Springer, Berlin, Germany.

Kirchberg, V., & Tröndle, M., 2012. Experiencing exhibitions: A review of studies on visitor experiences in museums, in *Curator: The Museum Journal*, *55*(4), pp.435-452, California Academy of Sciences, USA.

Kirshenblatt-Gimblett, B., 1998. *Destination culture: Tourism, museums, and heritage*, University of California Press, USA.

Klein, H.-J., 1993. Tracking visitor circulation in museum settings, in *Environment and Behavior*, *25*(6), pp.782-800, SAGE Publications, Newbury Park, USA.

Kotler, P., 1974. Atmospherics as a marketing tool. *Journal of Retailing*, *49*(4), pp.48-64, Elsevier, Amsterdam, The Netherlands.

Kottasz, R., 2006. Understanding the influences of atmospheric cues on the emotional responses and behaviours of museum visitors, *Journal of Nonprofit & Public Sector Marketing*, *16*(1), pp.95-121, Taylor and Francis, London, UK.

Kraeutler, H., 2008. *Otto Neurath. Museum and exhibition work: Spaces (designed) for communication*, Peter Lang GmbH, Frankfurt am Main, Germany.

Lampugnani, V. M., 2011. Insight versus entertainment: Untimely meditations on the architecture of twentieth-century art museums, in *A companion to museum studies*, S. Macdonald (Ed.), pp.245-262, Routledge, UK.

Lin, I. Y., 2004. Evaluating a servicescape: The effect of cognition and emotion. *International Journal of Hospitality Management*, *23*(2), pp.163-178, Elsevier, Amsterdam, The Netherlands.

Lindsay, G. L., 2013. *The Denver Art Museum and the Bilbao effect*. Thesis for the degree of Doctor of Philosophy in Architecture, UC Berkeley, accessed on May 2020 at https://escholarship.org/uc/item/6dm3924c

Liu, Y., & Jang, S., 2009. The effects of dining atmospherics: An extended Mehrabian-Russell model, in *International Journal of Hospitality Management*, *28*(4), pp.494-503, Elsevier, Amsterdam, The Netherlands.

Lorenc, J., Skolnick, L., & Berger, C. (2010). *What is exhibition design?,* Mies, Rotovision, Switzerland.

Macdonald, S., 2002. *Behind the scenes at the Science Museum*, Berg, Oxford, UK.

Macdonald, S., 2007. Interconnecting: Museum visiting and exhibition design, *CoDesign*, *3*(1), pp.149-162, Taylor and Francis, London, UK.

Mahnke, F. H., & Mahnke, R. H., 1987. *Color and light in man-made environments*,Van Nostrand Reinhold, New York, USA.

Massara, F., Liu, S. S., & Melara, R. D., 2010. Adapting to a retail environment: Modeling Consumer-environment interactions, in *Journal of Business Research*, *63*(7), pp.673-681, Elsevier, Amsterdam, The Netherlands.

Mastandrea S., 2014. How emotions shape aesthetic experiences, in *The Cambridge Handbook of the Psychology of Aesthetics and the Arts*, Pablo Tinio & Jeff Smith (Eds.), pp. 500-518, Cambridge University Press, Cambridge, UK.

Mastandrea, S., Maricchiolo, F., Carrus, G., Giovannelli, I., Giuliani, V., & Berardi, D., 2019. Visits to figurative art museums may lower blood pressure and stress, in *Arts and Health*, *11*(2), pp.123-132, Taylor and Francis, London, UK.

McCarthy, J., & Ciolfi, L., 2008. Place as dialogue: Understanding and supporting the museum experience, in *International Journal of Heritage Studies*, *14*(3), pp.247-267, Taylor and Francis, London, UK.

Melton, A. W., 1935. *Problems of installation in museums of art*. *Museum*, American Association of Museums, Washington, DC, USA.

Meerwein, G., Rodeck, B., & Mahnke, F. H., 2007. *Color: Communication in architectural space* (1st English), Birkhauser-Verlag AG, Basel, Switzerland.

Mehrabian, A., & Russell, J. A., 1974. *An approach to environmental psychology*, MIT Press, USA.

Miles, R., Alt, M., Gosling, D., Lewis, B., & Tout, A., 1988. *The design of educational exhibits* (2nd ed.), Allen & Unwin, London, UK.

Moser, S., 2010. The devil is in the detail: Museum displays and the creation of knowledge, in *Museum Anthropology*, *33*(1), pp.22-32, Wiley, Hoboken, USA.

Nelson, K. B., 2009. Enhancing the attendee's experience through creative design of the event environment: Applying Goffman's dramaturgical perspective, in *Journal of Convention & Event Tourism*, *10*(2), pp.120-133, Taylor and Francis, London, UK.

Ng, C., 2003. Satisfying shoppers' psychological needs: From public market to cyber-mall. *Journal of Environmental Psychology*, *23*(4), pp.439-455, Elsevier, Amsterdam, The Netherlands.

Ouellette, P., Kaplan, R., Kaplan, S., 2005. The monastery as a restorative environment. *Journal of Environmental Psychology*, *25*(2), pp.175-188, Elsevier, Amsterdam, The Netherlands.

Packer, J., 2006. Learning for fun: The unique contribution of educational leisure experiences, in *Curator: The Museum Journal*, *49*(3), pp.329-344, California Academy of Sciences, USA.

Packer, J., 2008. Beyond learning: Exploring visitors' perceptions of the value and benefits of museum experiences, in *Curator: The Museum Journal*, *51*(1), pp.33-54, California Academy of Sciences, USA.

Packer, J., & Bond, N., 2010. Museums as restorative environments, in *Curator: The Museum Journal*, *53*(4), pp.421-436, California Academy of Sciences, USA.

Pals, R., Steg, L., Siero, F. W., & van der Zee, K. I., 2009. Development of the PRCQ: A measure of perceived restorative characteristics of zoo attractions, in *Journal of Environmental Psychology*, *29*(4): pp.441-449, Elsevier, Amsterdam, The Netherlands.

Panciroli, C., Russo, V., & Macauda, V., 2017. When technology metts art: Museum paths between real and virtual, in *Proceedings*, *1*, p.913, MDPI, Basel, Switzerland.

Pekarik, A., & Schreiber, J. B., 2012. The power of expectation, in *Curator: The Museum Journal*, *55*(4), pp.487-496, California Academy of Sciences, USA.

Peponis, J., Dalton, R., Wineman, J., & Dalton, N., 2004. Measuring the effects of layout upon visitors'spatial behaviors in open plan exhibition settings. *Environment and Planning B: Planning and Design*, *31*(3), pp.453-473, SAGE Publications, Newbury Park, USA.

Pescarin, S., 2014. Museums and virtual museums in Europe: Reaching expectations, in *SCIentific RESearch and Information Technology*, *4*(4), pp.131-140, SCIRES-IT, Italy.

Pine, B. J. I., & Gilmore, J. H., 1999. *The experience economy: Work is theatre & every business a stage*, Harvard Business School Press. Boston, USA.

Plaza, B., 2006. The return on investment of the Guggenheim Museum Bilbao, *International Journal of Urban and Regional Research*, *30*(2), pp.452-467, Wiley, Hoboken, USA.

Plaza, B., 2007. *The Bilbao effect (Guggenheim Museum Bilbao)*, MPRA Paper 86, University Library of Munich, Germany.

Plaza, B., Tironi, M., Haarich, S. N., 2009. Bilbao's art scene and the "Guggenheim effect" revisited. *European Planning Studies*, *17*(11), pp.1711-1729, Taylor and Francis, London, UK.

Reber, R., Schwarz, N., & Winkielman, P., 2004. Processing fluency and aesthetic pleasure: Is beauty in the perceiver's processing experience? *Personality and Social Psychology Review*, *8*(4), pp.364-382, SAGE Publications, Newbury Park, USA.

Recupero, A., Talamo, A., Triberti, S., & Modesti, C., 2019. Bridging museum mission to visitors' experience: Activity, meanings, interactions, technology, in *Frontiers in Psychology*, *10*(Article 2092), pp.1-10, Frontiers Media SA, Lausanne, Switzerland.

Ritchie, J. R. B., Tung, V. W. S., & Ritchie, R. J. B., 2011. Tourism experience management research: Emergence, evolution and future directions, in *International Journal of Contemporary Hospitality Management*, *23*(4), pp.419-438, Emerald Publishing, Bingley, UK.Robinson, E. S., 1928. *The behavior of the museum visitor*, American Association of Museums Washington, DC, USA.

Roppola, T., 2012. *Designing for the museum visitor experience*, Routledge, UK.

Rounds, J., 2004. Strategies for the curiosity-driven museum visitor. *Curator: The Museum Journal*, *47*(4), pp.389-412, California Academy of Sciences, USA.

Rui Olds, A., 1994. Sending them home alive, in *The educational role of the museum*, E. Hooper-Greenhill (Ed.), pp.76-80. Routledge, UK.

Russell, J. A., 1980. A circumplex model of affect, in *Journal of Personality and Social Psychology*, *39*(1), pp.161-78, American Psychological Association, Washington DC, USA.

Scott, C. A., 2009. Exploring the evidence base for museum value. *Museum Management and Curatorship*, *24*(3), pp.195-212, Routledge, UK.

Schorch, P., 2013. The experience of a museum space. *Museum Management and Curatorship*, (April), pp.1-16, Routledge, UK.

Serrell, B., 1998. *Paying attention: Visitors and museum exhibitions*, American Association of Museums, Washington, DC, USA.

Singh, S., 2006. Impact of color on marketing, in *Management Decision*, *44*(6), pp.783-789, Emerald Publishing, Bingley, UK.

Shettel, H., Butcher, M., Cotton, T., Northrup, J., & Clapp Slough, D., 1968. *Strategies for determining exhibit effectiveness*, American Institutes for Research, Pittsburgh, USA.

Smith, E., 2011. Engaging the visitor: Architectural rhetoric and the inclusive art museum, in *International Journal of the Inclusive Museum*, *3*(3), pp.15-24, The Inclusive Museum Research Network, Hyderabad, India and Sydney, Australia.

Smith, L. F., & Smith, J. K., 2006. The nature and growth of aesthetic fluency, in *New directions in aesthetics, creativity, and the arts*, P. Locher, C. Martindale and L. Dorfman (Eds.), pp. 47-58, Baywood, Amityville, USA.

Spock, D., 2006. The puzzle of museum educational practice: A comment on Rounds and Falk, in *Curator: The Museum Journal*, *49*(2), pp.167-180, California Academy of Sciences, USA.

Staats, H., 2012. Restorative enviroments. *The Oxford handbook of environmental and conservation psychology*, S. D. Clayton (Ed.), pp.445-458, Oxford University Press, UK.

Stamps, A. E., 2005. Visual permeability, locomotive permeability, safety, and enclosure, in *Environment and Behavior*, *37*(5), pp.587-619, SAGE Publications, Newbury Park, USA.

Stamps, A. E., 2007. Mystery of environmental mystery: Effect of light, occlusion and depth of view, in *Environment and Behavior*, *39*(2), pp.165-197, SAGE Publications, Newbury Park, USA.

Steg, L., & de Groot, J., 2019. *Environmental psychology: An introduction* (2nd Ed.), Wiley, Hoboken, USA.

Stylianou-Lambert, T., 2011. Gazing from home: Cultural tourism and art museums, in *Annals of Tourism Research*, *38*(2), pp.403-421, Elsevier, Amsterdam, The Netherlands.

Sylaiou, S., Mania, K., Karoulis, A., & White, M., 2010. Exploring the relationship between presence and enjoyment in a virtual museum. *International Journal of Human-Computer Studies*, *68*(5), pp.243-253, Elsevier, Amsterdam, The Netherlands.

Tilden, S. J., 2004. *Architecture for art: American art museums, 1938-2008*, H. N. Abrams, New York, USA.

Tizi, L., & Pazzaglia, F., 2018. Musei, specchio della società. I cambiamenti in ambito espositivo e museale nell'ottica della psicologia architettonica, in *Trasporti & Cultura*, *50*, pp.74-81, Cannareggio, Venezia, Italy.

Tizi, L., Toffalini, E., Pavan, E., & Pazzaglia, F., 2019. Atmosfera percepita di due allestimenti museali in relazione a fattori ambientali e variabili cognitive, affettive e rigenerative. Analisi delle caratteristiche psicometriche dell'adattamento italiano del Perceived Atmosphere Instrument, in *Giornale Italiano di Psicologia*, *4*, pp.959-986, Il Mulino, Bologna, Italy.

Toon, R., 2005. Black box science in black box science centres, *Reshaping Museum Space: Architecture, Design, Exhibitions*, S. MacLeod (Ed.), pp.26-38, Routledge, UK.

Tröndle, M., & Tschacher, W., 2012. The physiology of phenomenology: The effects of artworks, in *Empirical Studies of the Arts*, 30(1), pp.75-113, SAGE Publications, Newbury Park, USA.

Turley, L., & Milliman, R., 2000. Atmospheric effects on shopping behavior: A review of the experimental evidence, in *Journal of Business Research*, *49*, pp.193-211, Elsevier, Amsterdam, The Netherlands.

Ulrich, R. S., 1983. Aesthetic and affective response to natural environment. *Human Behavior and Environment:Advances in Theory and Research*, *6*, pp.85-125, Taylor and Francis, London, UK.

Vogels, I., 2008. Atmosphere metrics: Development of a tool to quantify experienced atmosphere, in *Probing experience: From assessment of user emotions and behaviour to development of products*, 8, J. H. D. M. Westerink, M. Ouwerkerk, T. J. M. Overbeek, W. F. Pasveer, & B. Ruyter (Eds.), pp.25-41, Springer, Dordrecht, Netherlands.

Wagemans, J., Feldman, J., Gepshtein, S., Kimchi, R., Pomerantz, J. R., van der Helm, P. A, & van Leeuwen, C., 2012. A century of Gestalt psychology in visual perception: II. Conceptual and theoretical foundations, in *Psychological Bulletin*, *138*(6), pp.1218-1252, American Psychological Association, Washington DC, USA.

Witcomb, A., 2003. *Re-imagining the museum: Beyond the mausoleum*, Routledge, UK.

Yalowitz, S. S., & Bronnenkant, K., 2009. Timing and tracking: Unlocking visitor behaviour, in *Visitor Studies*, *12*(1), pp.47-64, Visitor Studies Association, Albany, USA.

Yellis, K., 2010. Cueing the visitor: The museum theater and the visitor performance, in *Curator: The Museum Journal*, *53*(1), pp.87-103, California Academy of Sciences, USA.

Yüksel, A., 2009. Exterior color and perceived retail crowding: Effects on tourists' shopping quality inferences and approach behaviors, in *Journal of Quality Assurance in Hospitality & Tourism*, *10*(4), pp.233-254, Taylor and Francis, London, UK.

Zomerdijk, L. G., & Voss, C. A., 2009. Service design for experience-centric services, in *Journal of Service Research*, *13*(1), pp.67-82, SAGE Publications, Newbury Park, USA.

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Minimal interventions

Leveraging on applied research to introduce small, yet radical, acts of change in the museum experience

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Abstract

There where the museum structure already exists, the collection is consolidated, but the economic resources are limited, minimal interventions, almost homeopathic injections, allow us to significantly improve the visitors' fruition and perception of the surrounding space. Years of applied scientific research in environmental psychology give us precious and precise indications on how to intervene. We know that disorientation and fatigue, both cognitive and physical, are among the main issues observed in museums. In order to improve orientation (wayfinding) some measures are fundamental.
The path itself, where the structure does not allow us to introduce radical transformations, can be improved through small actions such as a different distribution of the artworks, adequate and timely lighting, or the use of color backgrounds. The aim is to create an immersive setting that favors concentration and minimizes disturbing stimuli, both environmental and relational. All these measures, apparently simple, but derived from applied research, are those making the difference between a pleasant, enjoyable, and therefore repeatable museum experience, and an outdated museum, intended for a few fans and unable to act as a resource for its territory.

Keywords: Environmental psychology, Wayfinfing, Perception/Experience of use, Exhibition itinerary, Visitor

1. Introduction

In places where the museum structure already exists, the collection is consolidated, but the economic resources are limited, minimal interventions, almost homeopathic injections, allow us to significantly improve the visitors' fruition and perception of the surrounding space.

Years of applied scientific research in environmental psychology give us precious and precise indications on how to intervene. The observation of existing instances with concrete examples, both positive and negative, provide us with food for thought and stimuli.

The main elements of fatigue in undertaking a museum journey (experience) are of two types: physical fatigue and cognitive fatigue (attentive).

The typology (architectural or related to the exhibited materials) of the museum is scarcely relevant as far as the attentive aspects are concerned, which seem to be rather influenced by the choices related to the preferred exhibition mode. As a matter of fact it seems that the "way" in which the object is proposed is more relevant than the object itself.

On the contrary, we know that both cognitive and physical disorientation and fatigue, which are among the main problems encountered when visiting a museum, are related to the size and scale of the museum itself. In this sense we must intervene on the *wayfinding* of the visitor, which implies a more complex vision than the mere orientation within a place. This term, in fact, refers not only to communicative artifacts but to all the instruments of wayfinding in a general sense, that is, functional artifacts designed and conceived for spaces where we need to orient ourselves, move and experience the space itself. In fact, improving wayfinding mitigates physical and above all cognitive efforts: being aware of where we are and where we want to go through a meaningful, but at the same time non-invasive representation, puts us in a position of control and therefore of conscious management of space. Concretely, the role of Wayfinding Design is to create a map of space within the mind of a user who tries to navigate it. It goes without saying that the clearer the physical structure of the space, the clearer the mental map of the user, with a saving in terms of cognitive fatigue.

There are strategies to improve orientation (wayfinding) and the museum experience in general. In this respect, some expedients are fundamental:

The entrance must be clearly identifiable, and within it the functions and what will be met along the way must be clearly explained. It is key that the information found in this place allows us to plan the visit, informing us about what there is to do and to see and how to reach different points of interest, such as specific sections of the museum, refreshment areas and services.

An overall map that shows when and where the individual artworks or otherwise the thematic areas of interest (for example, medieval art, 20th century American painting, dinosaurs, etc.) will be found is fundamental not only to encourage orientation but also to allow a sense of autonomy and control over the environment, which is known to be associated with a more satisfactory experience of use, as it makes the visitor feel more secure and at ease. By providing, upon purchase of the ticket, a small paper map as a gift, we obtain the desired result together with a perception of value by the visitor, as the map itself can be used as a support for notes or annotations and can then be taken home to consolidate the memory of the experience. An identical map, always oriented from the viewer's point of view, and where possible placed horizontally, must be located at any possible junction of the route, accompanied by the simple wording "I am here". The orientation of the map from the observer's point of view is fundamental, as the map alone, if not oriented, is scarcely usable and generates a sense of disorientation such as the maps positioned at the entrances of the new public park called "Biblioteca degli alberi" in Milan.

The path itself, where the structure does not allow us to introduce radical transformations, can be improved through a different distribution of the artworks. Reducing the number of works displayed, by implementing a rotational mechanism instead if necessary, diminishes the boredom effect caused by the saturation of redundant information with an improvement in terms of perception and greater ease of remembering. Typical of archaeological museums, and others besides, is the display of a plurality of similar objects, such as cinerary urns, when instead the choice of a single specimen, perhaps the most representative, would be much more explanatory and effective in in terms of communication. Due to inertia, most of the visitors tend to observe only what is placed on one side and to take the first exit they encounter,

neglecting the totality of the room. It is possible to overcome this issue by tracing, through mobile barriers or plays of light, a defined track that guides without uncertainties along a logical pathway. The floor itself, using materials and color, can be the trail that accompanies the visitor. In this respect, an interesting intervention is the set-up up of the museum of ancient art of the Castello Sforzesco in Milan by the architectural studio BBPR: here the path is clearly highlighted using different heights for walkways and works on display. The content (work) and the display space (museum) must be understood in relation to each other, and in this respect color can provide some help.

The use of color both on a macro and a micro scale, always by paying attention to harmony of the whole, within the museum experience becomes a guide, a reference, accompanying the visitor in a pleasant experience. Color is a means of communication and categorization, and can be used in this sense both to highlight possible routes and to group elements thematically. The same color placed as background can guide us, for example, in identifying works or objects related to the same theme, or can identify entire areas of the museum as thematically homogeneous. In this sense, a masterful example is the Musèe du quai Branly in Paris where, in a seamless space, Jean Nouvelle determines thematic areas using color.

Light, if used in a relevant way, can become structure and guide. It is an extraordinary building material, it can guide the visitor along the path as an affordance, and can determine areas of attention by isolating them from the context. In an environment of soft light, which also leads to less buzz and dispersion, an intense light aimed at the artwork creates a strong contrast that focuses attention and improves concentration. The objective is to create an immersive situation (flow), i.e. of strong psychological involvement with the experience that one is living, which favors concentration and minimizes disturbing stimuli, both environmental and relational. The light must be calibrated, directed and coordinated so as to favor a clear dialogue between the artwork and the visitor, in a harmonious relationship. The articulation of an environment into zones through the use of light, makes it possible to identify the individual visual tasks within a museum: welcoming, promoting discovery, highlighting the artwork, leading to the navigation of space or inviting visitors to take a break. A recent anthological temporary exhibition of the Van Cleef and Arpels jewelry house at the Palazzo Reale in Milan used light in an exemplary way to focus attention on the display cases to the exclusion of everything else: the jewels shined and gained attention through the use of light. Another useful example is the use of a particular narrative path such as in the German cemetery of Quero in Veneto, a place of memory comparable today to a museum site. The natural light, which comes from openings in the ceiling, was used by its designer to guide the visitor through the path's experience.

Highlighting on the map one or more alternative routes, through the selection of chosen artworks, allows to build an alternative experience, aimed at different subjects such as children, the blind, or people with non-obvious but limiting disabilities such as rheumatic diseases. These are all subjects who need a journey that is less tiring, and which can be in an open dialogue with their specific characteristics.

Often, old-concept museums are equipped with wordy, non-precise signs that are difficult to read. Any explanatory note, whether it be the introduction to the theme or the identification tag of the work, must be positioned appropriately, be readable by anyone, be concise and, if possible, be interactive to some extent. For example, identification tags should be studied and positioned so that there is a clear and unambiguous convergence with the work to which they are associated, which must be observable without displacement. They must be placed at a suitable height and illuminated, and a sufficiently large and readable font must be chosen in order to be in contrast with the background. In very large museums, physical fatigue is a glaring problem, especially for some visitors. Selected and shorter routes or the simple introduction of adequate seating, scattered in strategic areas along the exhibition, allow to overcome the problem. The same issue can also be addressed through the introduction of "forced" stops such as video rooms or interactive moments. These measures, apparently simple, but derived from applied research, are those making the difference between a pleasant, enjoyable and therefore repeatable museum experience, and an outdated museum, intended for a more limited audience and unable to act as a resource for its territory.

References

Annechini, C., 2017. *Emotional engagement in children's visiting experience. Combining qualitative and quantitative research in museum learning settings*, Doctoral Thesis, Italy.

Baldin, L., 2001. *Il Museo dalla parte del visitatore. Atti della IV Conferenza Regionale dei Musei del Veneto*. Edizioni Canova, Treviso, Italy.

Baroni, M.R., 1998. *Psicologia ambientale*, il Mulino, Bologna, Italy.

Bitgood S.C., 2002, Environnementl psychology in museums, zoo, and other exhibition center, in R.B.Bechtel, A. Churchman (eds.), *Handbook of Environmental Psychology*, pp.461-80, Wiley, New York, USA.

Costa, M., Corazza, L., 2006. *Psicologia della Bellezza*, p. 192, Giunti, Firenze, Italy.

Costa, M., 2009. *Psicologia Ambientale e Architettonica*, p. 256, Franco Angeli, Roma, Italy.

Csikszentmihalyi M., 1990. *Flow: The Psychology of Optimal Experience,* Harper Perennial Modern Classics, USA.

Csikszentmihalyi, M., & Hermanson, K., 1995. What makes visitors want to learn? Intrinsic motivation in museums, in *Museum News*, *74*(3), pp.34-37, American Association of Museums, Washington DC, USA.

Eco, U., 1962. *Opera aperta*, Bompiani, Milano, Italy.

Gilli, G., Rozzi, F., 2013. *Smart Museum. Psicologia della fruizione artistica*, Franco Angeli, Milano, Italy.

Lombardo, G., 2014. Multiple interpretation and fluency: appreciating the unsolvable puzzles of art, Investigations of Cultural Life: Quantitative Aspects, in *Proceedings of the International symposium dedicated to the memory of Colin Martindale and 100-th anniversary of Russian formalist school*, V.M. Petrov, S. Mastandrea, N. Korytin (eds.), Moscow, Russia.

Lombardo, G., 2015. *Interpretazioni multiple e piacere estetico*, Parte II, *www.Unclosed.eu*

Lombardo, S., 1991. Event and decay of the aesthetic experience, in *Empirical Studies of the Arts,* 9(2), pp.123-141, SAGE Publications, Newbury Park, USA.

Macdonald, S., 2007. Interconnecting: museum visiting and exhibition design, in *CoDesign*, 3:sup1, pp.149-162, Taylor & Francis, USA.

Marković, S., 2012. Components of aesthetic experience: aesthetic fascination, aesthetic appraisal, and aesthetic emotion, in *I-Perception, 3*(1), pp.1-17, SAGE Publications, Newbury Park, USA.

Melton A.W., 1972, Visitor behavior in museums: Some early research in environmental design, in *Human Factors*, 14, pp.393-403, SAGE Publications, Newbury Park, USA.

Reber, R, Schwarz, N, Winkielman, P., 2004. Processing fluency and aesthetic pleasure: is beauty in the perceiver's processing experience?, in *Personality and Social Psychology Review,* 8, pp.364-82, SAGE Publications, Newbury Park, USA.

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Buncart Tirana: dialogue between the regimes in Albania

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Abstract

This study aims to explore the fascinating dialogue between totalitarian regimes introduced in two museums within the anti-nuclear bunkers in Tirana. Architectural projects preserved the identity of their interior.

While we are talking about careful architectural intervention to create the atmosphere of totalitarian ideology, in many cases we have to do with the continuity of existing architectural and urban elements in these kinds of projects.

In two museums, BuncArt 1 and BunkArt 2, it is quite interesting to combine parts of history, during the years of world wars and the period of dictatorship of communism, with the facilities and elements exhibited there.

Albania, a Balkan country with very interesting history, is a good study to understand the developments of museum architecture in relation to historical events. After a long period of centuries under the Ottoman Empire, the country goes through two different periods, two totalitarian regimes: fascist and communist. The presence of the three periods is quite evident and is clearly reflected in the Albanian territory. They are already part of the historical memory of the cities. In most major cities they are now central urban axes, around which today's cities develop.

The part designed and realized during the fascist period in the Albanian territory has a direct connection with what was happening in the Italian territory at that time. Initially, before the fascist invasion of Albania, a series of projects were implemented by Italian architects in Albania. They had begun since the reign of King Zog in the twenties with strong interference in the main Albanian cities and especially in Tirana.

In the meantime, thereafter, one can speak of a longer period for the period of the communist regime extending from 1945 to 1990. The impact of communist ideology, coming from the communist bloc of the East, also affects architecture and urban studies in Albania. In some respects, we have a silent follow-up to the monumental interventions that were made before the end of World War II. Another important element was the radical intervention in the bunkers in the territory and in the cities. Their quantity is considered with an amount of 700 thousand pieces. They were different in size and were seen more as defense-related parts rather than as a direct link to the new realist-socialist architecture.

The return of some of them to the exhibition space was a good step to revitalize them. Currently they have been transformed into successful tourist attractions. Visitors come to perceive three important elements:

- attractive military engineering, carried out in contrast to the challenges of the time
- the suffocating atmosphere during the communist dictatorship, which required extreme safeguards
- elements and historical facts of the World War period, as important elements during the Cold War.

Keywords: Memory, The regimes' architecture, Territory, History, Albania.

An ambitious third project, which is expected to be implemented in the future, is the conversion of the Pashaliman Naval Base in Vlora into another important military museum. This port was originally set up by mid-Fifties, by Russian troops, to have control over the Adriatic. The port is currently part of the military, but is thought to turn into a strong tourist pole.

Introduction

The study considers some of the important open exhibition spaces in Tirana in the last ten years, which have been dedicated to events during totalitarian systems in Albania. It is now well known that Albania's capital, Tirana, is a direct urban product of two dictatorial systems, the short Italian fascist occupation and the long communist dictatorship that ended in the 1990s. The architectural spirit of the fascist era created the new urban core of the city and during communism this core was consolidated and further expanded with new urban blocks of space in a real social style. Although a considerable part of the city developed during the Ottoman period remained intact, the city still transmits to a large extent the presence of the real socialist city. In addition to the presences of the architectures of the two regimes, in the city of Tirana and beyond, one of the attractions to visit are some museums especially associated with military facilities and espionage structures during the Cold War.

Some of them were realized several years ago and they are visitable. The common element between them is the topics they address, as well as the spaces in which they are located. We have analysed four cases of museums that are focused on events during the Cold War:

a- two underground museums, which are two anti-nuclear bunkers of the communist era, Bunkart 1 and Bunkart 2,
b- the museum of "The House of Leaves", which was a villa of the thirties, during the dictatorship turned into a place of espionage for dissidents and for Albanian intellectuals.
c- Unfinished project of the underground military port at Portopalermo, near Vlora, which was a military base for Russian submarines, built in the 1960s.

1.1. Albania between the regimes

It should be noted that Albania is an interesting case study in terms of linking the urban and architectural part with totalitarian systems. The presence of totalitarian systems is closely linked to the international developments of the 20th century. The independence of Albania was realized in 1912, after 5 centuries of occupation by the Ottoman Empire. In recent years there have been various dynamic developments from a historical point of view. In relation to all the Balkan countries, Albania is the only case where two totalitarian dictatorships are constantly following each other. In April 1939, Albania was militarily occupied by the Italian fascist troops of Mussolini, and this lasted until 1942. It is worth noting that, even before the military occupation, since 1924, during Ahmet Zog's dominance of Albanian politics, for a period of 15 years, Mussolini's government had a strong influence in the formation of the new Albanian state. This influence has not only had an impact on the economy and politics, but also on all walks of life. They were especially felt in urban planning, architecture, and art. The military invasion of 1939, which forced the Albanian king Ahmet Zog to flee, simply deepened the influence and dictatorship of the Italian fascist state in all areas of life in Albania.

The second totalitarian system that followed fascist domination is the communist system. It came directly after the end of the Second World War and lasted until the nineties. The established dictatorship was an extension of the influence of the communist dictatorships of the Soviet Union and of the east bloc. This automatically brought about a new political, ideological, economic, and social approach to a system similar to that of the Moscow Bolshevik regime. However, Albania's long-term political and ideological course would only be determined by Enver Hoxha[1] himself and other Communist Party members.

[1] Enver Hoxha was an Albanian communist politician who served as the Prime Minister of Albania, as the First Secretary of the Party of Labour of Albania, from 1944 until his death in 1985.

The years of the dictatorship are composed of several periods, which are divided according to different approaches, in which the dictator Enver Hoxha had in relation to his international relations. In 1947 Hoxha broke off relations with neighboring Yugoslavia, ostensibly because the less hard-line Yugoslavs were straying from the true path of socialism. Hoxha had a name for the state of preparedness all Albanians should be in – *gjithmone gati*, or "always ready". This state of mind came in part from his experiences in World War Two. Until the mid-1960s, his direct relations were with the Soviet Union and the Eastern Bloc countries. These links marked great progress in some aspects of industrialization, education, and the rise of the communist state. During his control of the country, Hoxha took radical steps in relation to other countries, banning religion, interrupting outward movements, and using his secret services against any opposition thought. Great empowerment was made especially by the military, exploiting the strategic position in that part of Europe that Albania represented in the eyes of Moscow. A series of different military bases were set up throughout the country. While almost a quarter of the Albanian state budget went to the military, much of that funding was spent on building bunkers. At that time a large system of bunkers of different typologies began to be built in every corner of the country. The most widespread was the fungal model named "M22", the prototype built in the 1950s. The engineers had assured Hoxha that he would withstand a full onslaught by hitting a tank shell. Hoxha decided to give it a try, with the design engineer inside, and when he appeared unharmed by the attack, so began their mass production. Albania then lurched into another problem in 1961 after Hoxha declaimed Stalin's reform-minded successor Nikita Khrushchev. The Soviets and the rest of the Warsaw Pact froze Albania out, forcing the isolated state to align itself instead with Mao Zedong's China.

Fig. 1. Picture from the bunkers in Albanian territory.

This honeymoon, too, was short-lived. Incensed by Mao's welcoming of US president Richard Nixon to China in 1972, Hoxha rapidly cooled relations with the Chinese too. By 1978, the Chinese had withdrawn all their advisors, leaving Albania without allies – and the most isolated country in the world.

From the paranoid thoughts of the Communist nomenclature on the possible occupation by his former Soviet allies, or the Usa and NATO forces, so many concrete and steel bunkers were built, with the aim of stopping a large army. The idea of protecting the country from the ground was the only military justice strategy of the time. Bunkers sprout, like large gray mushrooms from the mountains north, south, and up the coastline, sprouting in any urban neighborhood, or in the fields, between graves and beach umbrellas. The doctrine of Hoxha's military hard line had led him to think that the NATO attacks would come from neighboring Italy or Greece. But he also had other enemies, such as Tito's Yugoslavs, who in the forties had contributed to the establishment of the Communist Party in Albania. An invasion could come from the Yugoslavs themselves, or their country could be used as a war corridor for a Soviet invasion.

Albania's armed forces would not be able to withstand a conventional battle against all these enemies, much stronger, in Hoxha's view. He called for the mobilization of all strata of the population, most of whom had to

do basic military training each year. It was called "soft", and was a parallel form of resistance, alongside the real army. Taught in the days of the partisan war, where small units would carry out attacks on Italian or German outposts, descending from the mountain, the nomenclature coming out of that war, he wanted to ensure that every invader would face the same, creating a wide network of bunkers. The thought system was such that all people would fight every beach, village, and crossroads through the bunkers. Albania would become a land covered with these gray bunkers.

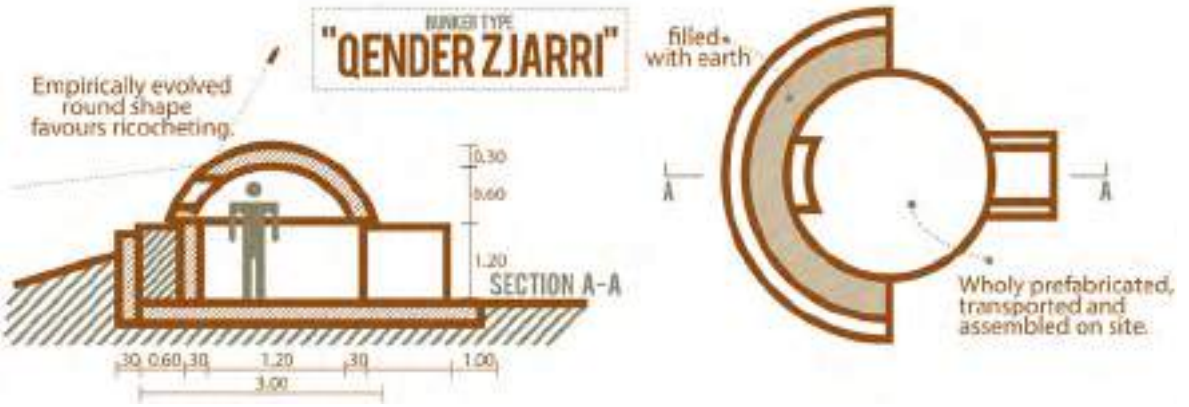

Fig. 2. Picture from QZ bunkers.

1.2. The bunkers

The bunkers were standardized by the Albanian Army. They were built with concrete, steel and iron, and in size from varjonte fighting facilities for one or two persons with light weapons, to large underground shelters, intended to be used by the leadership of the Party and the bureaucrats, to be protected from nuclear bomb attacks. Country bunkering could be divided into 3 main categories:

- *Qender Zjarri* ("firing position") or QZ bunkers[2]
- *Pike Zjarri* ("firing point") or PZ bunkers
- Large bunkers and tunnels

The first category of the most used bunker is a small concrete dome set into the ground with a circular bottom extending downwards, just large enough for one or two people to stand inside. Known as *Qender Zjarri* ("firing position") or QZ bunkers, they were prefabricated and transported to their final positions, where they were assembled. They consist of three main elements: a 3 m. diameter hemispherical concrete dome with a firing slit, a hollow cylinder to support the dome and an outer wall with a radius 60 cm. larger than the cylinder. The gap between the cylinder and outer wall is filled with earth.

At various places along the coast, large numbers of QZ bunkers were built in groups of three, linked to each other by a prefabricated concrete tunnel. Elsewhere bunkers were constructed in groupings around strategic points across the country, or in lines across swathes of territory. Tirana was particularly heavily defended, with thousands of bunkers radiating out in fifty concentric circles around the city.

The second category, the command-and-control bunkers, known as *Pike Zjarri* ("firing point") or PZ bunkers, were also prefabricated and assembled on site. They are far larger and heavier than the QZ bunkers, with a diameter of 8 metres. They are made from a series of concrete slices, each weighing eight or nine tons, which were concreted together on site to form an interlocking dome. Fully assembled, they weigh between 350–400 tons.

[2] The QZ bunker was designed by military engineer Josif Zagali, who served with the Partisans during World War II and trained in the Soviet Union after the war.

The third category of larger "special structures" for strategic purposes. The largest were bunker complexes tunnelled into mountains. At Linza near the capital, Tirana, a network of tunnels some two kilometers long was built to protect members of the Interior Ministry and the *Sigurimi* (the secret police) from nuclear attack. Elsewhere, thousands of kilometers of tunnels were built to house political, military, and industrial assets. Albania is said to have become the most tunneled country in the world after North Korea.

The tunnels were built in conditions of great secrecy. Engineering teams were not allowed to see construction through to completion but were rotated from site to site monthly.

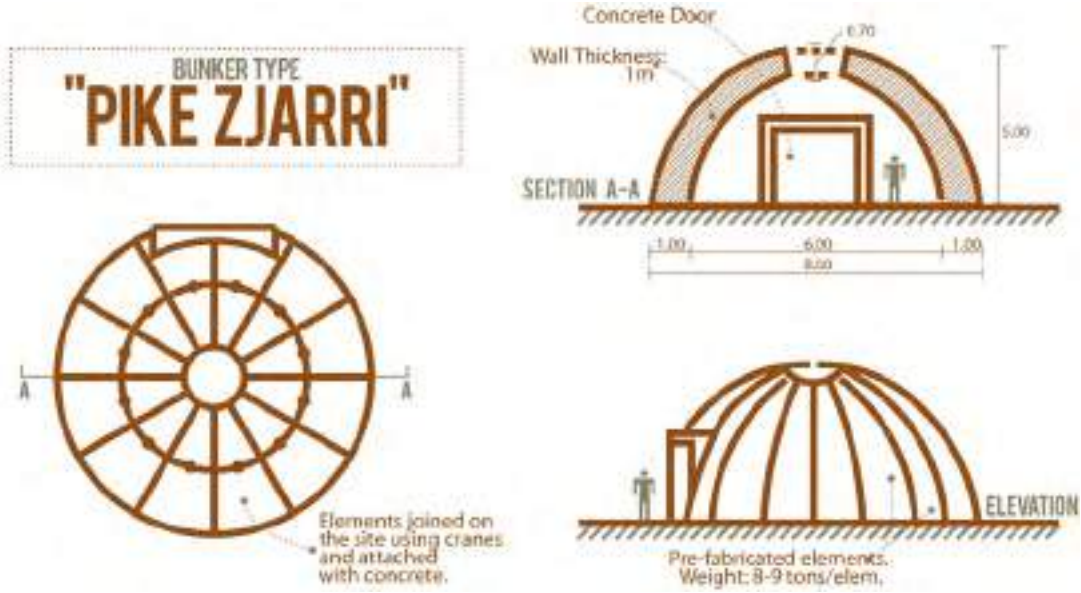

Fig. 3. Picture from PZ bunkers.

Bunkers and military bases entered daily life with their presence for the Albanian citizens, who watched in their windows at every corner, even though the long-awaited enemy never came. Decades after the end of Hoxha's totalitarian regime, bunkers still dominate the landscape in some places.

While some have been turned into hotels, restaurants, or residential homes by some creative citizens, most have been abandoned and covered by nature, or occupied by desperate people seeking shelter. They came across the hilly landscape of Albania, painting almost every picture in the small 28,000 square km of small country.

Twenty-five years after the fall of dictatorship, some of these formerly dominant elements of Albanian life were thought to be exposed to the public and future generations. So some of these bunkers or buildings used by the communal nomenclature, during that time, for military or espionage purposes, were turned into museums. Their opening had to show the physical, technological, and emotional state of these objects of collective memory. Inside they would have to show fragments of history, intertwined with the exhibition spaces inside them. Below we will talk about four projects of these categories. Three of them have been realized, and are located in Tirana, and one of them is still unrealized, is located in Vlora.

In Tirana, there are three recently opened museums, of which the first two are underground military galleries, similar in every respect to their treatment, as well as the other museum, which was one of the main headquarters of the secret services "*Sigurimi*"[3]. The Vlore museum project, meanwhile, deals with a gallery-based military base for submarines. The names of these museums are respectively:

- the first, Bunkart 1, is located on the outskirts of the city of Tirana.

[3] The mission of the *Sigurimi* was to prevent counterrevolutions and to suppress opposition to the regime.

- the second, Bunkart 2, is located in the heart of the city of Tirana, directly on Skanderbeg Square, behind the Albanian state ministries.
- The House of Leaves museum near the central square.
- Submarine Tunnel Porto Palermo in Vlora.

1.3. Bunkart 1 and Bunkart 2

Both of these museums have a similar physiognomy, and certainly both have been built to protect high communist political leadership in the event of an external military attack.

Fig. 4. Picture of bunkart external context of Bunkart 1.

As the name "Bunkart" implies, the two museums which are underground military galleries that already see themselves as art galleries. They are located in two different points of the city of Tirana, Bunkart 1 on the outskirts and Bunkart 2 in the center of the city. Both have curator and curator Carlo Bollino, an Italian journalist and publicist based in Albania, who received direct support from Albanian Prime Minister, Edi Rama.

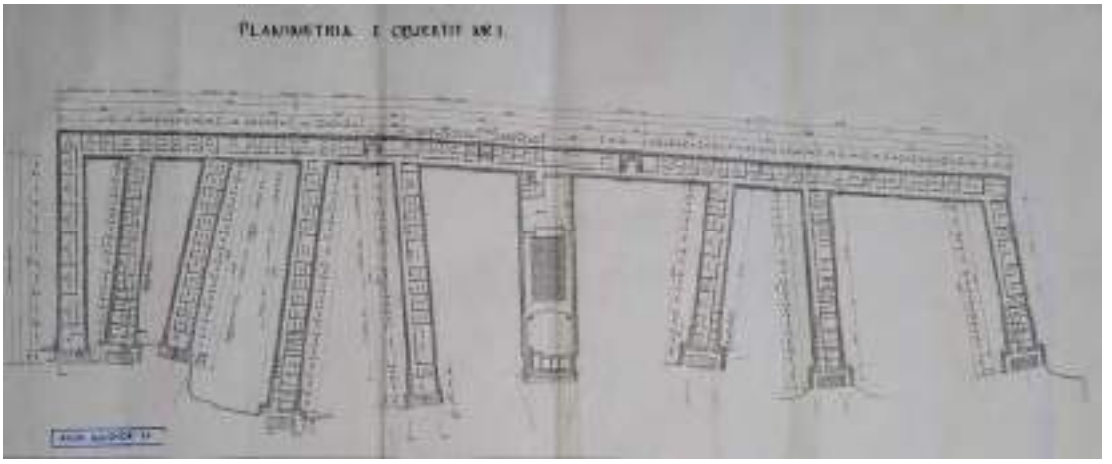

Fig. 5. Plan of existing tunnel condition of Bunkart 1.

The Bunkart 1 Museum, located in the eastern part of the city, in the Shish-Tufina area, near the General Staff Support Battalion. Although a military area, it is now accessible to the public. The museum is a living testimony to the secret lives of communist leaders Enver Hoxha and Mehmet Shehu inside a tunnel they created as a secret place to protect them in the event of an atomic war.

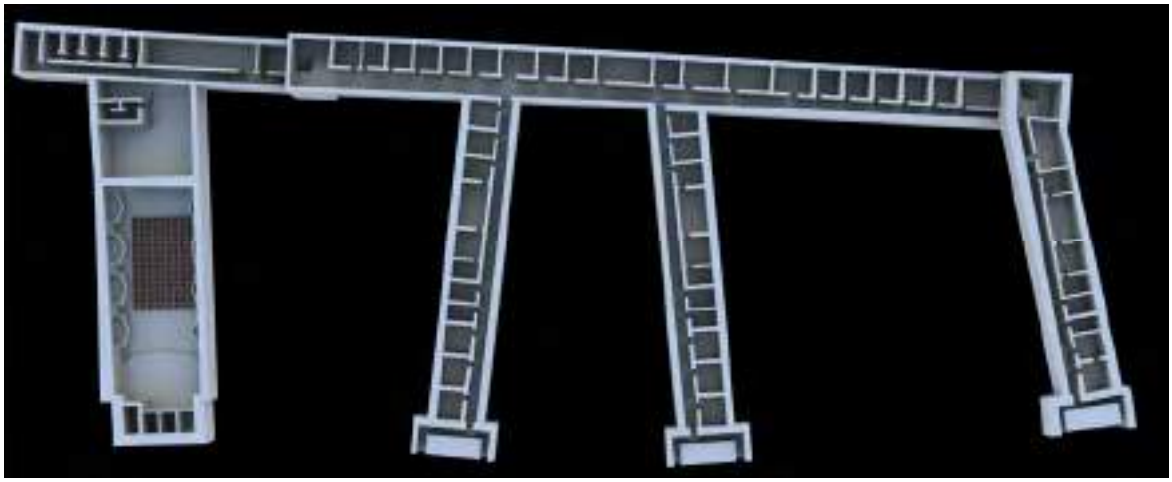

Fig. 6. Plan of the new museum Bunkart 1, curated by Carlo Bollino

Bunkart, in fact, was an anti-nuclear bunker, or more precisely an underground tunnel system, which was built in 1976. Its entrance is merged with the territory, and not very noticeable for the high military security it had. This tunnel system is located 5 floors underground and is composed of an amount of 106 rooms and auxiliary spaces.

Fig. 7. Photos from the interior of the museum Bunkart 1, curated by Carlo Bollino

It was built by the Communist Government with the idea of sheltering senior leadership in the event of a nuclear attack on Albania. Particular attractions are the room dedicated to dictator Enver Hoxh, and the room dedicated to the then Prime Minister Mehmet Shehu. While inside this underground bunker, there is also a large hall with 150 seats, which would be the underground hall of the Albanian parliament. The bunker has 5 armored doors at its entrance, named after the years of communist rule as "*Objekti 0774*".

Fig. 8. Photos from the interior of the museum Bunkart 1, curated by Carlo Bollino

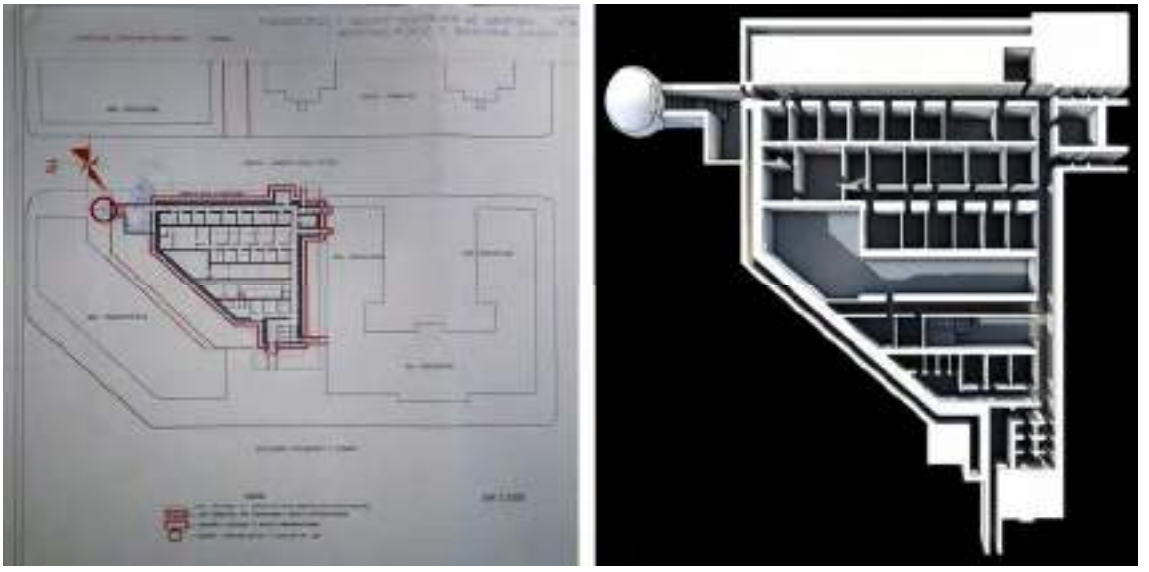

Fig. 9. Plan of existing tunnel condition and dhe new museum of Bunkart 2, curated by Carlo Bollino.

Now, this work of military engineering has turned into a Cold War museum, where the tunnels and other physical environments are the exposed part of it. The anti-nuclear tunnel system transmits an unusual message, and is named Bunkart. It was opened in 2014, on the occasion of the 70th anniversary of the liberation of Albania. The internal organization left intact, reveals through many expressive forms the messages that are transmitted within it. It symbolizes the isolation of communist Albania, but also the ongoing confrontations between the communist bloc and the West during the Cold War. The historical, museal and artistic lines come together to convey to visitors' clear messages about the two most discussed periods of albanian history, the period of World War II and that of the communist regime in Albania

The museum is still guarded by military forces, and this military presence makes even more prosecution of the time feel. Meanwhile, to make it soluble, it is interfering with selected elements of the images from all the important periods of history, not only during communism. The museum tends to show historical fragments,

sideways of the totalitarian periods, to intertwine the link between the construction of the anti-nuclear bunker and the historical continuity of Albania.

Fig. 10. Photos from the interior of the museum Bunkart 2, curated by Carlo Bollino.

In many of these areas are exposed, weapons, uniforms, documents, maps and other details which served at that time. These relics have been inherited from the army of the Albanian communist state. The mode of presentation is attempted to have a graphic language associated with periods, and with an artistic force of expression.

Bunkart 2 is located near Scanderbeg Square, almost directly behind the ensemble of ministries built in the 1930s by Italian architects. It was transformed into a museum, two years after the opening of Bunkart 1, and as it was said at the time of its opening, this museum would have the focus of attention on the victims of the communist dictatorship.

Fig. 11. Photos from the interior of the museum Bunkart 2, curated by Carlo Bollino

Fig. 12. Plan of ground floor and the first floor of museum is "The House of Leaves", Studio Terragni Architetti.

This was related to the fact that the galleries of this museum during the dictatorship had to do physically and functionally with the adjacent building which was the Ministry of Internal Affairs.

This institution was one of the main responsible for crimes during the communist era. The presence of the underground bunker was related not only to the defense system from an external attack, but was also used by the security structures of the communist state for the enemies of the system.Its construction began in 1981 and ended in 1986, two years after the death of dictator Hoxha. Its surface is considerable, but not as large, and as deep as Bunkart 1. Since the tunnels were connected to the ministry buildings, at the time of its transformation into a museum, some additional surface interference was carried out, adding two new volumes, which now serve the main entrance and the exit of visitors. The curators selected for the new entrance, the placement of an artificial concrete bunker according to the typology *Pike Zjarri* ("firing point" or PZ bunkers). This construction of this entrance began in 2015. Apparently, the main purpose was to visualize the bunkers that the communist system was built throughout Albania. The presence of this newly constructed facility raised protests by the end of 2015, a large mass of people organized by Albanian opposition parties, in memory of 1990s anti-communist student movements in Albania. The protesters hit the bunker, built recently, and then set fire to it, leaving numerous cracks. The damaged part was left untouched, giving this part a historical character. Part of the dome, the entrance bunker, was covered with photographs of victims who were persecuted by the regime. The dome treatment looks like a replica, similar to Yad Vashem, the Holocaust memorial in Jerusalem, where the cylinder with this treatment is one of its main parts. In the meantime, the outside entrance was complemented by a metal guard tower, wrapped in barbed wire, installed nearby the bunker. Bunkart 2, despite the point at which it was attempted to identify itself as a museum of the victims of communism, appears in a manner very similar to that of Bunkart 1.

So, we can say that the logic of the installations artistic, with historical military, and archival material, remains the character of the museum already seen at the other museum. The interior rooms have different installations but what impresses them is the engineering work itself, as in the case of Bunk'Art 1.

The real task facing Albania today is to successfully and critically share what is entangled: the beginnings of art, tourism, the creation of history and the work of understanding the past (Raino, 2017).

1.4. The House of Leaves

In 2017, another museum dedicated to the period of communist dictatorship in Albania was inaugurated in the center of Tirana and the name of this museum is "The House of Leaves".

The project was curated by Studio Terragni Architetti. The project of transforming the House of Leaves into a National Museum of Secret Surveillance was initiated by the Albanian Ministry of Culture in 2014 and supported by a multidisciplinary team of historians, victims' associations, engineers and craftsmen from different countries.

Fig. 13. Picture from the interior of the museum "The House of Leaves", Studio Terragni Architetti.

Built in 1931, this villa has an area of over 1300 m2 and a site area of 800 m2, it was the first private obstetrics clinic in Albania. The house has a total of 31 interconnected rooms that carry within them many sad stories related to totalitarian dictatorship. The house was used by the Gestapo during World War II occupation. Later, during the communist dictatorship, the house became the headquarters of the security, the Albanian secret intelligence service. In the early days, the regime's opponents were pierced or even sentenced to death, but in later years, it was used only as a center of espionage. It contained sophisticated equipment for the time, and a vast network of people used to survey the life, and activity of exponents of the former wealthy class, or even of the country's most renowned intellectuals. The data then passed on to the apartheid set up by the Communist Party, which in most cases made radical decisions about their lives and their families.

After the 1990s, the building was abandoned for decades. The house barely looked out of the way, from the dense layer of trees and leaves, a camouflage technique normally seen in war. It also received the metaphorical name "The House of Leaves".

The museum is divided into nine sections, and the main purpose is to discover the sophisticated and advanced ways of controlling the communist state over the Albanian people. The exhibit spaces in the museum vary, some of which are dedicated to the materials contained in it: microphones and various interception technologies used by *Sigurimi*. Other sections of the museum display declarations, work and files prepared by state informants. The sheer volume of surveillance, surveillance and surveillance equipment reveals the startling amount of investment made by the communist state, which is unbelievable given Albania's economic situation at the time. The exhibitions portray a Communist perception of the enemy, external and internal, for which a great deal of state vigilance was focused.

The House of Leaves has also combined a typical Albanian interior living space of the 1970s. The "Panopticon and Panacusticon" exhibit is something akin to a science lab of secret photos, recordings and visuals, all of which add to a wild experience. audio-visual for the visitor. A multitude of emotions permeate each visitor's mind and awareness as you walk through the rooms of this museum. Its realization at the beginning was intended to show not only the historical aspect of this house, but also the ideological and poetic pressure of the time, as you try to imagine that this was a reality for the Albanians in the not too distant past.

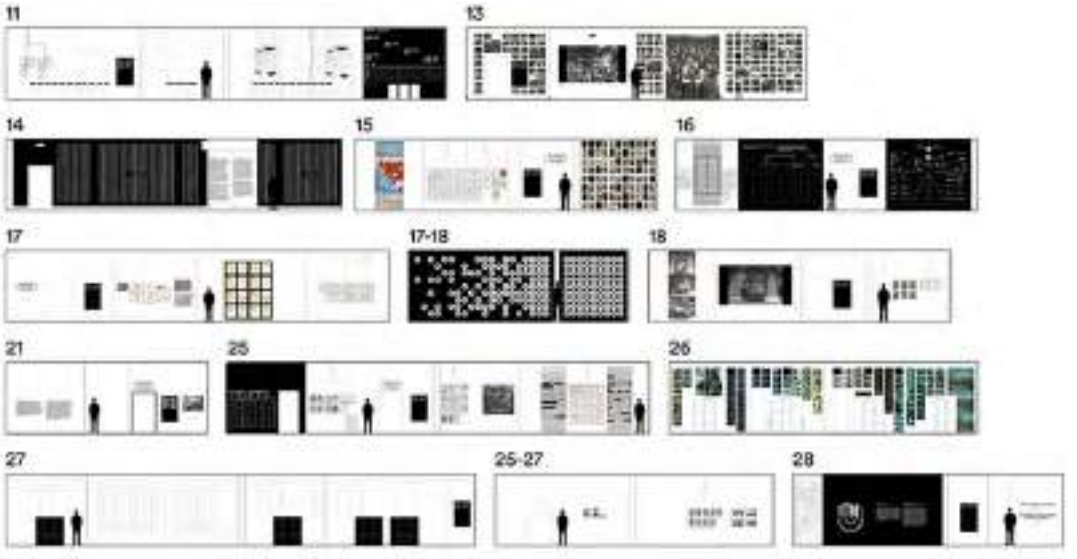

Fig. 14. The interior project of the museum "The House of Leaves", Studio Terragni Architetti

In a country that had used labor of the incarcerated in exchange for importing surveillance devices from 18 different countries, *Studio Terragni Architetti* decided to produce everything on site, relying on the skill of people and the low cost of materials. The total cost for 33 rooms, 800mq. was 540.000 euros.

Before entering the museum, a garden covered in convallaria japonica invites people to explore the sound of the city by handling these pre-war listening devices themselves.

Visitors can gather and collect their thoughts in the backyard, sitting on two long benches, a colorful and pleasant distraction in the backyard. Walking around you soon discover that only from one point of view, marked by a read seat, do the two objects collapse into the single image of a headset, the ultimate iconic symbol of surveillance.

1.5. Submarine Tunnel Porto Palermo

Porto Palermo's military base is located in the Gulf of Panorma, about eighty kilometers from Vlora. Nearby is also a monument of historic and architectural value, the Ali Pashe Tepelena Castle built in the XVIII century. In a spectacular panorama over the Ionian Sea, it was decided to build a naval tunnel and naval military base, worked for more than 15 years by Albanian military forces.

For its realization, mainly the work of soldiers and engineers who performed military service in this military area was used. Between 1955 and 1968, the Soviet Union landed twelve Soviet Whiskey Class submarines in Vlora.

They should serve to have direct control over the Strait of Otranto. The military point south of the Ionian Sea was totally strategic. After Albania withdrew from the Warsaw Pact, Hoxha appropriated all four submarines, controlled by Albanian soldiers, and placed them in Porto Palermo. This country turned into a strong military position for Enver Hoxha.

Fig. 15. Picture from the existing situation of Porto Palermo's military base, Photo by Debora Bilani.

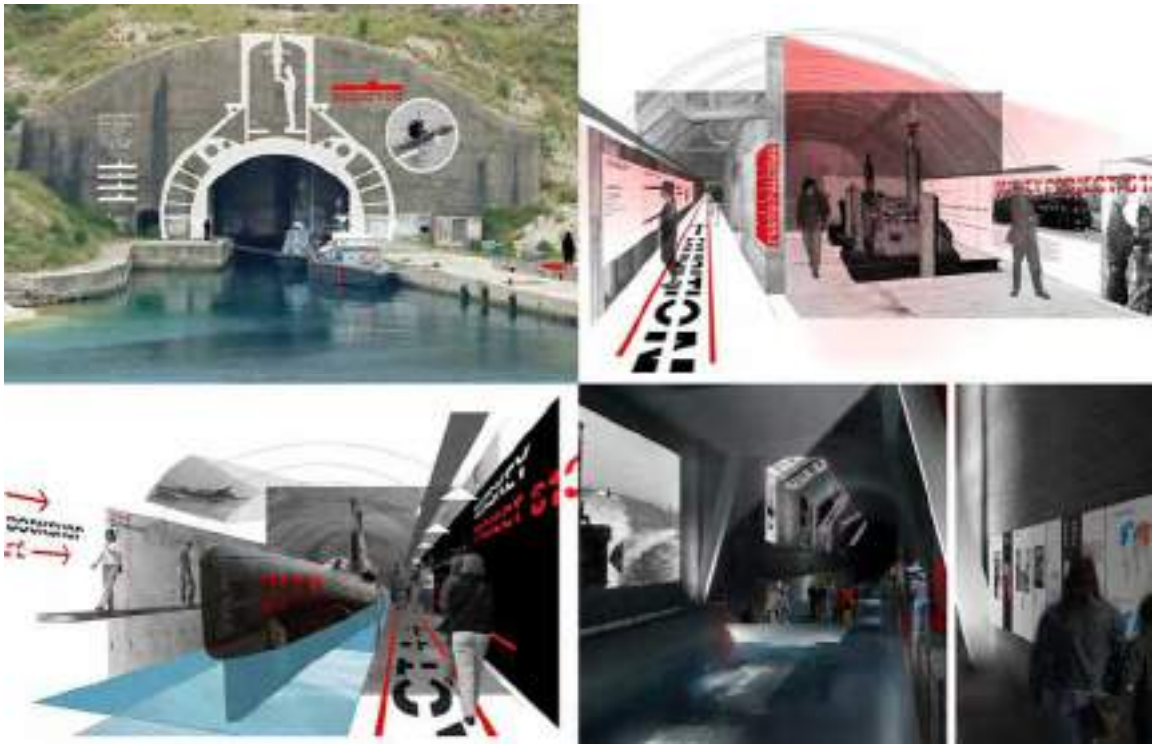

Fig. 16. The interior project of the museum " *The Submarine Tunnel Porto Palermo* ", Studio Terragni Architetti.

The military project's strategic design leaves the bay free and creates a long, straight tunnel on the small peninsula. Thus, began the construction of a 650 meter long, 12 metres high tunnel dedicated to submarines. Four submarines were placed inside it, one after the other. The rock formation was made so that the exterior of the tunnel did not look out of the sea.

The tunnel is a giant engineering feat, which has a host of secondary barracks-type military facilities, as well as a host of small, bunkers spread throughout the territory. Even the military base itself has been abandoned, for a long time, and at the moment we are talking, it consists only of rubble, it is not possible to get into the facility. The Albanian Coast Guard uses it as a base on the coast and also preserved undisturbed rest of the surrounding terrain.

The Submarine Tunnel Porto Palermo, from its opening in 1986 until 1993, served as the base of the Submarine Brigade. The construction of the base started in about 70 years and its construction took almost 17 years. Initially the base was planned to be built as the base for four rocket ships that were planned to be taken from China. The latter never materialized, so the base was adapted for submarines.

From 1993 to 2004, the Palermo base served as a reserve base of the Second Marine District, occasionally under the control of the Commando Regiment.

The museum, at the moment we are talking about, has not yet been realized, but the idea of transforming it is a good base to return to, following the example of the first three. There are several projects of public interest for this. One of the first ideas to turn this military space into a Cold War museum was once again commissioned by architects Elisabetta Terragni and Jeffrey Schnapp.

They had successfully designed and implemented a few years ago, something analogous, in Trento, Italy. It was also about an underground museum. existing galleries in Trento, had been part of the western ring road of the city, but after the construction of two new galleries, they were back in August 2008 in a museum space devoted mainly to the history and memory.

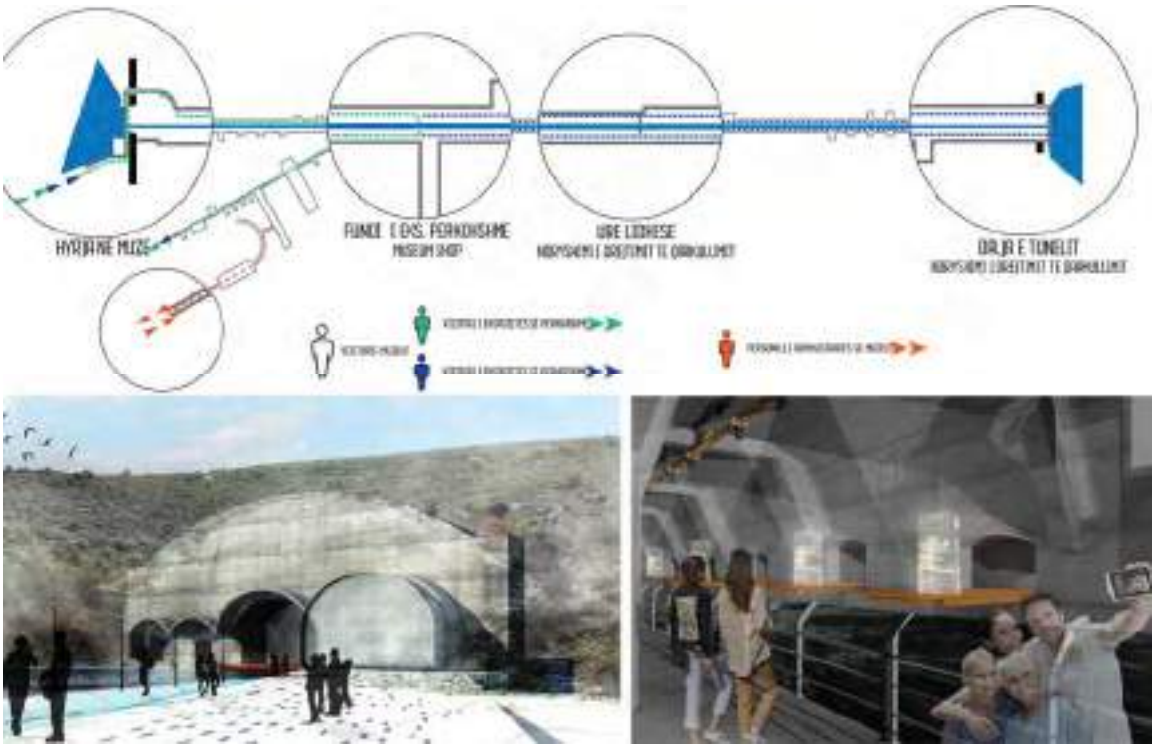

Fig. 17. The interior project of the museum "*Porto Palermo's military base* ", diploma thesis of Debora Bilani

In the project for the Porto Palermo Military Base, the tendency to treat it is the same as seen in the BunkArt project in Tirana. So, making a direct link to the past, by leaving out as many traces as possible, of the history of the tunnel itself. In the meantime, besides the physical space of the concrete tunnel, the project also puts underwear, which also adds to the excitement of the museum. While from the point of view of the presentation of its historical, but also historical pieces, it is played with materials and contemporary elements of museography, or even graphics, to bring to the visitor the atmosphere of time.

The project extends the museum across the 650 metres tunnel. An important part of it, are the graphic elements placed at the museum's entrance, which explain the first infotainment regarding the interior. The project had a resonance in various publications as well. There is also a quote from "Abitare" magazine, which dedicated a study by Anna Foppiano on concrete fences in Albania, and on the Terragni project in Porto Palermo (Foppiano, 2011).

It says: "The submarine base for submarines (a 650-foot-long, 12-foot-high tunnel for 4 Whiskeys, 90 meters each) cutting a strip of land in Porto Palermo, or more specifically in the Bay of Panorma, is definitely an extraordinary place, between water and heaven, to consider, document and transmit Cold War events."

The Porto Palermo Tunnel has been an object of great interest, even for architecture students, at the Polytechnic University of Tirana.

There have been some diploma topics, related to the tunnel, and to the surrounding area, especially one conducted by Debora Bilani, and led by me, where the graduate is dealing not only with the underground tunnel but also with buildings and captains military built in outer space.

They are currently in a degraded state. While studying the basic concept, it was important to come up with a multifunctional system that would give the museum more functionality than just a glimpse of its historical part. Especially taking advantage of the summer tourist area, where tourists who visit the area periodically have the opportunity to return to this museum from time to time.

The part of the degraded military buildings outside, under this project, was subject to restoration and completion for new functions.

Conclusion

Conceptually, we can say that all four museums have many similar elements. The main unifying idea is that, after a quarter of a century, after the fall of communist dictatorship, to realize and feel the intense pressure of time, even though the wounds caused by it are still fresh. What is attempted in the first place is a direct visit to the premises where the most extreme points produced by the totalitarian system, linked to the military, and espionage, were focused. They are thus left, as intact as possible, to perceive, during their visit, at any point, the direct connection of historical memory with its spatial interpolation.

So, this remains the main museumographic element. Second is the tendency to reflect through images, photos, archive materials and various military tools part of the country's history.

The tendency to translate it into an artistic form sometimes attenuates the strong emotion that the pristine environment can convey.

One shortcoming, which can be fulfilled a second time, is finding the premises, to have the opportunity to be completed with temporary exhibitions, or various events, in order to absorb the visitors who have once been inside. Their spaces are very special and attractive to promote other events of historical or artistic character.

The paranoia of the dictator and members of the Political Bureau of the Communist Party in Albania has tried, besides spatial experience of different environments, to bring with it different installations. The trend, especially in BunkArt museums 1 and 2, is the contrast between the invisible pressure of time and the paranoia of power, aligned in many intertwined ways. However, another element to be felt would be more of a concrete connection within the underground tunnels, and thousands of bunkers, where like mushrooms sprout in the landscape of Albania during the totalitarian dictatorship.

References

Foppiano, A., 2011, Albania: riavvolgere la bobina della memoria, in *Abitare*, 13 June, RCS MediaGroup, Milano, Italy.

Gallanti F., Zunino M. G., 201. Concrete Mushrooms, in *Abitare* 11 May, RCS MediaGroup, Milano, Italy.

Hutchings, R. L., 1997. *American Diplomacy and the End of the Cold War*, p. 261, Woodrow Wilson Center Press, USA.

Mema, B., 2010. Albanian quandary: How to use old regime's mountain hideouts, in Times of Malta, 3 November, AFP. 3, Malta.

Raino I., 2017. An Itinerary of the Creative Imagination: Bunk'Art and the Politics of Art and Tourism, in *Remembering Albania's Socialist Past - Cultures of History Forum,* Imre Kertész Kolleg, Germany.

Stefa E., Mydyti G., Muçaj N. A., 2012. Concrete Mushrooms: Bunkers in Albania, in *DPR-Barcelona*, p.74, Barcelona, Spain.

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Three different digitization techniques for works of art: RTI, photogrammetry, and laser scan arm. Advantages and drawbacks in the practical case of a Romanesque lipsanoteca

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Abstract

3D digitization of works of art is a procedure that is being strongly introduced in the field of cultural heritage conservation and artworks analysis due to the enormous potential that it offers. Nowadays, photogrammetry or 3D scanning are the most common techniques used by professionals.
Among the various types of scanning equipment available, measuring arms or laser scan arms offer great precision and detail. Reflectance Transformation Imaging (RTI), on the other hand, is a photographic procedure that facilitates the interpretation of the surface of and object and its irregularities.
In this paper, we present the possible application in cultural heritage conservation of these different techniques from reproduction of works of art to the geometric analysis of alterations or decorations, applied to the historical interpretation of cultural heritage.
Opting for one technique or another will be conditioned by the final objective of our study and the artwork characteristics. The most satisfactory and complete results may require the combination of different digitization methodologies, but laser scan arm may be the best solution for digitization of works of art where capturing the detail matters.

Keywords: photogrammetry, reflectance transformation imaging (RTI), laser scan arm, 3D digitization, cultural heritage

1. Introduction

In 2010, during the archaeological excavation of the Romanesque church of Sant Vicenç de Capdella (Pallars Jussà, Catalonia), findings of great importance were given, such as the Romanesque altar or the original lipsanoteca. Other findings were consequence of these discoveries, such as the medieval graffiti on the altar and a peculiar waxy putty sealing the lipsanoteca with decorative motifs printed on it. With the aim of documenting this artwork, it was decided to apply different digital image processing software and 3D scanning methodologies to compare the results and assess their applicability in the field of archaeology and cultural heritage conservation.

1.1. Archaeological background

The lipsanoteca was inside a contemporary structure, an altar built with slate and lime mortar from the end of the 19th century and repaired in the 20th century with cement. During the dismantling of this altar, in order to continue with the excavation of the presbytery, elements reused were detected from an old altar made of tosca stone from the medieval period, which contained a reconditorium in the base column with the lipsanoteca that kept the relics (Alegria & Castell, 2015, p. 667-674).

The romanesque lipsanoteca of Sant Vicenç de Capdella is a very rustic wooden box with a lid sealed with a mix of wax and chalk (Marín, 2015, p. 9-10) (fig. 1). This sealing was broken in four fragments and with an important loss in the middle. The wax sealing showed a very unusual decoration with a total of thirteen unintelligible round figures. Thanks to Reflectance Transformation Imaging digitization some busts were discovered inside the round marks. After conservation treatment and careful study, it was concluded that the sealing of the lipsanoteca was decorated with the imprinted of a bishop's ring according to the narbonnais ritual of church consecration ceremony (Marín, Castell, Alegría & Sureda, 2017, p. 649). It was a common practice in the middle age (Gros, 1966, p. 224, 392), but it appears to be one of the most ancient, profusely decorated and well preserved lipsanoteca in Catalonia to exemplify this practice.

The figures show a side bust, combed in the classic style, inside an oval profile surrounded by a diagonally grooved fillet (fig. 2). The marks seem to correspond to the action of applying a seal stamp repeatedly on the still fresh paste. In view of the marks, the stamp seems to correspond to an intaglio with the bust carved in negative, probably from roman origin (Graells, 2012, p. 212-215), and embedded in a goldsmith's frame with a grooved fillet. This type of rings, either antique or reworked in medieval times (fig. 3), are common in European collections. There are other testimonies of sigillary traces in *lipsanoteca* such as those of *Sant Pere de Casserres* and *Santa Eugènia de Berga*, which are kept in the *Museu Episcopal de Vic* (Junyent, 1971, p. 145-147).

Fig. 1 and Fig. 2. Sant Vicenç de Capdella's lipsanoteca with the wax sealing after restoration treatment (left) and detail of two of the busts (centre). Silvia Marín. Fig. 3. A frank ring that reuses a Roman intaglio, very similar to the marks studied in the Capdella wax coating. 6th century AD (right). Metropolitan Museum, MET Reference number:17.192.199.

1.2. Research aim

The need to study and interpret the decorations of the wax sealing, conditioned by its fragility, made it essential to find tools that would help in the analysis and safeguarding of the artwork. The traditional method of tracing was completely insufficient and, moreover, endangered its conservation. Therefore, it was necessary to obtain high quality digital documentation to evaluate the decorations while minimizing the handling of the preserved fragments.

3D digitization has been introduced as a fundamental tool at the service of heritage conservation and restoration because of its versatility and usability (Kuzminsky & Gardiner, 2012). 3D technologies facilitate the study and analysis of works of art from another point of view (observing the surface relief, obtaining sections; taking measurements; making exact calculations of volumes and surfaces, etc.), obtaining orthophotographs (very useful as a basis for mapping alterations or calculating measurements) or creating reproductions based on 3D printing (without manipulating the originals), among others. Furthermore, once we have digitized the artworks, the models can be shared on digital platforms or be used for digital restorations and recreations (Barberà, 2018).

It was decided to digitize the entire ensemble for different objectives: first of all, to facilitate the historical study of the artwork without the need to manipulate it; secondly, to have a security repository in case the work of art could be damaged or in order to evaluate degradation during time and, thirdly, to obtain a reproduction of the object intended for exhibition. The objective of our paper is to compare different digitization techniques in a very difficult scenario, such as a very fragile work of art with finest details such as carvings and fingerprints, according to our purposes.

2. Materials, techniques and methods

Among all different methods available for cultural heritage digitization, we test three different techniques: reflectance transformation imaging (RTI), photogrammetry, and laser scan arm. The choice was based on the search for economical methodologies accessible to most researchers. This is the case of photogrammetry and RTI, since they are techniques based on the processing of 2D images that can be taken with affordable digital cameras. On the other hand, the option of laser scan arm provides a high-resolution performance, even if it's a high economic cost tool. This equipment will allow us to achieve the highest 3D scanning quality possible to assess the results obtained in a comparative approach.

2.1. Reflectance Transformation Imaging (RTI)

RTI is a computational digital photographic method created to capture the surface of objects by emphasizing their three-dimensionality. RTI models are generated from a number of digital photographs taken from a camera in a fixed position. In each photograph, the light is projected onto the object from a different known direction, resulting in a succession of static photographs of a single object, with different lighting. The software knows where the light comes from because two reflective spheres must be included in the plane of each photograph. Therefore, the reflection of light on the spheres is the reference that the software needs to determine the angle of light in each image and to generate the final RTI model.

This technique records information about the surface geometry by taking a value for the Normal at each pixel, thus the software sets a result in calculating the angle between the light and the object in a number of photographs (CHI, 2020, p. 1). RTI improves, from mathematical calculations, the visualization of the photographed surface, emphasizing color and relief in an evident way.

Unlike a traditional photograph, the reflection information is derived from the three-dimensional shape of the object, so the RTI image knows how light is reflected from each pixel (Rabinowitz, Schroer, Mudge, 2009, p. 6). In addition, the light intentionally applied to the surface bounces in such a way that the angle of incidence of the light and the angle of the reflected light are angles equal to the Normal. In this way, each pixel is able to reflect the interactive light of the virtual software from any position selected by the user. This fact, gives as final

result a game of lights and shades that reveals the reliefs and irregularities of the photographed surface. In conclusion, it generates an image with very detailed 3D sensation of the object's surface.

The first step of the image capture methodology was to place the object on a white background in a dark room. Secondly, the camera was placed on a tripod in a zenithal position. To achieve a good result, both the camera and the object must be totally immobile during the photographic sequence (Rabinowitz, Schroer, Mudge, 2009, p. 7). The only source of light can be a lamp placed in different raking light positions to obtain light contrasts for the RTI software process. The illumination is moved in each shot: the object must be illuminated from all possible directions and with different angles of incidence, generating photographs that range from a very low light (15º) to a more zenithal light (65º) (fig. 4). Both the lamp and the camera should be at the same distance from the object which should be 2-4 times the distance of the diagonal of the object (CHI, 2020, p. 18). In the frame, the object was accompanied by two black reflecting spheres.

Fig. 4. Three images for RTI process with different angles of light incidence. Silvia Marín.

The spheres are the references that the software takes to know the angles of incidence of light in each photograph. We took tests shots with the light source (a small LED lamp) so that the maximum shadows projected by the spheres were out of the object. Spheres must be in the same plane as the object so that they are in focus while we focus on the object.

Specifically, for this study we used a Nikon D70 camera with a Nikon AF-S Nikkor 18-70 mm 3.5-4.5 lens and a flexible desk LED lamp. We set the camera to manual mode and ISO 100, and took test shots to determine the ideal aperture and shutter speed to achieve the correct exposure in both the lowest angle (lowest illumination) and highest angle (highest illumination). Once the results were optimal, we proceeded to start the RTI shots. The chosen shutter speed was in this case 1/13" with an aperture of *f*/5.6. We started a first shot at about 15º, and keep increasing the angle of incidence of the light until 65º. In this way, we took 4 pictures per axis, tracing 8 axes, with a total of 32 pictures. When the shots are finished, we process the photographs in the RTI Builder Software. The whole process took about two and a half hours.

2.2. Photogrammetry

Photogrammetry is the technique for creating three-dimensional models based on photographic images that with the development of structure from motion (SfM) has revolutionized the 3D world (Micheletti, Chandler & Lane, 2015). SfM, also described as kinetic depth, is the phenomenon by which the vision systems of humans or animals can reconstruct three-dimensional structures from 2D images projected on the retina thanks to the movement of these structures with respect to the observer or of the latter, with respect to these structures (Pereira, 2013b). To be precise, in the case study we have used SfM-based short range digital terrestrial photogrammetry to create a 3D model.

Photogrammetry has been widely introduced in the world of heritage or archaeology a complementary tool for documentation, diagnosis and dissemination. Currently we find a lot of specific literature on this topic (Arcusa [et. al.], 2016; Koutsoudis [et. al.], 2014; De Reu [et. al.], 2013; Remondino, 2011; etc.) and most

institutions and companies have already incorporated it naturally. Its relatively low cost, since it is based on the processing of simple photographs obtained sometimes even with a mobile phone, as well as the advance of increasingly fast and intuitive software has facilitated this fast development.

Considering that photogrammetry is based on the processing of photographs, the quality of these is a determining factor to obtain high resolution 3D models. To experiment the best results, we chose a professional full frame digital camera Canon® 5DS R with a 50,6-megapixel CMOS sensor and the use of a Canon EF 50 mm *f*/1.2L USM lens. Photographs were taken with the automated turntable Orangemonkie Foldio360 to obtain images every a 7,5º rotation step (48 images per circle) of up to a total of 12 circles around the object.

Photographs were taken in studio conditions and RAW mode with the following parameters: ISO100, manual light balance confronted to a gray card, diaphragm aperture *f*/13, exposure time of 1/15" seconds, autofocus mode and IR remote synchronization to the turntable with Foldio360 application (fig. 5). The later digital process for color management of the photographs was confronted to a ColorChekerTM Passport Photo 2 camera profile and correction of lens deformation and color aberration with Adobe® Camera Raw to a final jpg image (Pereira, 2013a). Time required to image capture and preparation was around 5 hours.

Fig. 5. Image during the photo capture process with a semi-automated shooting thanks to the synchronization of the turntable with the camera (left). Fig. 6. Image of the photogrammetric model creation process with the RealityCapture® software (right). Authors.

A total of 586 images were processed with the photogrammetry software RealityCapture® 1.0.3 (fig. 6). Alignment settings were stablished in "ultra" detector sensitivity with a maximum of 40.000 features per image. Reconstruction was settled in high detail mode and an image texture of 8192 x 8192 pixels resolution was obtained. Total processing time until mesh exportation in wavefront format was around 10 hours with a MSI® Stealth 95 G, Intel Core i7-9759H CPU, NVIDIA® GeForce RTX 2080 Max-Q GPU and 32 GB RAM.

2.3. Laser Scan Arm

Laser scan arm is one of the highest resolution 3D scanning equipment currently available. A measurement articulated arm is a type of coordinate measuring machine (CMM), a mechanical system that use measuring transducer technology to convert probe and physical measurements of an object's surface into electrical signals that are then analyzed by specialized software. The main difference is that articulated arms use rotary encoders on multiple rotation axes instead of linear scales to determine the position of the probe (qpluslabs.com).

This scanning equipment is portable and can move around objects thanks to an articulated 7-axis arm, as it pivots at the wrist, elbow, shoulder, and base of the system. The encoders at the system's base triangulate the location of each joint to the probe tip in a 3D space. The inclusion into the system of a laser line scanner allows a high precision three-dimensional surface registration of a diversity of materials, including reflective, glossy or

high contrast surfaces. Unlike fixed CMMs, the articulating arm is manual and dependent on the operator to take measurements, therefore is very sensitive to vibrations or tremor.

Unfortunately, the literature on the use of laser scan arm in heritage compared to other scanning techniques is scarce (Siebke, 2018). In order to find references, we will have to look at the equipment technical data sheets offered by providers, where the high precision of the system is highlighted, which ranges from 25 to 75 microns depending on the model.

For this study we used a FARO® 7-axis Design ScanArm 2.5C with the PRIZM™ full color Laser Line Probe. The scanner features volumetric accuracy up to 75 microns (system accuracy determined by scanning / probing a single sphere from multiple orientations and represented the maximum deviation of sphere position or by comparing measured versus nominal values between two points with the arm volume), with a minimum point spacing of 40 microns, all values represented in maximum permissible error (Faro, 2020).

The scanning was performed with Faro® RevEng™ 2019.4 software (fig. 7). Settings were configured with raw data capture and HDR modes to maximize the frame rate up to 150 frames per second and the scanning speed up to 300.000 points per second. Different orientation scans were captured and mesh generation was processed with the same software in high detail method with a 15 microns deviation tolerance. Total time required for scanning and mesh generation, cleaning and exportation was around 6 hours (fig. 8).

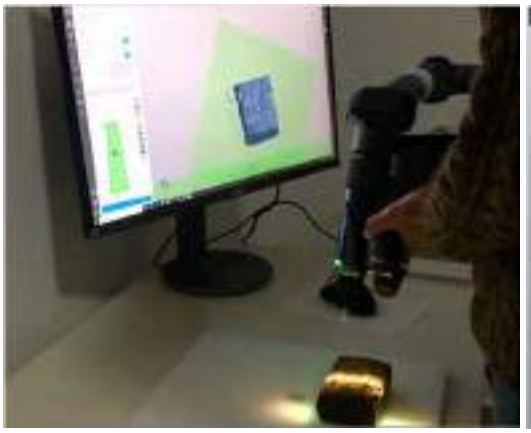

Fig. 7. Image during the 3D scanning process with the laser scan arm. Fig. 8. Image of the software process for data acquisition. Authors.

3. Results

We obtained two different outputs from our three digitization processes. On one hand, an image with normal map information in each pixel that can perform different illumination responses thanks to the software provided by RTI, what will be valuable for improved raking light analysis of the surface. On the other hand, we have two different 3D models to be studied, compared and analyzed (**table 1**).

3.1. Reflectance Transformation Imaging (RTI)

RTI result is visually excellent: all details of the relief can be seen with great precision, including the fingerprints of the person who sealed the *lipsanoteca* almost a thousand years ago. On the male busts, the hair, eyes, ears and lips can be clearly seen in great detail. The irregularities of the wax, the missing areas and the degraded areas are also visible and enhanced (fig. 9-10). RTI Viewer software allows the researchers to zoom in on any point of the image and change light direction incidence to achieve a better view of each area with different raking lights.

In addition, we can obtain both a normal static map (fig. 11-12) and photorealistic or specular color models, which further increases the three-dimensional sensation. Within these last modes, the software also

allows us to graduate the diffuse color, the specularity and the highlight size, obtaining very interesting results. Obviously, like in conventional photography, the resolution of RTI images depends on the resolution of the camera and the lenses used. In this case, a medium-low range camera of only 12 megapixels was used and the result is already very good. The better the camera and the better the pictures are made, the better the final result will be, in the best cases reaching a resolution of 2-8 microns (Payne, 2012) and a density of 4000 x 5000 pixels (Mudge, Schroer, Earl, 2010, p. 128). In this case, we have obtained a density of 4115 x 2894 pixels.

The combination of magnification, rendering, and lighting commands allows the texture of the object to be highlighted and the surfaces to be visualized much more accurately. And that is why the combination of lighting, color and texture produces a visualization very close to the actual perception of the object's three-dimensional properties.

Fig. 9-10. Specular RTI image of the *lipsanoteca* with the wax sealing after restoration treatment (left). Detail of four of the busts (right). All details are observed with great realism and precision, including fingerprints marked on the wax. Silvia Marín.

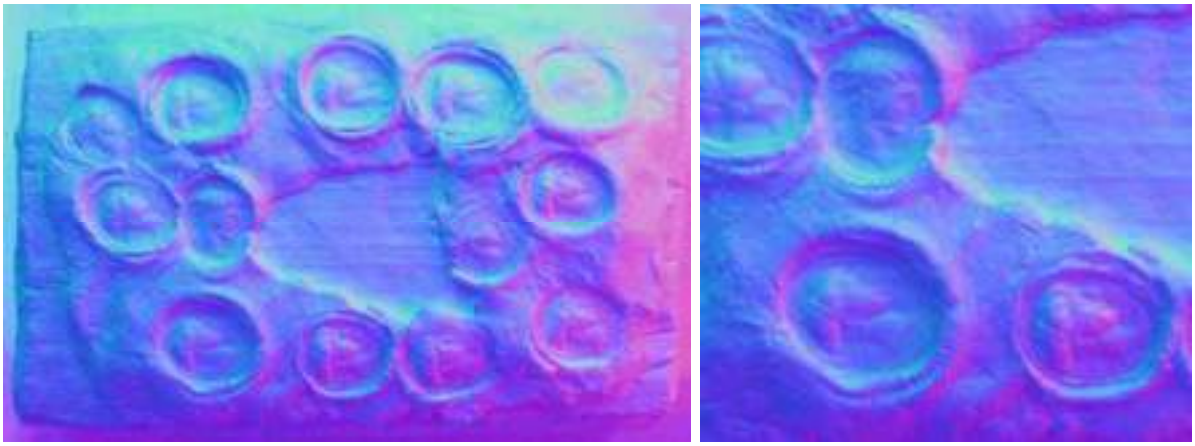

Fig. 11-12. Normal map of the *lipsanoteca* with the wax sealing after restoration treatment obtained with RTI software (left). Detail of four of the busts (right). Silvia Marín.

3.2. Photogrammetry

With photogrammetry we have created a high resolution 3d model optimized to a total of 20 million faces and a photorealistic texture of 8192 pixels. In terms of visual quality, the image obtained is faithful to reality and corresponds perfectly to the digitized object. The perception of photorealism is great, without any deformity,

cut or discontinuity identifiable in the texture. In this sense, photogrammetry has obtained a model with a high level of realism when visualization in texture mode (fig. 13-14).

When we go on to observe the geometry with solid mode we see that the main details have been captured to a great extent: the wood texture and even cracks and growth rings can be perceived in broad strokes. Detail and resolution have been lost, but the larger details can be perceived in general (fig. 15). The problem appears when trying to observe the fine details, such as fingerprints, the oval profile or the faces printed in the wax. In this case the geometric accuracy achieved has not been enough and does not correspond to reality. In fact, we observe a very characteristic noise on most of the surface that creates a fine distorted geometry that hides the details. We could say that approximately decoration below one millimetre have not been captured or are distorted by the noise of the model generated by the software (fig. 16).

Fig. 13 and Fig. 14. Front view in texture mode of the photogrammetric model (left).
Perspective view in texture mode of the same model (right).
The photorealism is good, but the noise of the geometry can also be perceived in some areas, disturbing the final result. Authors.

Fig. 15 and Fig. 16. Front view in solid mode of the photogrammetric model (left). Detail of the surface in solid mode of the same model (right). The distortion of the surface by a soft noise is evident. Although the general shape has been correctly captured, the fine details that could be enhanced with RTI with photogrammetry cannot be visualized. Authors.

3.3. Laser Scan Arm

With laser scan arm we obtained a high-resolution model optimized to 11.53 million faces and a texture based on the color of the point cloud with a resolution of 4096 pixels. In this case the texture offers a realistic color

but with a little blurred or confused definition in some areas of difficult access. The colors and details do not have enough photorealistic contrast or sharpness. Although the initial perception is to have a high-quality model, one can perceive that is a digital creation if studied carefully (fig. 17-18).

On the other hand, in one side of the wooden box we have observed a slight pattern of parallel lines due to the color combination of two juxtaposed scans. This is an operator problem, identified as an error in the capture procedure or during processing of the mesh. It makes evident that color capture is not homogenous on successive scans in the same area and this fact adds an important human factor to the proper capture procedure of the color of the models to be digitized.

From a geometric point of view, on the other hand, the capture of information seems to be almost absolute (fig. 19).

All the details of the artwork can be perfectly observed with a clear and concise reading of the finest decorative motifs on the faces, the fingerprints or even the alteration of the surface (fig. 20).

Only at some point one can see some characteristic noise appeared in the form of parallel lines. Just as with texture, it is an operator error during scanning process due to the high sensitivity of the equipment. Although, the high resolution of the mesh is constant in all the faces of the object and properly scaled in a micrometric dimension.

Fig. 17 and Fig. 18. Front view in texture mode of the scan model (left).
Perspective view in texture mode of the same model (right).
The color perception is correct in general terms, but does not capture the texture with fidelity to reality and can be perceived as digital. Authors.

Fig. 19 and Fig. 20. Front view in solid mode of the scan model (left).
Detail of the surface in solid mode of the same model (right).
The geometry of the artwork has been perfectly captured to the finest detail: fingerprints, wood fibers, degradations, etc. Authors.

		RTI	Photogrammetry	Laser Scan Arm
Resources	***Equipment****	Digital camera Single light	Professional digital camera Lights and portable studio Automated turntable (op.) ColorChecker Passport 2 (op.) Scales	FARO® 7-axis Design ScanArm 2.5C with PRIZM™ full color Laser Line Probe Tripod
	Software	RTIBuilder® 2.0.2 RTIViewer® 1.1	RealityCapture® 1.0.3	Faro® RevEng™ 2019.4
	Equipment costs	Around 300 €	Around 4.500 - 5.000 €	Around 50.000 €
	Software costs	Free	Licenses from 249 € to 15.000 €	Around 2.500 €
Acquisition	***Procedure***	1. Preparation 2. Photography 3. RTIBuilder software	1. Preparation 2. Photography 3. Image process 4. Photogrammetry software	1. Preparation 2. Scanning 3. Mesh generation and cleaning
	Time required	1. 20 minutes 2. 1-2 hours 3. 1 hour	1. 15 minutes 2. 2-3 hours 3. 2-3 hours 4. 10 hours	1. 15 minutes 2. 2-3 hours 3. 4 hours
	Total time	2-3 hours	15-16 hours	6-7 hours
Results	***Output***	2D image with interactive software	3D model	3D model
	Mesh	No mesh	20 million faces (optimized)	11,53 million faces (optimized)
	Image / texture	4115 x 2894 pixels	8192 x 8192 pixels	4096 x 4096 pixels

Table 1. RTI, photogrammetry and laser scan arm resources, equipment and results obtained in the case study

** For all cases results were processed with a laptop MSI® Stealth 95 G, Intel Core i7-9759H CPU, NVIDIA® GeForce RTX 2080 Max-Q GPU and 32 GB RAM with a cost around 3.500 €.*

4. Discussion

In terms of surface analysis to observe in detail the decorations and degradations of the work of art, RTI offers cost and accuracy advantages over both photogrammetry and 3D scanning.

The reflective information of this technique enhanced by software can be captured with a common digital camera. Moreover, it is an easy method to learn (by non-specialists), portable, fast, interactive and free. In addition, it can capture the surface characteristics of all types of materials, including the reflective ones such as gold or silver.

The level of detail and precision is very high in RTI obtaining an average density of 4000 x 5000 pixels image. Experts have stated that detail degree is similar to a stereoscopic microscope (Mudge, Schroer, Earl et al., 2010, p. 128), with a resolution provided from 2 to 8 µm (Payne, 2012) if possible, according to the resolution of the photographs acquired. On the other hand, with the method developed by the CHI association it is possible to capture objects with a range of dimensions from a few millimeters to 2 square meters.

As weak points, for very large objects (more than 2 square meters) RTI is not a useful tool and is also limited to analyze flat surfaces with subtle reliefs, not appropriate for sculptures or three-dimensional objects. It must also be said that the RTI image obtained does not generate a 3D model but a normal map. Therefore, it can only be used to observe the surface of one flat object and no further three-dimensional operations can be performed (calculations, measurements, sections, etc.) so it cannot be printed or worked as it is possible to work with models obtained with photogrammetry and 3D scanner.

Between the two techniques that acquire a three-dimensional model we observe evident geometry differences. The photogrammetric model captures most of the decorations, but does not go into detail on the smaller motifs, such as fingerprints and the features of the faces that decorate the wax. In addition, a noise is formed that hides part of the decoration or even distorts it.

On the other hand, the scaling of the model must be performed manually with scale reference, a fact that adds some imprecision to later measurements.

Confronting photogrammetry with the scan model there is a level of deviation around ± 0,5 mm in some areas (fig. 21), which can involve a total deviation of 1 mm in the worst scenario. This deviation must consider that the scan model can perform at least a 75 microns precision acquisition in terms of maximum permissible error. In this sense, the average performance of photogrammetry is great, but not enough to capture the details of this work of art, which are under the millimetric scale.

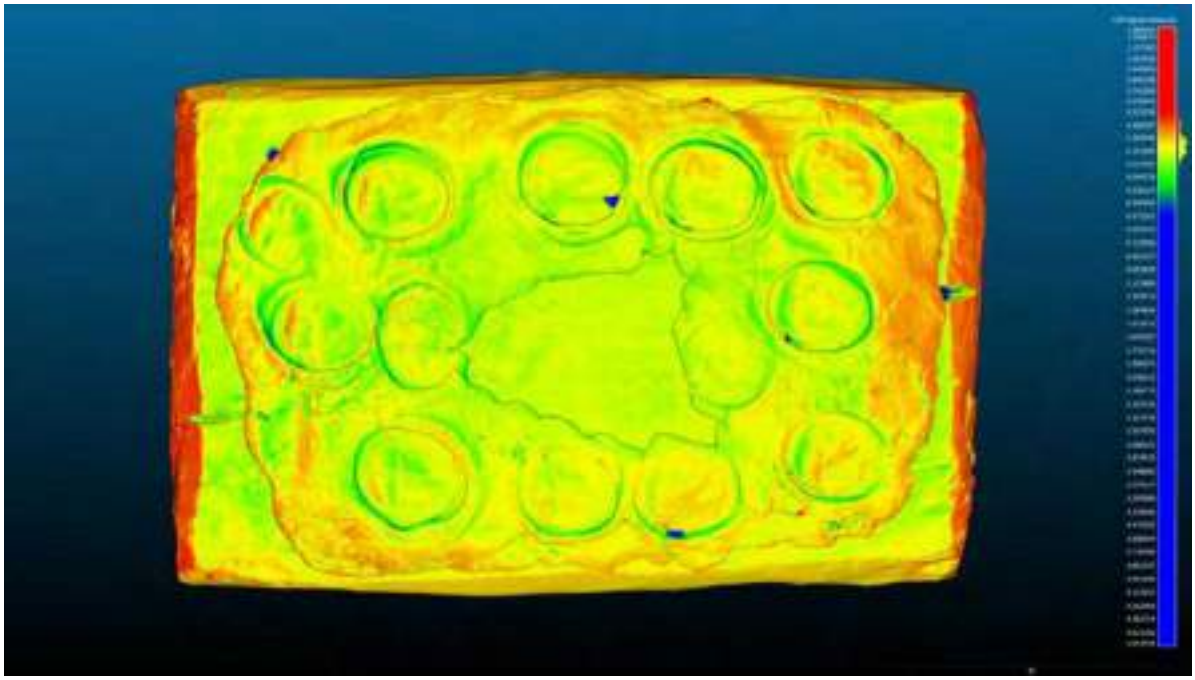

Fig. 21. Confrontation of the photogrammetry model to the scan model in CloudCompare software. There is a subtle deviation between the two models, clearly evident in the details of the decorations. Authors.

Therefore, photogrammetry generates a model that is not either suitable for detailed analysis of the surface of this artwork or 3D printing reproduction. In this case we are interested in capturing submillimeter details that could not be captured with the workflow executed. We could think of alternative methods to improve the results, such as the use of even more powerful photographic equipment, but is really likely that we would not see many improvements but a higher cost. On the other hand, one could consider using macro-magnification lenses and capturing even more images of the surface in greater detail. But it should be remembered that the limited depth of field of these lenses would force us to opt for focus stacking strategies that would involve an even greater amount of image capture and post-processing time.

We can also consider as a handicap the fact that with photogrammetry, until the whole process is finished, we do not see if the image capture strategy generates correct models or there are settings to be improved. This fact gives little room to propose alternatives and strategy changes during the image capture phase. In addition, the model generated by photogrammetry is much heavier although it has lower geometric quality than with RTI or laser scan arm models.

On the other hand, in the view of texture and appearance, photogrammetry allows us to create very realistic visual models with higher image quality. In addition, its cost is highly competitive and accessible for any user or institution. In this sense, is a highly recommended technique for obtaining orthophotographs of the artwork or probably to create models for dissemination to the general public. In the case of requiring a detailed analysis of the relief and decorations, RTI could be a perfect complement.

But probably the most complete technique is the laser scan arm. Geometrically it offers the highest quality and captures all details at almost the same level as RTI. It does not reach the precision and clarity of this other technique, but it can be said that the captured detail is really three-dimensional. The object can be turned over and its entire surface can be recorded, not just a static side of the work. Furthermore, about the color texture, although it does not achieve a photorealistic image, the appearance it presents is more than acceptable for online diffusion and general perception. On the other hand, in terms of the results obtained laser scan arm is faster to process than the other tools, so its potential is indisputable.

The main disadvantage of this technique would be its cost, which is exorbitant for most heritage projects, considering that by combining RTI and photogrammetry, which are much more economical techniques, satisfactory results can be achieved for most scientific objectives. Furthermore, it requires software knowledge and training to obtain the best results. However, this is the only technology that allows a sufficient quality reproduction of the work through a subsequent 3D printing. Or it would be the only tool with which we could analyze in enough detail the eventual degradation over time of this artwork by comparing different scans in a 4D scanning strategy (Bitelli, 2018). Moreover, in this case it is likely that we do not need to complement this digitization equipment with more tools, since the quality of the result is at its highest. Only in terms to achieve a higher photorealistic model, laser scan arm models could be combined with photogrammetry models in order to bake the color texture from them.

	Pros	**Cons**
RTI	- Most affordable solution - Portable equipment - Simple software operation - High visual precision - Photorealistic result - Color representation - Performs even with shiny and translucent surfaces	- Only 2D information (normal map) - Only digitize one view of the object - Limited to relatively flat surfaces with subtle relief - No measurements available - Limitation on object size (maximum of 2 m^2) - Not recommended for transparent surfaces (spray required).
Photogrammetry	- 3D model with photorealistic result - Relatively economic solution - Portable equipment - Simple software operation - Automated image acquisition - No limitation on object size - High precision geometry (1-2 mm limitation) - 3D analysis (measurements, analysis, sections…)	- Results and errors visible when the process is finished - Long process for 3D model creation - Not recommended for glossy, translucent or transparent surfaces (spray required) - Not enough surface detail intended for analysis - Model must be scaled with external references - Not enough detail for 3D printing in this scenario
Laser Scan Arm	- 3D model with surface color - Relatively portable equipment - High precision geometry (micrometric order) - High visual precision - Direct results on screen - Fast process for 3D model creation - Performs even with shiny surfaces - Automatic and precise model scale - 3D analysis (measurements, analysis, sections…) - Can be used for 3D printing	- Very expensive equipment - No photorealistic texture - Knowledge of software usage - Not recommended for translucent or transparent surfaces (spray required). - Recommended for little to medium size objects

Table 2. Results discussion and comparison of each technique

5. Conclusions

When digitizing cultural heritage objects, it is essential to make the equipment right choice to be used according to the objectives to be achieved. Among the different techniques evaluated or available, not all have the same characteristics or are useful in all situations. For this reason, it is essential to have previous experience, to consult the equipment data sheets and to search for specialized comparative studies (Koutsoudis, 2014; Daneshmand, 2018; Remondino, 2011).

According to our experience, photogrammetry is an economic and very versatile 3D digitization technique optimal for the virtual presentation of cultural heritage and dissemination. The photorealistic quality of the models allows its use for general public dissemination and even scientific study of the artifacts, but limited to some detail degree in this case. Reflectance Transformation Imaging (RTI) does not offer 3D models but can be a very interesting tool for the study of the surface that provides more visual detail quality for this type of analysis. A combination of photogrammetry and RTI can offer an interesting package for most researching objectives with a very reasonable cost.

We have found that despite being an expensive equipment, 3D scanning with laser scan arm is the technique that offers more precision on a micro-metric scale. The scans obtained with this equipment perfectly capture all the decorations and degradations in the objects surfaces in a three-dimensional coloured model. Therefore, it can be a useful digitization method for most of the purposes related to cultural heritage: documentation and study in high resolution of the works of art; 3D analysis of the objects; dissemination; monitoring of the state of conservation in long term and 3D non-contact reproduction of the finest details.

Table 3. RTI, photogrammetry and laser scan arm performance according to the final purpose

	RTI	**Photogrammetry**	**Laser Scan Arm**
Surface study	Best choice	Possible with limitations	Best choice
Dissemination	With video or software support	Best photorealistic aspect	Best geometric accuracy
3D studies (sections, etc.)	Not available	Possible with limitations	Best choice
Orthophotographs	Not available	Best choice	Not photorealistic aspect
Measurements	Not available	Possible with limitations	Best choice
3D printing	Not available	Not enough resolution	Best choice
Evaluation of degradation during time (4D digitization)	Limited to image evaluation and comparation	Limited to image evaluation and comparation	Best choice

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References

Alegría, W., Castell P., 2015. L'evolució d'una església romànica del segle XII al Pirineu: Sant Vicenç de Capdella, in *Proceedins of the V Congrés d'Arqueologia Medieval i Moderna de Catalunya*, p. 667-674, Barcelona, Spain.

Arcusa, H., Rojo, M., Royo, J. I., Tejedor, C., García, I., Garrido, R., 2016. La fotogrametría como alternativa al registro de materiales arqueológicos: su aplicación en la Cueva de Els Trocs y Valmayor XI, in *Proceedings of the I Congreso de Arqueología y patrimonio aragonés*, p. 533-539, Colegio Oficial de Doctores y Licenciados en Filosofía y Letras y en Ciencias de Aragón, Spain.

Barberà, A., 2018. Fotogrametria per a la conservació-restauració de béns culturals, in *Unicum*, Núm. 17, p. 57-76, Barcelona: Escola Superior de Conservació i Restauració de Béns Culturals de Catalunya, RACO, Spain.

Bitelli, G., Alena, V., Sammarini, G., 2018, 4-dimensional recording and visualization of urban archeological excavations, in *Applied Geomatics* 10, p. 415–426, Springer, Switzerland.

Chi, Cultural Heritage Imaging, 2010, in *Reflectance Transformation Imaging: Guide to Highlight Image Capture*, Online, http://CulturalHeritageImaging.org/downloads/ (accessed 9th February 2020).

Daneshmand, M., Helmi, A., Avots, E., Noroozi, F., Alisinanoglu, F., Sait Arslan, H., Gorbova, J., Haamer, R. E., Ozcinar, C., Anbarjafari, G., 2018. *3D scanning: a comprehensive survey*, online https://arxiv.org/abs/1801.08863, (accessed: 3rd March 2020).

De Reu, J., Plets, G., Verhoeven, G., De Smedt, P., Bats, M., Cherretté, B., De Maeyer, W., Deconynck, J., Herremans, D., Laloo, P., Van Meirvenne, M., De Clercq, W., 2013, Towards a three-dimensional cost-effective registration of the archaeological heritage, in *Journal of archaeological science*, vol. 40, 2, p. 1108-1121, Elsevier, Netherlands.

Cam/2, Faro, 2020. *Faro 8-Axis Design ScanArm 2.5C Technical Data Sheet,* Germany.

Graells, R., 2011-2012. Dactylothecae Cataloniae. La col·lecció glíptica del Museu Episcopal de Vic, in *Quaderns del Museu Episcopal de Vic*, V, p. 212-215, Museu Episcopal de Vic, Spain.

Gro,s M. S., 1966. El ordo romano-hispánico de Narbona para la consagración de Iglesias, in *Hispania Sacra*, 19, p.224 and p.392, Editorial CSIC, Spain.

Junyent, E., 2001. El sello inédito del conde Bernat Tallaferro, in *Destino*, 1772, 1971, p. 19, republished in: Junyent, E. 2001. *Estudis d'història i art*, R. Ordeig (Ed.), Vic, pp.145-147, Patronat D'estudis Osonencs, Spain.

Koutsoudis, A., Vidmar, B., Ioannakis, G., Arnaoutoglou, F., Pavlidis, G., Chamzas, C., 2014. Multi-image 3D reconstruction data evaluation, in *Journal of cultural heritage*, 15, p. 73–79, Elsevier, Netherlands.

Kuzminsky, S. C., Gardiner, M. S., 2012. Three-dimensional laser scanning: potential uses for museum conservation and scientific research, in *Journal of Archaeological Science*, 39, 8, pp.2744-2751, Elsevier, Netherlands.

Marín, S., 2015. *FTIR Capdella's wax sealing technical report: cobriment segellador de la lipsanoteca romànica de Sant Vicenç de Capdella*, CCiT UB FTIR Lab. Universitat de Barcelona, Spain.

Marín, S., Castell P., Alegría, W., Sureda, M., 2017. L'RTI (Reflectance Transformation Imaging) com a eina clau per a l'estudi del registre material. Exemples d'anàlisi sobre el segellament de cera de la lipsanoteca de Sant Vicenç de Capdella i els grafits de l'altar major romànic, in *Proceedings of the III Congrés Internacional d'Història dels Pirineus*, p. 637-651, La Seu d'Urgell, Andorra.

Micheletti, N., Chandler, J. H., Lane, S. N., 2015. Structure from Motion (SfM) Photogrammetry. British Society for Geomorphology. Geomorphological techniques. Cap. 2, sec. 2.2.

Mudge, M., Schroer, C., Earl, G., Martinez, K., Pagi, H., Toler-Franklin, C., Rusinkiewicz, S., Palma, G., Wachowiak, M., Ashley, M., Matthews, N., Noble, T., Dellepiane, M., 2010. Principles and Practices of Robust, Photography-based Digital Imaging Techniques for Museums, in *Proceedings of VAST 2010, The 11th International Symposium on Virtual Reality, Archaeology and Cultural Heritage*, Paris, 21-24 September 2010, Eurographics Association.

Payne, E. M., 2012. Imaging Techniques in Conservation, in *Journal of Conservation & Museum Studies*, Vol. 10, n. 2, pp.17-29, Institute of Archaeology, UCL, London, UK.

Pereira, J., 2013a. *Gestión del color en proyectos de digitalización*. Barcelona, Marcombo, Spain.

Pereira, J., 2013b. Modelado 3D en patrimonio cultural por técnicas de structure from motion, in *PH Investigación*, 1, pp.77-87, Instituto Andaluz de Patrimonio Histórico, Spain.

Rabinowitz, A., Schroer, C., Mudge, M., 2009. Grass-roots Imaging: A Case-study in Sustainable Heritage Documentation at Chersonesos, Ukraine, in *Proceeding of Making History Interactive. CAA*. Williamsburg, 22-26 March 2009, British Archaeological Reports, UK.

Remondino, F., 2011. Heritage recording and 3D modeling with photogrammetry and 3D scanning, in *Remote Sensing*, 3, pp.1104-1138, MDPI, Basel, Switzerland.

Siebke, I., Campana, L., Ramstein, M., Furtwängler, A., Hafner, A., Lösch, S., 2018. The application of different 3D-scan-systems and photogrammetry at an excavation, a Neolithic dolmen from Switzerland, in *Digital applications in archaeology and cultural heritage* 10, pp.1-11, Elsevier, Germany.

Web references

https://www.qpluslabs.com/blog/how-does-it-measure-up-cmms-vs-articulating-arms, How Does It Measure Up: CMMs vs. Articulating Arm (accessed March 2020).

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Teaching Tools and Methods for Doing History. The History of Architecture in the Digital Era

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Abstract

This paper falls within the scope of the Digital Heritage theme and concerns methods for teaching the history of the city and of architecture in the digital era. Its aim is to highlight the potential of the new technologies for research, for increasing the dissemination of research results and for the training of young students.

The history of architecture is one of the main teaching elements in the syllabus of young architecture undergraduates and graduates at all levels. Teaching the history of the city and of architecture provides a foundation of knowledge of what was done, a heritage from the past, and affords answers to when, where and by whom something was built, through a critical interpretation of events. Understanding the underlying dynamics of architecture is important for architecture students, and helps them decide how to approach a project, becoming a useful tool for knowing where exactly one is going to intervene and how to approach the various layerings and transformations that have occurred over time.

The reconstruction of the past using historic sources is a serious matter, even difficult at times, certainly long and laborious, and one that is not usually attempted outside of a dissertation. However, students should be offered the opportunity to familiarise themselves with research methods during their training, and be guided towards the discovery of archives, so that they will be equipped to tackle autonomously any research that they might need in their future profession.

Keywords: Digital Heritage; History of Architecture; New Technologies.

1. Introduction

The History of Architecture, and more particularly of its teaching, is prone to cyclical crises. Recent evidence of this we find in the debates provoked by the seminar "L'insegnamento della storia dell'architettura" (Teaching the History of Architecture) held in Rome in 1993 (Simonicini, 1995). The range of discussion is ample. Bruno Zevi states "after teaching the subject from 30 years, from 1948 to 1979, I decided to learn it instead, and therefore left the University, which I thought a place of self-cretinisation" (Zevi, 1995). Luciano Patetta asks, "Why is it that historians of architecture are the only ones needing continually to convince themselves and others of their right to exist?" (Patetta, 1995). More recent confirmation can be seen in the results of a "Osservatorio sulla didattica e sulla ricerca" (Teaching and Research Audit) conducted by Cettina Lenza and her team (Rocco, 2018), presented in March 2019 to Rome's *Casa dei Crescenzi*, on the Academic Fields and Disciplines sector (ICAR/18) and its role in the Italian education system at university level. No less pertinent, in the international sphere, is "Teaching the History of Architecture: A Global Inquiry", a study co-ordinated by Zeynep Çelik of Columbia University (Çelik, 2002, 2003) and published in the "Journal of the Society of Architectural Historians".

The issue before us is 'Why and how to teach the History of Architecture?" – what should be the scope of such teaching for future architects, for example? A discussion that has its roots in the perception that something is changing, and that the change threatens to undermine the autonomy of the discipline and its role within a general "Riforma dei saperi" (Reform of Knowledge Transmission). What is not in dispute is that the History of Architecture should continue to play a fundamental role in the education of young students.

To keep things simple, one can say that while the teaching of History of Architecture should follow ministerial guidelines in the relevant degree courses, methods and contents are largely left to the discretion of individual teachers. Little, in fact, has changed even in the last couple of decades, those often defined as the 'Digital Era'. Although it is clear that the new technologies have a contribution to make to History teaching, that research can be conditioned by Big Data, that Public History may have a role to play, historians by and large continue to put their trust in tried and tested historical research methods, and in the autonomy of the discipline. What the Digital Era can profitably contribute, thanks to the deployment of new technological tools, is a new, more up-to-date critical evaluation of past events, the possibility of improving the communication and dissemination of research results, and of using those results in teaching. The potential offered by our new tools can amplify the answers to historians' questions, but above all can ensure a wider understanding and reception of those answers. Contemporary languages of communication and dissemination tools can be the drivers for making available a knowledge of the past to an ever wider public. There are many instances of ventures in this direction. Increasingly frequent, for example, are exhibitions on themes having to do with the history of architecture or of individual cities that make use of digital devices and content.

Alongside original prints and drawings, in their protective atmospherically-controlled showcases, we find displays telling the story of techniques of representation and translating into a more readily understandable language the information contained in those originals. Or there may be touch screen monitors which can zoom in on details of the artworks displayed in a show, immersive multimedia projections that bring to life the textures of the past, video mapping of 3D physical models that can pull together themes linked to a space over different historical moments, effectively replacing traditional explanatory panels with their reams of text.

If all these were put to use by architectural historians, validated by their expertise and philological research, we could facilitate a much broader knowledge of the past, also available online, with the guarantee that the content was based on research conducted in scholarly fashion among the sources.

2. Digital Architectural History

2.1. A new history

In the digital era computerization and the internet have brought about a technological revolution in the humanities. The 'personal computer', now a couple of decades on from its appearance on the market at affordable prices, has become an obligatory tool for every researcher. From writing electronically to

processing data from archival sources, the architectural historian has had to adapt, moving towards more or less established working practice. Going into the archives and copying documentary texts using an appropriate writing programme is as much the new normal as the fact that the most ancient of study halls have needed to install power outlets for recharging the laptops that all researchers carry with them. But here we are still only talking of the limited use of computers as no more than glorified typewriters.

In this brave new world, the historian cannot afford to ignore the potential of consulting online the websites of archives that have made much of their patrimony available. It is now easy to find out, at a distance and in advance, the holdings of any archive, their history and scope. One can reconnoitre an archive's contents before physically entering the building, perform searches using key words on dedicated websites, often finding all but immediate answers to one's questions. Other possibilities offered by the web are digital libraries that house and place at our disposal electronic texts scanned from the originals. But the use of a computer, of the internet and of digital materials is not the whole of 'digital history'. Perhaps thus far the more appropriate term would be 'history with digital' (Noiret, 2015).

Doing digital history means learning a new trade, understood as something more than just updating old practices. It means adopting new tools and using them to formulate a more modern research method with potentially stronger results. This will involve accepting a change of approach to problems, perhaps even a change of mentality. It will require a working knowledge of information technology and software, and a clear idea of the questions to be answered. Last but not least, it will mean being able to work together with experts who can provide the necessary specialist IT support. In recent years, in relation to the possibilities offered by the new technologies, and to engage with new questions thrown up by ongoing historical studies, particularly in the field of urban history, new methodologies have been experimented with, using software designed for other uses (Ferrighi, 2015). The challenge is always to identify the appropriate technologies, and, once found, to master them. But what might the new tools for the architectural historian be? Certainly, those for the organisation and management of data from historical sources, such as applications for the creation of data bases. As well as alphanumerical data banks, geographical ones can be used, allowing us to localize quali-quantitative data, and visualize their collocation in an urban or territorial context. Thanks to the geographical datum, we can make further historical evaluations on the basis of the contents of documents. Furthermore, the possibility of georeferencing historical cartography on virtually any scale of representation that is topographically commensurable with the situation today enables us to make reliable comparative evaluations among transformations and persistence in time and space, in relation to the stratifications of history. Reconstructing 3D models from a careful reading of the contents of historical documents, such as maps or the plans and elevations for projects, allows us to better understand proposed solutions and to verify their technical practicability – and thus to comprehend the planning choices of the architects of the past.

2.2. Digital History in the classroom

The students that have frequented the universities these last ten years and more have been, generationally, 'digital natives': they have grown up familiar with electronic devices of every kind, and internet connection more or less everywhere. But this has not made them experts in the digital world. Indeed, they are often classified as 'digital naifs' for their incapacity to distinguish between news sources online and an inability to search intelligently for the information they hope to acquire.

Among the tools of the trade rarely to be found on their desks, even in degree courses supposedly teaching the profession of architecture, are the traditional instruments – drawing pad, pencils, rulers, adjustable triangle – all now replaced by a laptop computer on which they 'work' daily towards their degree exams. The computer has become their sole instrument for research, drawing and design. That ought not to be a problem in itself, but it can easily become one, because in their use of the tool and their internet navigation, they are rarely guided, and, precisely because they are 'digital natives', it is taken for granted that they know how to do everything. For example, they will typically conduct a simple bibliographic search online by putting a couple of keywords into Google or Internet Explorer, but hardly ever go to dedicated library sites because they are unaware of their existence – and it is the same story for archival information, documents or historical maps.

They put what they are looking for into a search engine, and if nothing emerges, then nothing exists! As if the internet were today the only available archive. And how can one not sympathise, if they live continually connected, and the web is their world? More generally, alas, they also look for ready-made answers that they can import wholesale into their essays without critical scrutiny.

In the architectural faculties it is assumed that the study of history is a fundamental part of the students' educational journey. They should therefore be taught about the architectures of the past, the forms and techniques of construction, the stories of the architects and their patrons, as well as how to read the artefact-as-text. But how could students be helped to study in an innovative way, through individual research, the history of architecture or the city? To approach the past in such a way as it can help them understand the places and themes of their research projects?

Fig. 1. Pages from a presentation on *Forte Manin* by the students Arianna Dalla Cia, Marco Tosato, Marco Viel (group 25), *Digital History course. Visualising the city*, 2016-17 academic year, Prof. Alessandra Ferrighi. Forte Manin is one of the Napoleonic era military forts on the edge of the mainland linked to the defence of Venice.

In order not to limit the History of Architecture to the study of facts and ideas to be memorized while plodding through the usual sequence of historical periods, we can try introducing the students directly to the sources and guiding interpretations in a specific research exercise. Once a research theme is chosen, they can be accompanied through an initial bibliographical sweep to see who has previously dealt with the subject and when, helping them to compile bibliographic 'cards' (if only to teach them that a book has an author, a title and a year of publication – unfamiliar details to Digital Era students). They can then be nudged into tracing the published archival sources, indicated by the just identified earlier scholars in the field, running through the archive research to learn the nature of historical archives and compiling records for the primary textual or iconographic sources (Fig.1). They will learn in this way how to construct a basic source data base, essential at any level of bibliographical research, and learn to draft a bibliography, organize data in chronological order, like the bibliographic sources, phases of construction or later alterations to a building.

Having rounded up the accessible sources and outlined the historical background, the students can begin to work on the historical cartography, interpreting it with a view to understanding the phases of construction and reconstruction, starting with what today remains of the site and working backwards in time. Using GIS software, either the university's own, under license, or open source, they can explore the areas to be studied

through digital cartography. After the cartographic material is assimilated, like the historical maps previously organized in the data bank, they can redraw plans of the key moments in the history of the building georeferencing the cartography, creating as many layers as there had been main phases and observing what has changed over time. With the aid of this redrawing process, they students will have recomposed the most interesting historical phases and acquired a greater awareness of the processes that contribute to the continual layering of places and architectures of the past (Fig. 2).

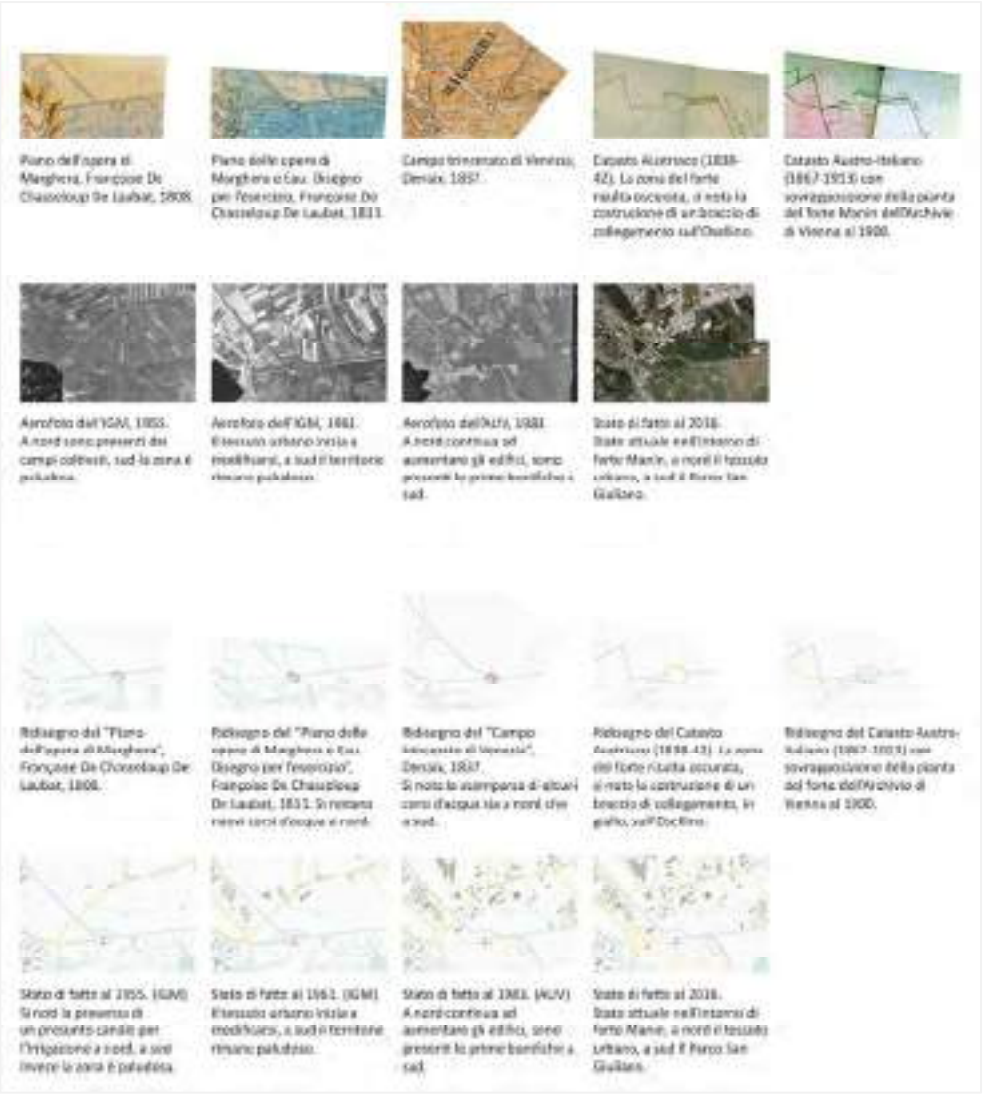

Fig. 2. Pages from a presentation on *Forte Manin* by the students Arianna Dalla Cia, Marco Tosato, Marco Viel (group 25), *Digital History course. Visualising the city*, 2016-17 academic year, Prof. Alessandra Ferrighi.

Once the redrawing of the historical phases, together with the measurements of the buildings, are to hand, these can be physically reconstructed with 3D modeling. Here too it is a question of exploiting software already available to the students – it is normally used in planning – redirected to historical study. In this case it is a matter of 'translating' what can be gleaned from iconographic sources and interpretively rebuilding. With the help of digital drawing, it is possible to trial more than one hypothesis on the basis of different readings of the data. Students will be able, through this exercise, to navigate through the currents of historical events and

create new digital products on their own. Reconstructive drawings of historical phases, and the videos that can be mounted on the basis of them, with a minimum of clear captioning, can serve as testimony to what they have learned from their research and analysis, and make the results available to others.

2.3. Digital history for projects

If we think of the great architects of the Renaissance and the mass of their drawings of the architecture of the past, and particularly of the remains of ancient Rome, we cannot fail to note that their study of the antique was generally with a view to learning the language and techniques of that architecture. Mapping and drawing old buildings was a preparation for their own projects. For Renaissance architects, ancient architecture was a practical manual for construction and the only route to go down for the design and execution of new works.

In today's architecture schools the study of history is, as we have seen, still considered essential for understanding our heritage, for understanding specifically, say, the evolution of the language and techniques of construction. For the students, however, this can mean in practice relying on the history lectures and study subjects proposed by their teachers. First-person historical research, conversely, without aiming to make all future architects historians, helps them to understand the contextual collocation of projects, an essential prerequisite to designing and introducing new elements, whether on the city, infrastructure or single building level, whether converting, preserving or constructing *ex novo*. Our experience with a number of degree course laboratories at Venice's Iuav University has been that undergraduates who have applied procedures using some of the above-described digital tools to their theses have designed more 'context aware' projects – projects that take account of history and its processes, of space-specific issues, of the importance of working with the stratifications and still visible traces of the past: a sensitivity to place that is increasingly demanded by our fragile urban and rural environments.

Fig. 3. Interactive kiosks of the three study cases, mounted in the wall chambers. Graphic processing by Pallino&co, 2018.

There is also another issue connected with history and design. Decisions that come under the procedures for managing and preserving our cultural heritage can no longer ignore what needs to be shared by administration and citizens. It is increasingly important that our patrimony is known about and enjoyed, that everyone

appreciates the value of their heritage and the need to invest in safeguarding it. It is essential to get this message across, in a straightforward contemporary language that reaches the widest possible public. It is a question of using history in new ways: its contribution should be linked to a new awareness of belonging, of identity, in relation to the places to be protected and cherished. The research project entitled "PAMU Parco Multimediale delle Mura di Padova. Valorizzazione di paesaggi e percorsi culturali in un'ottica creativa e innovativa" (Padua Town Walls Multimedia Park – Enhancement of cultural landscape and itineraries in a creative and innovative), winner of an open funding competition in June 2017, was one which took the path suggested above (Ferrighi, 2018, 2019). Here again, the application of the research method outlined previously resulted in a content that lacked nothing in academic rigour, being produced according to strict philological criteria. The aim of the project was to make the history of Padua's imposing Renaissance fortified walls better known, deploying innovative techniques, creating a virtual, immaterial museum with multimedia tools, such as video production and the creation of an iOS augmented reality application (De Feo et al., 2018). Narration was spread across a series of videos lasting from 3 to 7 minutes, viewable in chambers within the walls (Fig. 3).

The idea was to bring the public, in this manner, closer to the history of the walls – in the context of a wider vision of the urban history of cities – and to the detail of the events they enclosed, using a simple, immediate, and easily assimilable language. The public was invited to listen and to watch in moving images very brief accounts in videos projected onto the walls of these inner spaces, hopefully stimulating further exploration. Those who added a small piece to the mosaic of their knowledge of their city did so enthusiastically, and began to look with new eyes at what else like their Renaissance walls might be surrounding them.

3. Conclusion

The Digital Age, and the availability of data on the internet, has raised new questions and reflections on the past, to the point of giving rise to a series of round tables and publications – on Public History for example (Cauvin, 2016) – while alerting historians to the questionable reliability of online data, given a pervasive lack of verification. Historians of architecture, however, are still at the early stages of a possible revision of teaching and research methods making use of the new technologies. The deployment, for example of certain IT tools would permit the creation of imaging as described above. Images have the advantage of being free of linguistic barriers, and in that respect are more powerful than words in communicating their content. They are a way of involving more people in understanding historical phenomena and getting a hold on the facts and processes of the past.

Digital tools call for an effort on the historian's part, an openness to using new instruments and borrowing them from other disciplines that have used them extensively for decades. Such growth, in technological terms, cannot but transform historians into new kinds of experts, not only in past 'things' but in 'Digital History' itself, thanks to the new tools that from time to time they will find productive in their fields. This, as already mentioned, will also mean a certain convergence with other disciplines, constant exchanges with experts from other sectors with different approaches and mentalities; it will mean escaping from predetermined schemata and widening our horizons.

Outcomes, certainly already fruitful for those who are already making use of the new technologies, have to do with the streamlined resolution of issues relating to the organisation of one's work, with entirely new results that may be obtained, and with the possibility of obtaining new products for the communication of one's results. In short, an added value to research that will enable even non-experts to confront new and different questions.

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References

Antinucci, F., 2011. *Parola e immagine. Storia di due tecnologie*, Editori Laterza, Roma-Bari, Italy.

Bloch, M., 1998. *Apologia della storia o Mestiere dello storico*, Einaudi, Torino, Italy.

Bodenhmer, D.J., Corrigan, J., Harris, T.V. (Eds.), 2010.*The spatial Humanities. GIS and the future of Humanities Scholarship*, Indiana University Press, Bloomington, USA.

Bruschi, A., 2009. *Introduzione alla storia dell'architettura. Considerazioni sul metodo e sulla storia degli studi*, Mondadori, Milano, Italy.

Burke, P., 1992. *Una rivoluzione storiografia. La scuola delle «Annales» 1929-1989*, Laterza, Bari, Italy.

Casciato, M., 2003. The Italian Mosaic. The Architect as Historian, in *Journal of the Society of Architectural Historians*, 62(1), pp. 92-101, University of California Press, USA.

Cauvin, T., 2016. *Public History. A Textbook of Practice*, Routledge, New York and London, UK.

Çelik, Z., 2002. Introduction, in *Journal of the Society of Architectural Historians*, 61(3), pp. 333-334, University of California Press, USA.

Çelik, Z. (2003). Editor's Concluding Notes, in *Journal of the Society of Architectural Historians*, 62(1), pp.121-124, University of California Press, USA.

Clark, T., Woodley, R., De Halas, D., 1962. Gas-Graphite Systems, in *Nuclear Graphite*, Nightingale, R. (Ed.), p. 387, Academic Press, New York, USA.

De Feo, E., Venier E.A., Russo, A., Breschigliaro, M., Pretto, N., 2018. PAMU. A Multimedia Park to Enhance the Renaissance Walls of Padua, in *DisegnareCon*, 11, pp. 7.1-7.19, Univaq Università degli studi dell'Aquila, L'Aquila, Italy.

Ferrighi, A., 2015. Cities over Space and Time: Historical GIS for Urban History, in Brusaporci, S. (ed.), *Handbook of Research on Emerging Digital Tools for Architectural Surveying, Modeling, and Representation*, pp. 425-445, IGI Global, Hershey PA, USA.

Ferrighi, A., 2016, VISU. Il sistema informativo integrato sulle trasformazioni urbane di Venezia, in *GEOMedia*, 3, pp.44-49, Mediageo, Roma, Italy.

Ferrighi, A., 2016. *Dopo il Ghetto, in Venezia, gli Ebrei e l'Europa 1516-2016*, p. 401, Marsilio, Venezia, Italy.

Ferrighi, A., 2017. 1797-1848: "tempi infelicissimi" per la Chiesa veneziana. Trasformazioni urbane e nuove geografie, in Bartalozzi, C. (ed.), Patrimonio architettonico religioso. Nuove funzioni e processi di trasformazione, pp. 55-65. Gangemi, Roma, Italy.

Ferrighi, A., 2017. VISU: il sistema informativo per lo studio delle città, in Plosnić Škarić, A. (ed.), *Mapping urban changes*, pp. 544-557, Institute of Art History, Zagabria, Poland.

Ferrighi, A., 2018. Il parco multimediale delle mura di Padova: valorizzazione di paesaggi e percorsi culturali in un'ottica creativa e innovativa, in Marotta, A., Spallone, R. (eds.), *Defensive Architecture of the Mediterranean, vol. IX*, pp. 1223-1228, Politecnico di Torino, Torino, Italy.

Ferrighi, A., 2019. Un progetto per la valorizzazione di paesaggi e percorsi culturali: il parco multimediale delle mura di Padova, in Peron, I. (ed.), *Dipartimento di Architettura Costruzione Conservazione*, pp. 224-231, Ricerche 2012-2016, Mimesis, Milano, Italy.

Giordano A., Bruzelius C., Lanzoni K., (eds.) 2018. *Visualizing Venice: Mapping and Modeling Time and Change in a City*, Routledge, London, UK.

International Federation for Public History, https://ifph.hypotheses.org/ (accessed May 2020).

Knowles, A.K., 2008. *Placing History. How Maps, Spatial Data, and GIS Are Changing Historical Scholarship*, Esri Press, Redlands, CA, USA.

Minuti, R., 2015. *Il web e gli studi storici. Guida critica all'uso della rete*, Carocci editore, Firenze, Italy

Noiret, S., 2015. Storia digitale o storia con il digitale? in *Storiografia*, 18, vol. 66 2014/2, Fabrizio Serra editore, Pisa, Italy.

Patetta, L., 1995. *L'insegnamento della storia dell'architettura, Atti del seminario Roma 4-6 novembre 1993*, Simoncini, G. (Ed.), p. 26, Casa dei Crescenzi, Roma, Italy.

Rocco, G., 2018. Presentazione, in *Bollettino del Centro di Studi per la Storia dell'Architettura*, 2 (n.s.), Edizioni Quasar, Roma, Italy.

Rovida, M.A. (ed.), 2008. *Fonti per la storia dell'architettura*, University Press, Firenze, Italy.

Simoncini, G., 1995. *L'insegnamento della storia dell'architettura, Atti del seminario Roma 4-6 novembre 1993*, pp. 5-7, Casa dei Crescenzi, Roma, Italy.

Tamborrino, R., 2016. The Public Use of History in the Digital Society, in *DigitCult - Scientific Journal on Digital Cultures*, vol. 1, n. 1, pp. 49-58, DigitCult, Milano, Italy.

Terpstra, N., Rose, C. (eds.), 2016. *Mapping space, sense, and movement in Florence Historical GIS and the early modern city*, Routledge, Abingdon, UK.

Vellati, E., 2013. Come cambia la storia nell'era digitale, in *Novecento.org*, 1, DOI: 10.12977/nov4, Italy.

Vitali, S., 2004. *Passato digitale. Le fonti dello storico nell'era del computer*, Bruno Mondadori, Milano, Italy.

Zevi, B., 1995. *L'insegnamento della storia dell'architettura, Atti del seminario Roma 4-6 novembre 1993*, Simoncini, G. (ed.), pp. 16-17, Casa dei Crescenzi, Roma, Italy.

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Documenting the restoration process in 3D digital catalogues

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Abstract

Digital Heritage is an established area nowadays and has expanded in a lot of directions. One of those is related to the digitalisation of cultural objects; another one is related to digital libraries where the new digital content is organised, managed, and disseminated in a global networking. Among the media, 3D content proved to be a valid support to documentation, research, and communication of Cultural Heritage (CH) and 3D catalogues have been developed in many projects and initiatives. Oppositely, in the conservation field, digitalisation and digital archiving are still auxiliary instruments for the documentation of the processes and only recently the need of a systematic documentation started to be a concern. In this paper, we describe the documentation phases of a typical restoration process and discuss the components to be defined and developed to leverage digital archiving in more advanced CH fields, such as archaeology. Finally, we propose 3D annotation as a powerful tool to document digital content with data and information referenced to the geometry, illustrating the potential in the conservation field.

Keywords: Conservation; Restoration; 3D models; 3D semantic annotation; Digital archives

1. Introduction

Digital archiving has become a common practice in Cultural Heritage, spanning from textual digital libraries to digital catalogues of cultural resources. In fields like archaeology (Carandini, 1991), the digitisation process of artefacts and surveys is widespread (Evans et al., 2006) and consequently the need of creating structured repositories of heterogeneous data (e.g. 2D, 3D, text) to share digital content and knowledge has been already tackled. In particular, 3D data are not used only for visualisation purposes by now; 3D modelling, processing and analysis are now mature enough to allow handling 3D digitized objects as if they were physical, and then conducting specialised qualitative and quantitative analyses to support researchers and practitioners in different applications.

Several initiatives have been carried out for streamlining the digitalisation process and proposing strategies for the successive documentation and publication. A crucial aspect is the definition and adoption of specific vocabularies and semantic schemes based on ISO standards, which are able to describe the complexity of 3D data together with their context of investigation. This is the approach generally followed in the set-up of CH infrastructures.

Oppositely, in the field of conservation, and in particular, of restoration, 3D digital catalogues are not extensively adopted yet. Indeed, conservation and documentation have always moved in parallel (Chéné et al., 1987). During the working day, restorers must document in detail their operations in the restoration journal with photographs, annotations, videos, and surveys. Moreover, they have also to manage third party documentation, such as archive and bureaucratic documents, and diagnostic analyses, such as samples, XRF, spectrographies and chemical analyses. This recording is a basic operation of the conservation workflow: the restoration becomes part of the object history (Maramotti, 1989). At the end of the activity, the restorer is called to reorganise a huge amount of information, since restoration final reports are mandatory by Italian law, but they are more and more often required even in private and museum institutions around the world. However, all these data are not generally structured and indexed using standard practices and formats, when created, this makes the documentation process a bureaucratic burden, which is usually postponed and even neglected.

In this paper, we propose to leverage the latest approaches to 3D documentation of cultural artefacts to design a platform devoted to conservation. The final goal is to find a coherent and interoperable solution to integrate knowledge with its digital replica. Here the 3D asset is used as a reference model to accommodate the description and documentation of the restoration work, where contextual information and accurate measures are referenced to specific areas of the artefact. We will discuss these aspects as necessary to achieve the goal and propose the key components of a platform for a structured and accurate documentation of restoration data, which considers the reusability and sustainability issues required in current advanced digital archiving.

The paper is organised as follow. In Section 2, the current documentation process in the restoration field is described. In Section 3 the existing IT solutions supporting, even partially, some phases of the workflow are reviewed. In Section 4 a preliminary discussion on the steps towards an innovative platform supporting the conservation field is presented, concentrating on the aspects of the data model and 3D annotation. Finally, Section 5 concludes the paper.

2. Documenting the restoration process

The restoration process is a knowledge act before to be a practical action (Maramotti, 1996). The conservator is asked to study the cultural object under numerous points of view, collecting information about its material, but also about its history and cultural relevance. This information derives only partially from existing references, but mainly from the critical analysis of heterogeneous data collected by the restorer during his activity. They are, therefore, real discoveries, which deserve to be recorded, becoming part of the history of the object itself.

In addition, the practical part of the restoration process is notoriously a destructive act (Chéné, 1987), even when it is conducted in a conservative way, based on the principle of minimal intervention, as theorised in The Venice Charter (1964). The conservation process, despite its name, causes the change of the shape of an object, translating its material aspect from an initial state (the condition before restoration) to a final state (the condition after restoration): the restoration destructs a layer of the physical object, which often corresponds to the history

of the mutations occurred over time, in favour of aesthetic improvement and the general conservation of the whole object (Maramotti, 1989). This change is a loss of information about the history of the cultural object. The gap can be filled documenting carefully the state of the object before the conservation process starts and recording the whole restoration process.

After these considerations, the initial sentence needs to be specified further: before to be a practical action, the restoration process is an act of analysis and integration of the knowledge of a cultural object.

Consequently, a question arises: what is the best methodology to document the restoration process? This question would lead to the definition of appropriate standards or, at least, to guidelines shared by authorities of the conservation sector. Nevertheless, a common either standard or methodology is still missing in the state-of-the-art.

Even the Italian Cultural Heritage Authority, the *Ministero per i Beni, le Attività Culturali e il Turismo*, via its local offices, the *Soprintendenza*, gives restorers scarce information about this aspect.

The Italian law (Articolo 21, comma 4, d.lgs. n.42 del 2004) requires operators to structure the documentation about the restoration process of Cultural Heritage objects in two technical documents: a preliminary restoration project and a final technical report. Both are mandatory in order to obtain an official clearance to work on public proprieties.

The preliminary project is a basic step of analysis of the object and a conservation work plan. The final report is a fundamental act saving the memory of the object state before the restoration process and an important document to plan future restoration actions. About the preliminary restoration project, the Italian Authority gives a clear list of the documents to request an authorization to work on a painted or decorated object:
"Documents to attach at the clearance request in three copies:

- *Colour photographic documentation in minimum format 13x18 cm. in original with attached planimetry of the shooting points. For buildings, the documentation has to illustrate fully both the exteriors and the interiors. Snapshots or digital photographs printed on plain paper are not accepted;*
- *art-historical report;*
- *technical restoration project including also the evaluation of the results of the material survey and degradation; it has to be specific about the executive techniques, the materials to be used, the structural intervention, the plant engineering;*
- *quantity surveying with specific descriptions of the operating methods for the mapped degraded areas. The calculation has to be divided according to the different parts, a reference plan must be attached to the calculation;*
- *plans and elevations in 1:10 scale or reduced for large surfaces with painted surfaces and shooting points;*
- *geometric reliefs in 1:50 scale;*
- *material and degradation relief that has to be included in the geometric relief. The nature of the materials, the pathologies of degradation in progress and the causes that determined them have to be described, with hatches or with a life drawing. The different observations must be reflected on the graphic works. Where possible, refer to the forms of alteration and degradation codified in the UNI regulation;*
- *relief of degradation in 1:10 scale with indications of the causes of degradation."*

In these official recommendations, the technical requirements are superficially explained, and no indication is given about the documentation format; indeed, it is requested only in a printed format. The only official reference is provided by the ICCD's recommendations (ICCD: *Istituto Centrale per il Catalogo e la Documentazione*), dating back to 1998: "The photographic documentation of catalogue records: Methodologies and shooting techniques" (Galasso et al., 1998) and "Regulations for the digital acquisition of photographic images" (Auer et al., 1998), specifically related to photography in diffuse Visible light.

The required information about the final technical report is much less detailed. Here an abstract of a conservation clearance by the *Soprintendenza* of Verona regarding the documentation requirements (2018):

"At the end of the work, the technical report of the interventions made by the restorer has to be sent to this Office. The related photographic documentation (including the reports of any diagnostic investigations) can also be accepted in digital format, provided that: l) it has a resolution of at least 300 dpi; 2) it has dimensions

of at least 2036x3060 pixels; 3) TIFF, CMYK format, single layer; 4) 16-bit colour or higher; 5) stored on digital DVD media, preferably M-DISK. The digital support must show the usual indications written with a special permanent label on top: 1) title; 2) location; 3) year; 4) author; 5) cultural context of the work; 6) name of the restorer; 7) date of the intervention.

The delivery of the digital images has to be accompanied by colour prints on good quality photographic paper in 18x24 cm format of the work before, during and after the restoration. The prints have to show the usual indications described above, adding the identification code of the file. The documentary methods remain unchanged, delivering both photographs of the entire work and details as indicated in the authorisation".

In this official document, the *Soprintendenza* requires only two documents: a basic photographic documentation of the process and a final technical report about the activity. It may also be noted that the requirement for photographic documentation is very generic and outdated, and any information about the final technical report structure and content is missing. Moreover, it ignores the set of documents produced in the first phases of the restoration process. In the next section the documentation phases of a restoration process will be outlined.

2.1. Phases of a restoration process

The restoration process consists of four documental phases: initial research, survey and analysis, conservation recording, final technical report.

The *Initial research* is the first documentary phase and concerns the study of all the aspects related to the life-time of the cultural object before the restoration. Typical documents collected in this phase are:

- catalogue records, such as the ones provided by ICCD and ICCD SIGECweb (SIGEGweb) in Italy;
- both textual and photographic reference documentation;
- past technical reports on conservation processes;
- reference papers about the specific object;
- technical reference papers, e.g., restoration manuals.

In the second phase, *Survey and analysis*, documents from the direct analysis of the object and the study of the documentation collected during the previous phase are produced. Typical documents collected in this phase are:

- raw survey data, such as preliminary surveys, raw point clouds, generally acquired by means of photogrammetry;
- 2D graphical drawings deriving from processing the raw survey data, and visualising the geometric, material and degradation reliefs (they may be both digital CAD and analogical drawings);
- 3D models reconstructed from point clouds or generated with photogrammetry techniques;
- photographs and multispectral imaging;
- scientific analysis reports including heterogeneous data (spectroscopies, images, textual documents, etc.);
- textual preliminary conservation project.

The third phase, *Conservation recording,* produces heterogeneous documents during the whole restoration activity. This documentation is generated by the restorer day-by-day, and it allows operators to supervise the activities and guide future interventions. Typical documents collected in this phase are:

- the daily technical journal of the restoration;
- photographs documenting the activities;
- images, point-clouds and 3D models generated by 3D scanning systems;
- annotations both on paper and on digital CAD models sketching the restoration activities in a graphical form.

The last phase is the *Final technical report,* which consists in the critical revision of the whole documentation process. This review generates a set of new documents:

- general photographs of the object in the previous phases (before, during, after the restoration), following the indications of the *Soprintendenza* in the conservation clearance;

- selected photographs documenting the activities;
- relevant scientific analysis reports;
- a sketch of the restoration activities in a graphical form;
- a textual final technical report.

The quality of the final documentation strictly depends on the approach followed to create the intermediate documentation and the quality of the documentation itself. Clearly, these aspects heavily affect the time needed to produce the mandatory final report: if all the data are not consistently and coherently organised, the generation of the final report becomes labour-intensive, and then, it is usually postponed and even neglected.

3. Existing IT solutions

There exist sparse IT solutions employed to support the management, processing, and visualisation of data in the restoration activity. Each of them is not tailored for conservation and addresses only a few specific tasks in the workflow. Table 1 illustrates the most relevant commercial software including documentation tools.

Activity	**IT solutions**								
	Digital catalogue	IT solutions for restoration		Condition report activity		3D visualisation platforms			SfM
	SIGEC	SICaR	Modus Operandi	Horus C. Report	Aïoli	3D HOP	Cl3ver	Sketchfab	SfM software
initial research									
catalogue records	●	●							
references		●							
past cons. reports									
survey and analysis									
raw survey data			●		●				
2D drawings		●	●	●	●	●	●	●	●
3D models						●	●	●	●
3D annotations									●
scientific reports		●	●						
textual project									
conservation recording									
daily journal			●	●					
2D drawings		●	●	●	●	●	●	●	●
3D annotations									●
photographs		●	●	●	●		●		
final technical report									
photographs		●	●	●	●		●		
scientific reports		●	●						
2D drawings		●	●	●	●	●	●	●	●
textual final report									

Table 1. Commercial software addressing documentation.

The following solutions have been developed to address the documentation process of the restoration work.

SIGECweb (SIGECweb) is a web-based platform created by ICCD to support a standardised archiving of resources. It is accessible through credentials that allows the user to visualise and record quickly the documentation relating to the ICCD's Cultural Heritage Catalogue Records. It presents very few fields about conservation.

SICaR (SICaR) is a web-based application package accessible via credentials, created as a documentation register of specific restoration projects. This is the only standardised solution for restoration, but it is limited only to the restoration sites managed by entities or institutions directly related to the Italian Ministry.

Modus Operandi (MO) is a proprietary and closed software based on a relational database (SQL) for consultation on the intranet for Cultural Heritage documentation.

Horus Condition Report (HCO) is an application for mobile phones mainly devoted to museum condition reports. In a specific record, the operator can report the state of conservation of an object under investigation, usually part of a museum collection. It gives the option of upload photos and annotate them.

As seen in Section 2, digital content is produced to enrich the documentation: 2D images and 3D models are the most used. 3D geometry is currently used for visualisation purposes and its potential is not exploited in the conservation field yet. Several software applications are available in the community mainly for 3D digital visualisation. In particular, there may be mentioned:

Sketchfab (Sketchfab) is an online platform that shares the photogrammetric reliefs of three-dimensional models. It adds the possibility to inspect 3D models since the creation phase (alignment of images, mesh grid, application of texture, etc.) and create annotations connected to the 3D mesh.

3D HOP (3D HOP) is an open-source application package to create web presentations of high-resolution 3D models. It allows the user to insert textual tags related to the work of the photogrammetric model, providing simple annotations.

blend4web (blend4web) is a framework for creating and displaying interactive visualisation videos. It is connected to the Blender open-source software.

3D PDF (3D PDF) allows to create PDF documents containing interactive 3D models, and to insert textual annotations, to perform measurements directly on the model, and add notes on the model (Tucci et alii 2014).

Cl3ver (Cl3ver) is a software that allows the user to visualise 3D models by inserting not only textual annotations, but also videos and files related to the object as tags themselves. The software is intended only for visualisation and it does not permit any interaction to the user.

Aïoli (Aïoli) is a collaborative platform that aims to expand the documentation, the level of safeguarding and sharing of data on cultural heritage. Users can create spatial semantic annotations directly on the point cloud of the object, generated by photographs via a Structure from Motion (SfM) photogrammetric image matching. It is mainly intended for museum condition reports. The software may be accessed via formal request.

Additional crucial tools in the process are the SfM software with visual survey tools, which include photogrammetric software packages.

They permit to create vector drawings on the 3D object and obtain information about the 3D shape. The main software packages are Agisoft Metashape, 3DF Zephyr and Aspect 3D.

The last one, in particular, contains a PostgreSQL database which helps to manage, sort and systematically combine the data.

Finally, the BIM, GIS and Arches software were not considered in this analysis, being very specific software in the context of the creation of digital construction models, e.g. in architectural surveys (BIM), and the creation of geospatially enabled databases (GIS - Arches) for the inventory and management of mainly immovable works.

4. Towards a platform for conservation data

From the review of the previous section, two main issues emerge.

From the one hand, the existing software and even ministerial initiatives have not comprehensibly tackled the definition of a standard data model yet, to be used by the institutions and single operators for the documentation.

Systems like SICaR and SIGECweb are closed and do not disseminate the schemes adopted to manage data and metadata for archiving to be used in the sector.

On the other hand, the systems supporting the visualisation and processing of digital data are not tailored to restoration. They are starting to also support tools for annotation of 2D and 3D resources, but these are often only visualisation facilities for the data interpretation and labelling. Again, such systems do not allow for information share among different actors: this happens because the information coding is ad-hoc for each system, but also because no attention is paid to interoperable annotation coding. Some initial proposals addressing specifically conservation are appearing in the scientific community (Ponchio et al., 2020; Mandelli et al., 2017; Wang et al., 2018; Apollonio, 2017), but they suffer from the same limitations as described above.

The typical operations a digital heritage platform has to include are cataloguing, semantic enrichment, search and retrieval, and content visualisation. The core aspect in conservation is the management of heterogeneous data, which need proper formats and a suitable data model to represent all the information to be shared. Indeed, an effective data model populated with a rich set of instances in the realisation phase allows many applications, such as classification, aggregation, provenance even before directly accessing the resources.

This general issue applies also to conservation data, where the definition of a shared model (e.g. metadata scheme, domain ontology) has not been tackled coherently yet. Thus, the first steps to be addressed to develop an operational system targeting daily activities of restorers and collection conservators are: the formalisation of sound semantic schemes for a correct and interoperable archiving of the conservation work, and the definition of specific vocabularies to index digital resources in this field.

In the following, these two components are discussed in the perspective of designing an innovative and comprehensive platform for the documentation of the restoration process.

4.1. Data model

A proper data model needs to be conceived to store opportunely conservation data based on a scheme to index the restoration projects: similarly to other CH applications, the key points in this context are the heterogeneity of data, and the fact that different resources may be associated to each restoration work. To keep trace of the whole restoration process, the tasks we are tackling towards the formalisation of the data model are:

- the creation of a taxonomy to index precisely the artefact to be restored together with information about the production technique;
- the identification of the most relevant analyses on material made on the object to be restored;
- the management of the photogrammetric surveys, 3D models and all the digital data;
- the formalisation of the conservation state;
- the formalisation of all the types of intervention to perform.

Regarding the formalisation of the semantic schemes, we will rely on the ISO standard CIDOC CRM, which focuses on CH in general. The CIDOC CRM reference model (CIDOC CRM) is a theoretical and practical tool for information integration in the field of cultural heritage across diverse and dispersed datasets. It provides definitions and a formal structure for describing the implicit and explicit concepts and relationships used in cultural heritage documentation and for the querying and exploration of such data. Such models are also known as formal ontologies.

It is then extended with two other compatible formalisations, which may be useful in this application: CRMdig (CRMdig), an ontology and RDF schema to encode metadata about the steps and methods of production ("provenance") of digitisation products and different synthetic digital representations; it includes the initial acquisition processes and their parameters; CRMsci (CRMsci), a formal ontology intended to be used as a global schema for integrating metadata about scientific observation, measurements and processed data in descriptive and empirical sciences and in research IT environments and research data libraries. Both of them are useful to model different concepts in the conservation domain, and we intend to provide a data model based on these standards.

The general CIDOC CRM will frame the restoration process as a whole including the different phases and the data related to those phases (see Section 2); CRMdig will be used to organise mainly provenance data deriving from photogrammetric surveys and 3D reconstructions; CRMsci will be used to include the diagnostic analyses, such as samples, XRF, spectrographies and chemical analyses in the scheme. This conceptualisation will lead to the metadata scheme to index and catalogue the restoration projects and assets.

4.2. 3D indexing

Once defined the general data model, the proposed platform will allow the user to index resources further by the annotation of 3D assets and their parts: indeed, we see the 3D model as a document itself, where it is possible to reference the relevant information on the corresponding areas of the model.

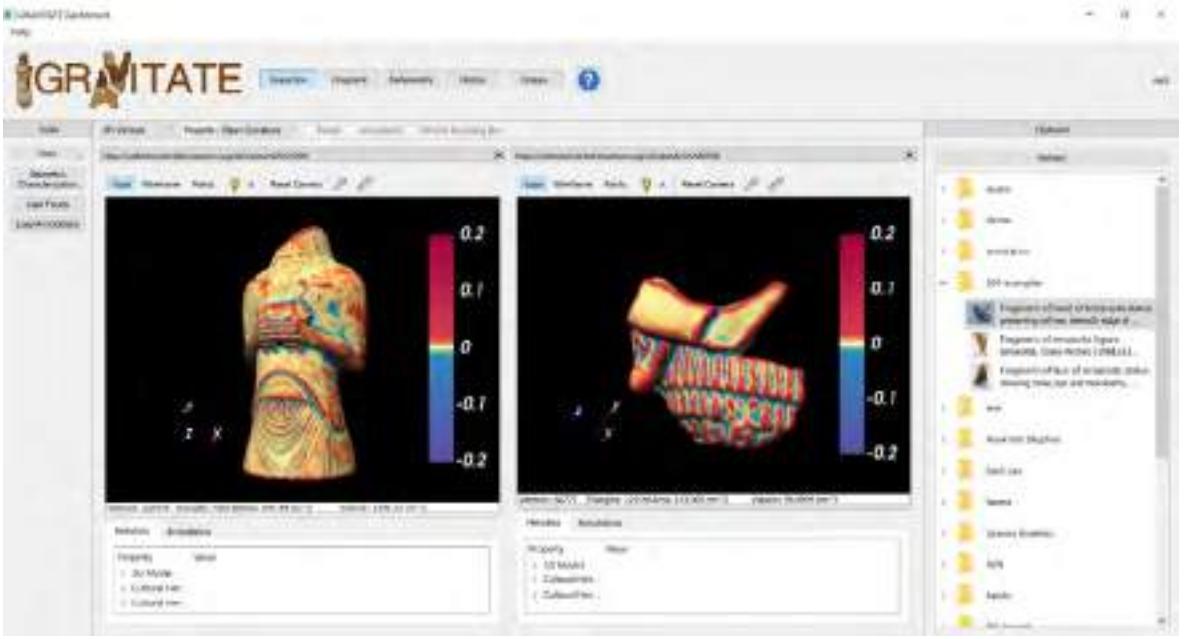

Fig. 1. Parallel visualisation of the mean curvature on two different fragments in the GRAVITATE platform.

In this way, it will not only possible to list in a textual note either the type of damage, the types of analyses and measurements carried out on the object to be restored, or the type of intervention that has been performed, but also to localise them on the digital replica of the object itself. In this case, we intend to formalise a taxonomy with all the information and data that are considered useful to be indexed directly on the 3D model. Indeed, such new information contributes to enrich the knowledge base with formalised knowledge, which may be searched and retrieved, exactly as traditional metadata.

This is the most innovative component of the platform proposed here and is based on the approach presented in Catalano et al. (2017). The idea is to exploit the research successfully carried out in the archaeological domain within the GRAVITATE project (Phillips et al., 2016).

The aim was proposing an innovative methodology to the study of heritage artefacts, which includes virtual reconstruction, classification and morphological analysis, steps that are currently limited by the access to physical items and the impossibility to re-unite them physically, either because they are stored in different museums or because physical refitting fails.

The primary goal of the annotation of 3D artefacts and their parts in that context was serving data retrieval in archaeological research. In particular, experts would have been able to prove or disprove research hypotheses with the aid of geometrical reasoning and comparisons on digital artefacts.

The Dashboard is the front-end of the GRAVITATE platform, aimed specifically at processing, analysing and documenting cultural assets and is described in Catalano et al. (2017). It proves the value of the combination and integration of several shape and semantic tools, providing web and desktop functionalities. It is composed of two clients: the web client is devoted to semantic modelling and search, while the desktop client addresses the visualisation, analysis, and annotation of 3D high-resolution digital resources. The web-client includes the interface to browse and search resources and metadata: the semantic scheme has been inherited from British Museum (ResearchSpace), which holds a wide part of the cultural artefacts studied in the project and is based on CIDOC CRM.

In Figs. 1-3, we show different tools to support geometric analysis and annotation in the desktop client of the platform in order to make the main concept clearer. In Fig. 1, the *Inspection view* includes the parallel visualisation of 3D models and geometric properties: the archaeologist is able to interact with the models, compare catalogue metadata and visualise geometric properties (e.g. curvature, bounding box) and previous annotations on the selected models.

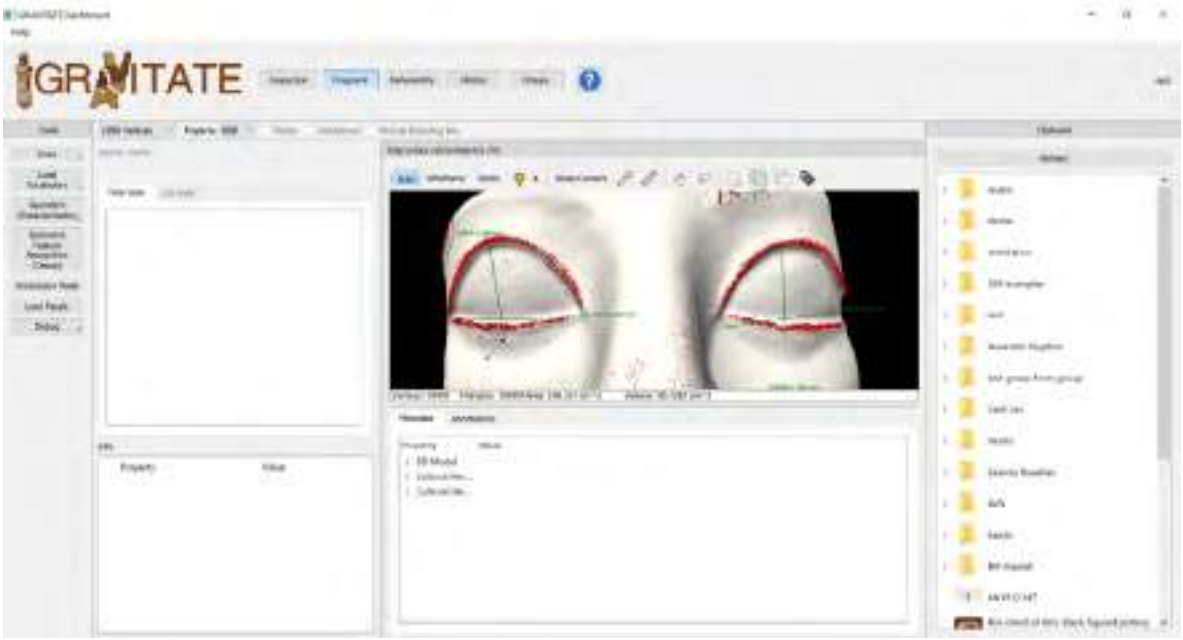

Fig. 2. Feature recognition demo in the GRAVITATE platform.

In Figure 2, the *Fragment view* is illustrated, where the focus is on a single digital artefact. The computed geometric properties are visualised in the canvas; moreover, a tool for the automatic recognition of some morphological features has been implemented; more importantly, this is the view where the parts of a digital artefact may be annotated on the model. In the figure, an example of automatic recognition of eyes on a Salamis fragment is given, where some significant measures pertaining eyes (the two major axes, in this case) are also displayed in the 3D canvas (see Torrente et al., 2018).

A textual description related to the style of the artefact, and in particular of the eyes was inserted in the catalogue records by a curator, but, thanks to this algorithm, it is possible to localise the eyes on the model, characterise geometrically and annotate them to make them searchable.

Once a feature is automatically identified (eyes, in the current example), the successive operation of annotating the model is possible in the Dashboard thanks to a controlled vocabulary concerning typological, stylistic, and morphological analysis; it is encoded in SKOS (SKOS), which provides a standard way to represent knowledge organisation systems using RDF, and extending the general semantic scheme mentioned above (Catalano et al., 2018).

In the current implementation the area has to be selected manually by the user and then it is annotated with the terms of the Cultural Heritage Artefact Partonomy.

In Fig. 3, the annotation mode is shown: the vocabulary is displayed on the left, the central 3D canvas includes tools for the manual selection of digital areas (i.e. points, lines and areas), and the box at the bottom shows all the annotated areas.

Annotations are saved in the knowledge base with qualitative and quantitative data (relevant measures) on the artefacts and can be retrieved using traditional SPARQL queries as in all knowledge-based systems, making the proposed system interoperable and compliant with sematic web guidelines.

The approach described above paves the road to several advances in the conservation area. For instance, precisely measuring degradation areas on the digital model may support the restorer in the quantification of the damage and consequently in the definition of the best intervention.

Moreover, shape and texture analysis with consolidated computer graphics techniques could extend the shift from qualitative to quantitative analysis to support conservation. Chemical analyses, colorimetric properties and so forth can be referenced to specific regions or points on the model as additional annotations, supporting data correlation.

Aligning 2D photogrammetric data and the corresponding 3D reconstructed model, also the annotation may be preserved and transferred from 2D and 3D making the diagnosis process seamless. Aioli partially addresses this point, but it lacks in the effective and efficient management of the corresponding 2D and 3D resources.

Finally, thanks to the rigorous organisation of knowledge and data, the automatic generation of activity final reports would be straightforward.

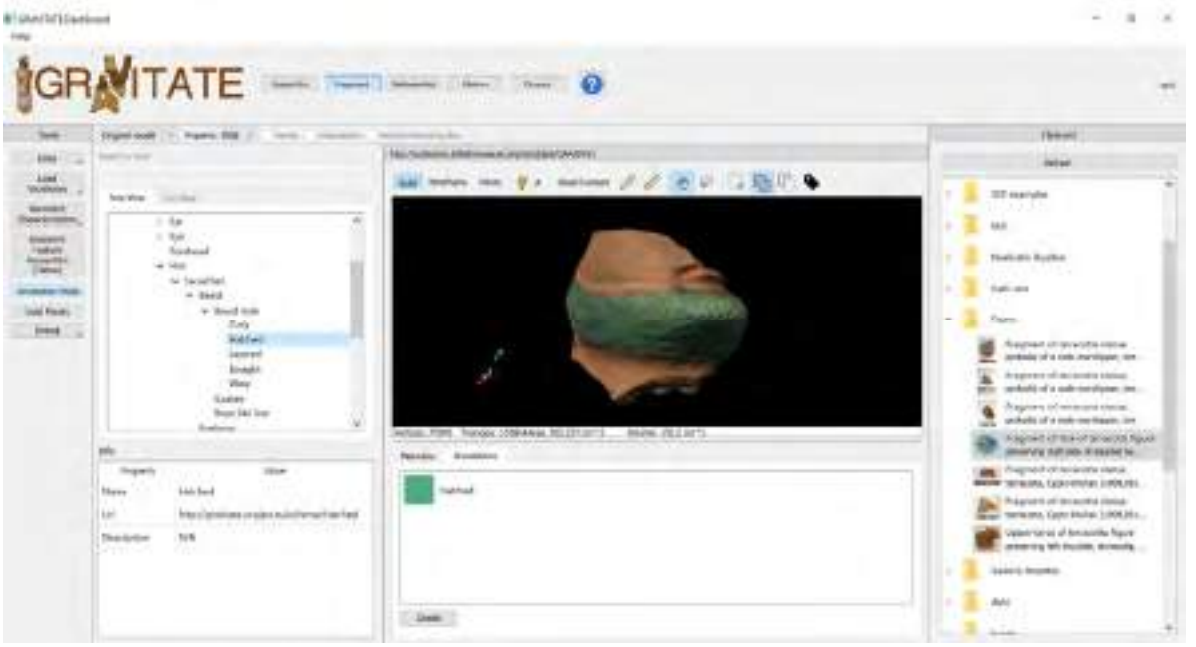

Fig. 3. 3D part-based annotation of a “Hatched beard” on a 3D artefact in the GRAVITATE platform.

5. Conclusions

In the present paper an analysis of the current restoration practice has been carried out, highlighting the limitations of the documentation process and the existing IT solution to support the digital conservation of artefacts. An ideal platform in this field should rely on a formal data model to manage heterogeneous data and a 3D annotation system for an extensive, accurate, quantifiable, and shareable documentation. This is the goal we are currently addressing.

The next step will consist in the operative design and development of the platform, starting from the requirements elicited from the restoration community and based on experience gained in the design and development of 3D documentation systems. A general open problem is related to information and data ingestion: an intuitive user interface is necessary to guide the insertion phase by the operator and then supervise and validate the process for a reliable and certified documentation.

In a longer-term perspective, the benefits of such approach will go beyond single CH application domains. Interlinking data from different sources guarantees data sharing in order to create and enrich new applications: for instance, the communication of restoration projects for educational purposes and the dissemination to general public.

References

3D HOP, http://vcg.isti.cnr.it/3dhop/demo.php (accessed May 2020).

3D PDF, http://3dpdfmaker.com/it/ (accessed May 2020).

Aïoli, http://www.aioli.cloud (accessed May 2020).

Apollonio, F.I., Basilissi, V., Callieri, M., Dellepiane, M., Gaiani, M., Ponchio, F., Rizzo, F., Rubino, A.R., Scopigno, R., Sobra G., 2017. A 3D-centered information system for the documentation of a complex restoration intervention, in *Journal of Cultural Heritage*, Vol 29, 89:99, Elsevier, Amsterdam, Netherlands.

Auer, P., Cavallini, F., Giffi, E., 1998. *ICCD Normativa per l'acquisizione digitale delle immagini fotografiche*, ICCD, Roma, Italy.

Blend4web, https://www.blend4web.com/en/ (accessed May 2020).

Carandini, A. 1991. *Storie dalla terra. Manuale di scavo archeologico*, Einaudi, Torino, Italy.

Catalano, C.E., Repetto, A., Spagnuolo, M., 2017. A dashboard for the analysis of tangible heritage artefacts: a case study in archaeology, in *Eurographics Workshop on Graphics and Cultural Heritage*, Graz, Austria, 27-29, Eurographics Association, Goslar, Germany.

Catalano, C.E., Vassallo, V., Hermon, S., Spagnuolo, M., 2020. Representing quantitative documentation of 3D cultural heritage artefacts with CIDOC CRMdig, in *International Journal of Digital Libraries*, 21, pp. 359–373, Springer Nature, Switzerland.

Chéné, A., Foliot, P., Réveillac, G., 1987. *De la photographie en archéologie*, A.N.R.T., Lille, France.

CIDOC CRM, http://www.cidoc-crm.org/ (accessed May 2020).

Cl3ver, http://3d.cl3ver.com/pSUGw (accessed May 2020).

CRMdig, http://www.cidoc-crm.org/crmdig/home-2 (accessed May 2020).

CRMsci, http://www.cidoc-crm.org/crmsci/home-1 (accessed May 2020).

Evans, T.L., Daly, P.T., 2006. *Digital Archaeology: Bridging Method and Theory*, Routledge, London, UK.

Galasso, R., Giffi, E., 1998. *La documentazione fotografica delle schede di catalogo: metodologie e tecniche di ripresa*, ICCD, Roma, Italy.

Horus Condition Report (HCO), http://horus-conditionreport.com/en/home/ (accessed May 2020).

Mandelli, A., Achille, C., Tommasi, C., Fassi, F., 2017. Integration of 3D models and diagnostic analyses thought a conservation-oriented information system, in *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, Volume XLII-2/W5*, 26th International CIPA Symposium 2017, 28 August–01 September 2017, Ottawa, Canada.

Maramotti, A.L., 1989. *La materia del restauro*, Milano, Italy.

Maramotti, A.L., 1996. *Passato Memoria Futuro. La conservazione dell'architettura*. Giosia, Guerini Editore, Milano, Italy.

Modus Operandi (MO), http://www.modusexplorer.net/mweb/Default.aspx (accessed May 2020).

Phillips, S.C., Walland, P.W., Modafferi, S., Dorst, L., Spagnuolo, M., Catalano, C.E., Oldman, D., Tal, A., Shimshoni, I., Hermon, S., 2016. GRAVITATE: Geometric and Semantic Matching for Cultural Heritage Artefacts, in *Eurographics Workshop on Graphics and Cultural*

Heritage, Genova, Italy, October 5-7, 2016, pp. 199-202, https://gravitate-project.eu/ (accessed May 2020), Eurographics Association, Goslar, Germany.

Ponchio, F., Callieri, M., Dellepiane, M., Scopigno, R., 2020. Effective Annotations Over 3D Models, in *Computer Graphics Forum*, 39: 89-105. doi:10.1111/cgf.13664, The European Association for Computer Graphics and John Wiley & Sons Ltd.

ResearchSpace, https://www.researchspace.org/ (accessed May 2020).

SICaR, http://sicar.beniculturali.it:8080/alpha/main.php?subpage=schede_interventi/list (accessed May 2020).

SIGECweb, http://www.sigecweb.beniculturali.it/it.iccd.sigec.axweb.Main/ (accessed May 2020).

Sketchfab, https://sketchfab.com/features (accessed May 2020).

SKOS, https://www.w3.org/2004/02/skos/ (accessed May 2020).

The Venice Charter, 1964, https://www.icomos.org/charters/venice_e.pdf (accessed May 2020).

Torrente, M.L., Biasotti, S., Falcidieno, B., 2018. Recognition of feature curves on 3D shapes using an algebraic approach to Hough transforms, in *Pattern Recognition*, Volume 73, 2018, pp. 111-130, DOI: https://doi.org/10.1016/j.patcog.2017.08.008, Elsevier, Amsterdam, Netherlands.

Tucci, G., Conti, A., Fiorini, L., 2014. The Mock-up of the "Ratto Delle Sabine" by Giambologna: Making and Utilization of a 3D Model, in *ICONARP International Journal of Architecture and Planning*, Volume 2, Issue 2, 73:83, ICONARP.

Wang, Z., Shi, W., Akoglu, K., Kotoula, E., Yang, Y., Rushmeier. H., 2018. CHER-Ob: A Tool for Shared Analysis and Video Dissemination, in *Journal on Computing and Cultural Heritage*, 11, 4, November 2018, DOI: https://doi.org/10.1145/3230673, ACM Digital Library.

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Documentation and Digitalization of Ceramic Collections in Veneto: the MemO Project

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Abstract

The Italian Archaeological Heritage, which also includes ceramic collections, is characterized by a continuous change: in fact, its protection modalities, its valorization systems and its intrinsic and extrinsic value are modifying. According to data compiled by ISTAT, in 2015 archaeological museums (public and private) kept 23,518,266 objects, of which they exhibited only 5.4%; furthermore, only in 2018, the Direzione Generale Archeologia, Belle Arti e Paesaggio authorized about 390 excavation and research concessions on national soil. If we analyze the 2015 data on a qualitative level, we find that only 30% of the objects kept in the archaeological museums have been inventoried, while 13.3% have been cataloged for scientific purposes and only 1.844.714 objects, equal to 7.8%, have been digitized.

For these reasons, the Department of Cultural Heritage of the University of Padua has started a three-year research project called "*MemO Project - The Memory of Objects. A multidisciplinary approach for the study, digitalisation and enhancement value of Greek and South Italian pottery in Veneto*". The final purpose of the MemO Project, supported by the Fondazione Cassa di Risparmio di Padova e Rovigo, is to study the material conserved in the main regional museums, in order to implement knowledge on Greek and South Italian pottery presences (through the creation of a dedicated open-access and online database), on the world of collecting, on the illicit phenomenon of falsification and on the new possible communication methods of the museum heritage.

This article wants to describe two of the different research lines of the MemO project, that is 1) the enhancement of the methods of access to cultural heritage thanks to the development of innovative communication strategies of the exhibited objects. Thanks to 3D models we can bring the public closer to the objects using display, web app and copies; and 2) the development of technologies and solutions for bringing the museum public closer to the exposed ceramic archaeological material and inform people about the dangers inherent on illicit traffic and falsification, promoting a culture of legality.

Keywords: Valorisation; 3D models; database; multidisciplinary approach; stories.

1. Introduction

Museum accessibility can be declined in many aspects, often connected with each other. In fact, a museum is accessible when it offers certain services for people and, at the same time, maintains high standards for the research and conservation of the manu-eco-arte-facts. In this sense, speaking about accessibility means providing the best tools and developing efficient strategies: from the organization of the visit - that is, the website to obtain the first useful information - to the possibility of accessing economic benefits, from attention to some categories of special users (children, the elderly, people with disabilities) up to the possibility of access to merely cultural data, that is the most free and inclusive possibility of visiting the spaces and objects preserved by the museum institution.

On the basis of the data provided by Istat (2016, 2019), however, it is clear that only 57.4% of Italian museums have a dedicated website, a percentage that decreases due to the use of social media (48% in 2017 vs 40.5% in 2015), although more and more studies show that almost all tourists rely on the network to organize their visit: in fact, 91% of tourists have booked at least one product or service online in the last few Twelve months, 42% use a mobile device to plan, book or inquire and 68% perform online searches to choose the place and methods of travel, see Eurostat (2017).

Moreover, the data on accessibility appears alarming: only 37.5% have assistance services and/or facilities for physical access to disabled visitors and only in 20.4% of cases these categories can find materials and supports specific information (tactile paths, braille panels, etc.). Attention is not greater for children given that only 31.2% of institutions have provided a path dedicated to them. Eight out of ten museums and similar institutes offer the public the opportunity to take guided tours (58.7%) and to book them in advance (only 6.6%, however, have activated an online booking service).

The situation of Italian museums does not improve when it comes to access to exhibited goods: only 40.2% of museums claim to have exhibited at least 90% of their collections, more than a third of them exhibit about half of the preserved goods (among the least dynamic are indicated as archaeological sites). Only 67.9% of museums have inventoried their assets and, among them, only 37.4% have archived in digital format.

Cataloging is not the only problem of Italian museums as also the rearrangement and movement of the manu-eco-arte-facts, in order to ensure the use of all the goods kept, appears difficult: in this case, the most deficient museums are those that exhibit objects devotional and religious (15.2%), archaeological (19.2%) and ethnographic and anthropological (20.1%).

Another sore point for Italian museums is their update to new technologies: 19.5% have interactive displays and/or virtual reconstructions, only 9.1% have applications for mobile digital devices and 14% have equipped themselves with QR-code or proximity systems. This difficulty in adhering to new technologies is easily explained by the almost total absence in Italian cultural institutes of a free wi-fi network, in fact attested only in 18.6% of cases.

Despite these alarming data and to which the ministerial action of recent years has been trying to remedy, if the museum is a "permanent institution" and "at the service of society", that is, it performs research on the "tangible and intangible heritage of humanity and its environment" through the acquisition of new traces of human action, their conservation and their communication, as defined by the International Council of Museums, then the comparison and in-depth analysis on the methods of documentation and digitization of the preserved material.

In the light of these considerations, one of the cornerstones of the research and action of the MemO Project, "*The Memory of Objects. A multidisciplinary approach for the study, digitalisation and enhancement value of Greek and South Italian pottery in Veneto*", is configured in the work of enhancing the ceramic collections of Greek and South Italian materials preserved in the museums of Veneto.

1.1. MemO Project: documentation and digitalization of Ceramic Collections in Veneto

The MemO Project, coordinated by the Department of Cultural Heritage of the University of Padua and supported by the Fondazione Cassa di Risparmio di Padova and Rovigo as part of the "Progetti di Eccellenza 2017" call, was born around the Chair of Classical Archeology, taking up a tradition of studies started some time ago by Irene Favaretto (2000, 2001, 2013) and by Elena Francesca Ghedini (2002, 2006, 2007).

The MemO Project owes its formulation to the value and meaning that the ceramic material, produced in Greece and Magna Grecia between the 6th and 4th century BC, has represented and still represents in society, be it ancient or contemporary. The vases, in fact, represent one of the richest, and perhaps most complete sources, for understanding Greek society and the close relationships between it and the Italic world during the classical age. Veneto and, in particular, the provinces of Padua and Rovigo are distinguished by the massive presence of Greek and South Italian vases, which now find their place in the major museum collections (Braccesi and Veronese, 2005).

The MemO Project was born from the awareness of the social and cultural role that the Greek ceramic heritage has played and continues to play not only in the history of archeology but also in the definition of our western identity.

In recent months, thanks to the material made available by the *Musei Civici agli Eremitani di Padova*, the *Museo di Scienze Archeologiche e d'Arte* of the University of Padua, the *Museo Archeologico Nazionale di Adria*, the *Museo Nazionale Atestino*, the *Museo di Torcello*, the *Museo dei Grandi Fiumi di Rovigo*, the *Museo Archeologico Nazionale di Venezia*, the *Museo Civico di Bassano*, the *Fondazione Museo Miniscalchi-Erizzo*, the *Centro Archeologico Ambientale - Museo Civico di Legnago* and by the *Musei Civici di Verona*, the MemO Project is working of the archaeological study of the ceramic material contained therein, in order to put the shape, function and decoration of the vases in a system to shed light on the mentality of the company that produced them.

At the same time, photographic and 3D surveying campaigns, imaging diagnostics and chemical-physical analyzes were started to integrate the strictly archaeological approach and improve its quality data. All the information obtained flows into an open access database within a specially created website (www.progettomemo.it).

Also thanks to this considerable amount of data, the MemO Project intends to frame the practice of collecting in the Veneto region at a social, legal and economic level, a very complex phenomenon that declines differently depending on the times.

Finally, with the collaboration of the *Comune di Padova*, the *Direzione regionale Musei del Veneto*, the *Soprintendenza Archeologia, Belle Arti e Paesaggio per l'area metropolitana di Venezia e le province di Belluno, Padova e Treviso*, the *Soprintendenza Archeologia, Belle Arti e Paesaggio per le province di Verona, Rovigo e Vicenza*, the University Center for the Museums of the University of Padua and with the sponsorship of the International Council of Museums (ICOM), the MemO Project will focus on the analysis of museum installations and their perception by users, aimed, together with the definition of innovative ways of accessing goods, to guarantee total fruition for each category of person, with a view to inclusion and accessibility, not only scientific, of museum collections.

2. The survey of Cultural Heritage: structured light system

The MIUR (Italian Ministry of Education, University and Research) website defines Geomatics in this way: ''[…] it studies the scientific and educational activity in the fields of physical, spatial and geometric geodesy, topography and aerial and terrestrial photogrammetry, cartography, telesurvey, navigation and geographic information system (GIS). The scientific and disciplinary contents concern the acquisition, elaboration, feedback, analysis and management of the data of a metric or thematic nature related to the Earth surface or to some of its parts. This includes the urban spaces, infrastructures and the architectural heritage, identified by their position and qualified by the precision of survey. The fields of application concern the global and local reference systems, the global and local field of gravity, the tools and methods of the survey, the control and monitoring of the territory, of the structures, of CH, the treatment of measurement data, production and updating of cartography and topographic database, the tracking of works and infrastructures, the mobile systems of surveying, the numerical models of the land and surfaces, the management and sharing of multidimensional and multi-temporal geographic information.''.

Considering this definition, it is possible to analyse the applications of Geomatics in the field of Cultural Heritage, even follow the experiences of the scientific international research:

- Documentation for study, knowledge, conservation and renovation.
- Control and monitoring.
- Fruition and dissemination.

The conservation and enhancement of Cultural Heritage (CH) require an exhaustive study in terms of shape, colour, geometry and of the historical and artistic features. 3D Survey methods have polished data acquisition techniques in line with technological progress. IT technologies, that are the tools of modern Geomatics, allow the survey and representation of 3D objects in different scales: from architectural structures to sculptures and also archaeological findings.

In CH surveying, many applications and several scenarios could appear: each one requiring a specific planning to obtain the best results operations in term of accuracy and resolution. In the last few years, in the field of CH, laser scanners (triangulation or time-of-flight) and structured-light systems were very successful, making easier the acquisition process of data related to the geometry and shape of both simple and more complex structures (Balletti and Guerra, 2015).

The structured light systems use light patterns (or codes) and are based on digital cameras and projector. The projector shines a single pattern or a set of patterns onto the surface of an object; the camera then records the patterns on the surface. If the surface of the object under scanning is planar, then the pattern acquired by the camera would be similar to the pattern illuminated by the projector. However, if the object has some variations on the surface, the pattern acquired by the camera would be distorted compared to the projector pattern. Therefore, the 3D shape of the object can be reconstructed by comparing the projected patterns acquired by the camera.

These systems have several advantages: they are fast, can be used for large areas, are able to reconstruct the geometry and to acquire texture of the 3D objects, at high resolution with high accuracy. However, they are sensitive to ambient illumination and they are also not suitable for scanning reflective and transparent surfaces (Laga et al., 2018).

The instrument used for the acquisition is Cronos Dual, a structured light system by Open Technologies, with an accuracy of 10 ÷ 40 μm; camera resolution: 2x1.3 MPixels. The acquisition and post processing software is Optical RevEng 2.4 SR 8 Pro.

In order to guarantee the better overlapping, an automatic turntable synchronized with the scanner was used. The rotation angle was set at 20° for each scan and 18 scans for set were made in order to complete the 360° rotation angle

The pipeline of the processing phases is (Fig. 1):

- Range map alignment: in order to put all the range maps into a common coordinate system where all the scans lie aligned on their mutual overlapping region. The pairwise ICP alignment algorithm, followed by a global registration, was used. An automatic pre - alignment technique was applied during the acquisition phase to improve this task and to verify, in real time, the acquisition quality.
- Range map merger (or fusion): to build a single, non-redundant triangulated mesh.
- Mesh editing: to improve the quality of the computed mesh. This step requires the use of holes filling algorithms and the editing of the topological mistakes (like cross section triangles or anomalous vertices.
- Mesh decimation: to accurately reduce the huge number of triangles, producing geometrically correct 3D models with different decimation factors (100%, 75%, 50% and 25%).
- Colour mapping, to enrich the information by adding colour information to the geometry representation, producing in output a 3D high resolution and photorealistic model.
- Mesh export in STL (Standard Triangulation Language) and OBJ, used for Rapid Prototyping and Computer Aided Manufacturing techniques.

3. MemO Project website and database

Compared to traditional forms of academic research, digital approaches are more collaborative and multidisciplinary, while referring to traditional methods: in fact, the affirmation of the Internet as a privileged tool for accessing and sharing cultural heritage, has introduced new opportunities for archeology and for cultural heritage.

This digital system takes the form of a website for the communication of research, training and dissemination activities carried out thanks to the support of the *Fondazione Cassa di Risparmio di Padova e Rovigo*.

At the website, in parallel, a 3D survey and modeling campaign and a database are being completed for the conservation and promotion of the data obtained during the research phases.
The results obtained from archaeological research and digital documentation are included in a sector that sees the intervention and management of the cultural asset from a formal, conservative and popular point of view as central elements, with repercussions on the museum sector, training, tourism cultural and communications industry that exploits ICT (Information and Communications Technology): in fact, the goal is to create a digital system (website and database) that can be used to upload all information relating to the asset onto it , becoming a sort of information container (also 3D), suitable for the management of the vessels both from the point of view of their cataloging and of virtual use in the museum (Stylianidis and Remondino, 2016).

Fig. 2: the data collected by the scanner are X, Y, Z coordinate triplets of each single point acquired, taking a set of partially overlapping range scans. Different colours represent the contribution of each different scan (on the left). The points were triangulated in order to obtain the polygon mesh, a collection of vertices, edges and faces that defines the shape of the artefact (in the middle). The result is a 3D very high resolution and photorealistic model (on the right).

The website (Fig. 2), in fact, represents the access interface for the Project database, previously mentioned. The database, created by Marco Tognon, Paolo Kirschner and Luciano Giacomel, was designed by the writer to be usable online, to be usable by different categories of users (open-access) based on their characteristics (researchers, students, collectors, members of the Italian Ministry, museum professionals) and to provide the possibility of researching over 120 items sorted in 15 different sections, elaborated on the basis of the needs expressed by the individual museums, by the *Soprintendenze* involved and by the most recent legislation issued by the *Istituto Centrale per il Catalogo e la Documentazione*.

F ig. 2: home screen of the MemO Project website (progettomemo.it).

A fundamental contribution in archiving, sharing, and enhancing the value of the archaeological heritage will be given by computerized means, along with some excellent experiences promoted by the Department of Cultural Heritage of the University of Padua as far as diverse material classes are concerned, e.g. TESS and TECT projects, regarding wall and floor coverings, and digital recording of domus in Roman Tunisia and Cisalpina (Ghedini et al., 2007; Salvadori and Scagliarini, 2014; Ghedini and Annibaletto, 2009); or the ADAM project for cataloging material from archaeological excavations (Kirschner, 2008).

This idea is further based on the notable example of the OXION experience "The Beazley Archive" (beazley.ox.ac.uk), Kurtz (2009), of the Corpus Vasorum Antiquorum (cvaonline.org) and of the Progetto Post-Paralipomena (Giudice and Barresi, 2003).

MemO's first objective lays in cataloguing the extensive Greek and South Italian ceramic documentation present in Veneto in an online database, easy to update and consult, open-access and with a searchable interface, initial considerations in Favaretto and Bodon (1999) and more recently in Dobreva and Baggio (2013).

The database will be not only a working tool for data collection and management, but also allow to cross-check the data on collection items (with no origin context) with those on items coming from recent stratigraphic contexts, on the basis of scientific excavations carried out in Italian sites.

It will then be possible to map the finding contexts and, consequently, to refine dating and study material associations. Moreover, recent discoveries have further enriched the patrimony of artefacts that, in themselves, are the basis for studies on the figures of vase painters and potters, on workshop structure and on the relation between artisanal production and buyers. Furthermore, they are key to the reconstruction of iconography dissemination dynamics and to understanding the link between iconographic theme and vase shape and function and, lastly, to the symbolic ideology behind figurative choices (Sena Chiesa, 2006).

Secondly, the database will be the starting tool to carry out socio-economic and cultural analyses not only regarding the ancient world, but also the modern and contemporary ones, when the vases, precious testimonies to Classical antiquity, have become part of a collection.

Thanks to MemO and through service implementation, it will be possible to map (to varying degrees and with quantitative and qualitative analyses) the practice of art colleting in a diachronic perspective - Arnesano (2016) - and the historical antiques market dynamics that lay behind it (Elia, 2001; Norskøv, 2002; Chippendale and Gill, 2000).

Furthermore, the database, like the above-mentioned examples, will provide a useful instrument of research and comparison for scholars: as proven by archaeologist Gemma Sena Chiesa, having a simplified version of the digital archive available online (progettocultura.intesasanpaolo.com) may eventually result in a "virtual musealization", that is, an important occasion for disseminating and sharing cultural heritage knowledge with a wider audience (Sena Chiesa, 2008).

Moreover, the database, developed thanks to the collaboration between research institutes and institutions whose aim is to preserve (*Soprintendenze*) and enhance the artefacts' value (Museums), will be the first instrument to combine scientific research and documentation purposes with preservation and promotional goals (see Digital online exhibitions – MOVIO), linked to the item's history in itself and to the culture it is tangible evidence of (both in the ancient world and in the modern, current one), following the GLAM sector's example. As a matter of fact, in a second phase the database will become an educational tool for museums, experts and the general public (Greco, 2016).

To summarize, the database of the MemO Project wants to be configured as a tool for:

- archaeological research (study of the Greek and South Italian material present in Veneto), see Wingfield (2017), Luby et al. (2013), Voss (2012), Voss and Kane (2012), Copley (2010);
- the digitization and enhancement of currently unexposed assets, as defined in Luigini and Panciroli (2018), Kim (2018), Alunno (2017), Chow and Chan (2009), Srinivasan et al. (2009);
- the creation of a regional network between member museums and cultural institutes, to simplify the subsequent methods of knowledge of the material preserved (for example for the creation of an exhibition or for the design of common educational and educational paths);
- the investigation of the phenomenon of collecting, i.e. for the quantitative, qualitative and distributive analysis of public and private collections present in Veneto;
- the sharing of expert reports carried out on non-authentic goods, see Hilgert (2016) and Phelan (2016), with the aim of making known to the general public the risks that are incurred through careless collecting and, at the same time, with the desire to unmask any shopkeepers of counterfeiters still active;
- the dissemination of scientific and/or archaeometric analyzes (Knoll, 2011);
- to improve the understanding of often difficult to read objects (Frank, 2007);
- the increase in accessibility to the national cultural heritage;
- the diffusion of a culture of legality in the historical-artistic field with the aim of creating a sense of respect and protection for the original cultural heritage in future generations.

The last points have been designed in clear reference to the European Convention for the Protection of the Archaeological Heritage (Valletta, 1992). In fact, in article 9, it commits the Contracting Parties (including Italy, law of April 29, 2015, n. 52) to undertake an educational action aimed at reawakening and developing public awareness of the value archaeological heritage for knowledge of the past, and the dangers to which this heritage is exposed, as well as promoting public access to important elements of its archaeological heritage, in particular to sites, and to encourage the public display of goods selected archaeological sites, Murphy (2016).

The database (Fig. 3) will be based on a filing system, managed through the DBMS (DataBase Management System), with an interacting web and online browser interface, which will allow for updates, revisions and new real-time implementations, following research advancement.

Each data sheet will be organized in 13 sections, each dedicated to a particular aspect of the ceramic repertoire: from a general definition, to the details of the decorative and epigraphic apparatus, concluding with bibliographic references and photographic documentation of the vase. Some of the entries in the individual input masks have a drop-down menu in order to speed up compilation and eliminate any chance of error. The words and terms in the drop-down menus will be chosen according to criteria based on uniqueness, clarity and completeness.

Although the MemO Project focuses on the study, digitization and enhancement of Greek and South Italian ceramic material, the database has been prepared to contemplate any type of archaeological artefact and any historical period.

For the best use of the data and for scientific completeness, the database is made up of 15 different sections (Fig. 4):

Table 1. Database structure.

Sections	Sections description
Collection	Description of the nature of the Collection and its history. The legal status of the owner, owner or holder of the collection, the date of its constitution, the place of conservation, a history of the past owners are indicated and, finally, the possibility is given - to the owners, owners or holders - to compose a register on the movement of the individual objects making up the collection.
Object	Summary of the main characteristics of the product. In addition to the main references (such as the general catalog number or inventory and any name), the sheet describes all the intrinsic characteristics of the object: the material used for its creation; the class of origin; the description of the shape, type and element considered; its chronology; the alleged or certain provenance; the main technique to which it can be traced and/or the workshop or manufacture where it was made.
Object subsections	
Technique and physical characteristics	Description of the technical considerations made on the product. This takes into account the production characteristics which, in ceramics, must consider the ceramic body (color, consistency and composition) and its coating.
Technique and decorations	Analysis of the decorations on the artifact with the possibility of describing the shape, position, themes, subjects and settings that may be present.
Dimensions	Particularly useful during authentication/appraisal operations of objects of presumed archaeological nature. The diameters of the rim, body and bottom, the thickness of the walls, the height of the vase and some of its main parts, the size of any handles or any additional elements are therefore taken into consideration.
Archaeometry	Description of the analytical techniques used and discussion of the results obtained, with a view to extreme sharing of scientific data.
Epigraphy	Particular attention to any epigraphic presences placed on the artefacts: the epigraphic card allows you to analyze, that is to put in the system, the text of the inscription, its dimensions and its position.
Conservation	Verification of the physical condition of the building as well as all past, present or future interventions, with a view to scheduled conservation. The state of conservation is joined by particular notes for the storage or display of the object, as well as by the main references to the restorations that have taken place.
Authentication and esteem	Verification of the authenticity of the object with the possibility of indicating the possible counterfeiter or the identified contemporary shop from which the object originates and a chronology relating to the production date. Ample space is prepared for the analysis of the conclusions for the determination of the status of the artefact. Finally, the section is completed with the possible estimate of the object according to the contemporary antiques market and based on ministerial dictates.
Legal condition	The legal condition of the thing being evaluated takes into consideration the methods of acquisition, its possible changes over time, the change in the material condition if it undermines it and, finally, any declaration of cultural interest pursuant to art. 13 of Legislative Decree 42/2004.
Documentation	Description of the type of information present and stored for the artefact.
Images	Access to a gallery of high-resolution images of the artefact.
3D models	Online viewing of the 3D models of the object.
Exhibition	Section reserved for professionals or owners and holders of objects that have joined the MemO Project. The section contains a history of the exhibitions in which the artifact took part, in order to narrate its importance also in the eyes of scholars and the general public.
Bibliography	List of the scientific bibliography used for the description of the artefact, for its contextualization and for its possible authentication. Enumeration of any publications on exhibition or museum catalogs.

4. Conclusions

Modern 3D graphics technologies allow us to acquire accurate digital models of real objects or complex scenes; these 3D models are the starting point for the design of a large number of applications based on visual presentation, ranging from the passive (video, animations, images, database and website) to the more interactive and immersive ones (multimedia books, interactive navigation, immersive VR/AR systems, etc.). This technology opens great opportunities for a very broad set of applications in the Cultural Heritage field.

Both innovation in depth sensing devices and the increase of computational power have made the digital reconstruction of 3D models an ongoing research field and many challenges still exist when building an entire acquisition and process pipeline. The digital acquisition of Cultural Heritage is an area of application of these 3D technologies whose interest has increased in the past two decades.

The focus of this contribution is the interdisciplinary. The synergy between the archaeological field and new technologies has allowed to start a new phase of studies on the ceramic artefacts. The main goal was to use the virtual model for an increment of knowledge on the archaeological heritage. The structured light methodology has allowed to produce 3D models of ceramic artefacts with a micrometer resolution. These are the starting point for the surface analysis and further investigations that may be carried out in the future. Born for engineering areas, these technologies, prove to be useful and show their full potential event in the archaeological field.

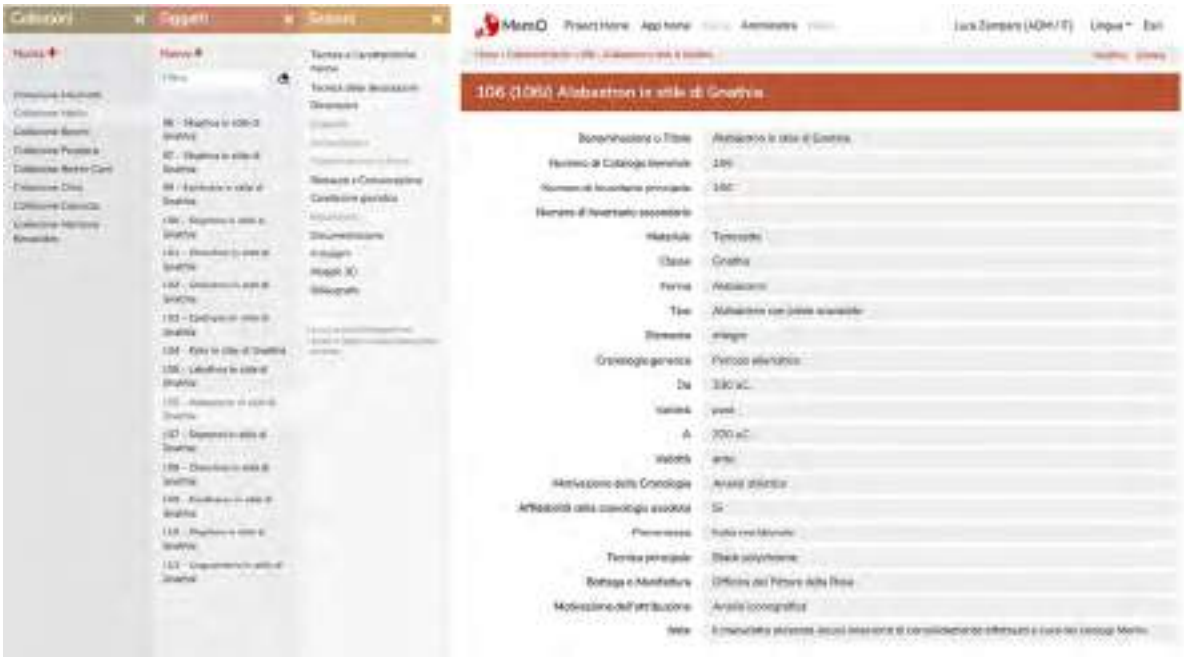

Fig. 3: description sheet of the artifact n. 106 of the Merlin Collection
(Museo di Scienze Archeologiche e d'Arte, Padova) and structure of the MemO Project Database.

MemO Project has started its study into three different lines of research: 1) museological analysis of museum environments; 2) development of technologies and solutions for bringing the museum public closer to the exposed ceramic archaeological material; 3) the enhancement of the methods of access to cultural heritage thanks to the development of innovative communication strategies.

For all these reasons, the main motivations for using 3D models are:

- to allow the collection of specific geometric or texture information when difficult to obtain from the real object (dimensional analysis, technical analysis, etc.);
- to allow the dissemination of digital media collections for a large audience via virtual exhibitions;
- to create replicas (for didactic and educational purposes, in academia and in museums);
- to identify art forgery (verification of the production process and subsequent manipulations);
- to ensure that the information of the shape and appearance of an object is not lost.

The best learning experiences come when people are actively engaged and can interact with "things". For this reason, 3D high resolution and photorealist models open up new ways of engaging with shared cultural heritage and they are used for an open access database within a website specifically created for the Project MemO, which will be the basis for the creation of a network of museum collections in Veneto region.

The database and the website will provide a useful instrument of research and comparison for scholars: from a general definition to the details of the decorative and epigraphic apparatus, concluding with bibliographic references, photographic and 3D models documentation of the ceramic artefacts.

Each object has a "story" that we want, through the database, to tell anyone, in a perfect combination of research (formal, iconographic, epigraphic, etc.), conservation and enhancement (3D models and 3D copies, using rapid prototyping methodologies, for a depth understanding of the objects with an increasing of the accessibility and knowledge).

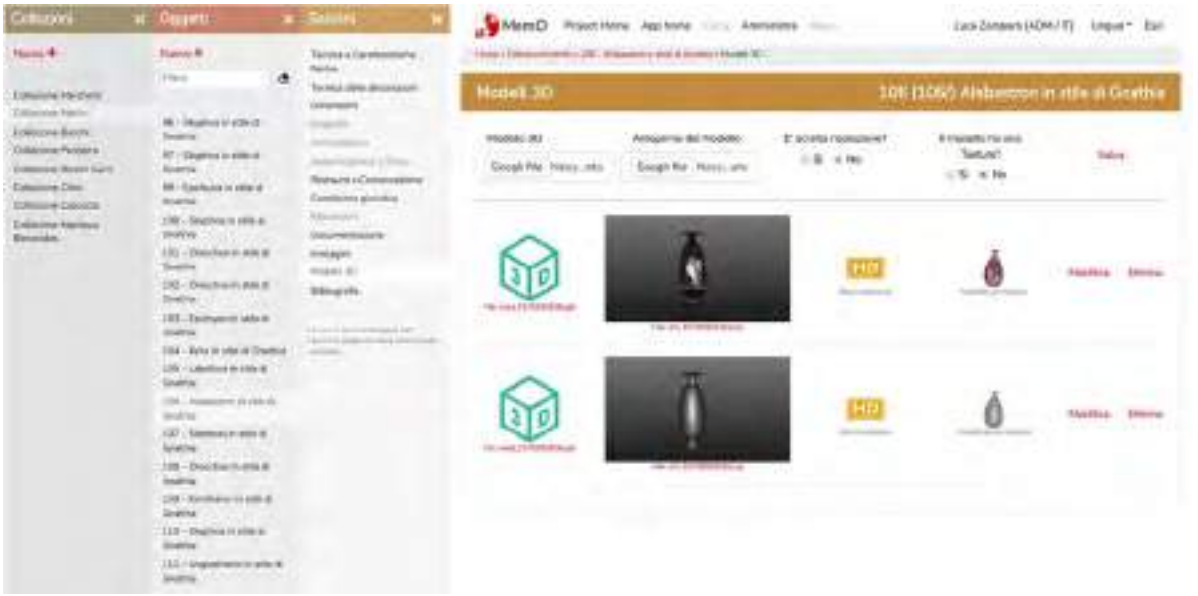

Fig. 4: the result of the combination of archaeological research (documentation) and digitization (3D survey and modeling, high resolution photographic campaign and online open access cataloguing). The image shows the section dedicated to 3D models (made by E. Faresin) with the possibility to view and enlarge them for a remote study of the artefacts.

As regards the website, promotion, and display of the object to the public, 3D models were used in this study as a tool to collect information and represent the shape of the artifacts in the clearest, most comprehensible, and differentiated way for different classes of viewers who may appreciate the complexity of the find, in particular its decorations. 3D models can be used for the reproductions of objects, for the material narration of their history, their use, their technical and formal characteristics. In this way, even a decontextualized ceramic fragment can be revised by a non-professional public for the intact object that it was, thus restoring a narrative by now lost. The concept of virtual reproduction is not considered in the negative meaning, but it is considered as a re-appropriation of the cultural value, highlighting its uniqueness and its historical and artistic importance. "Living a cultural heritage" means knowing it in the best way, even with the use of cognitive artefacts for greater communicative effectiveness.

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References

Alunno, V., 2017. Le tecnologie multimediali per la fruizione museale e l'esperienza dei visitatori. Prima indagine sui Musei Civici di Palazzo Buonaccorsi a Macerata, in *Il Capitale culturale Studies on the Value of Cultural Heritage* 15, 265–295, Università degli Studi di Macerata, Macerata, Italy.

Arnesano, G., 2016. Il ruolo sociale e la biografia degli oggetti. Palaver 5, 1, 125–136, Coordinamento SIBA, Università del Salento, Italy.

Balletti, C., Guerra, F., 2015. The survey of cultural heritage: a long story. In *Rendiconti Lincei* 26, 1, 115–125, Springer, Switzerland.

Braccesi, L., Veronese, F., 2005. Ceramica attica e commerci Greci dal Timavo al Po, in *Il greco, il barbaro e la ceramica attica: immaginario del diverso, processi di scambio e autorappresentazione degli indigeni,* Giudice, F., Panvini, R. (Eds.), pp.99-116, L'Erma di Bretschneider, Roma, Italy.

Chippendale, C., Gill, D. W. J., 2000. Material consequences of contemporary classical collecting, in *American Journal of Archaeology* 104, 3, pp.463–511, Archaeological Institute of America, USA.

Chow, S.-K., Chan, K.-L., 2009. Reconstruction of photorealistic 3D model of ceramic artefacts for interactive virtual exhibition. *Journal of Cultural Heritage* 10, pp.161–173, Elsevier, Amsterdam, Netherlands.

Copley, M. S., 2010. Towards presenting scientific research in archaeology museums, in *Museum Management and Curatorship* 25, 4, 383–398, Taylor & Francis Group, UK.

Dobreva, D., Baggio, M., 2010. La ceramica greca in Veneto: progetto di schedatura informatizzata KERAMOS, in Eidola International Journal of Classical Art History 10, 19–30, Fabrizio Serra editore, Italy.

Elia, R. J., 2001. Analysis of the Looting, Selling, and Collecting of Apulian Red-Figure Vases: a Quantitative Approach, in "*Trade in illicit antiquities: the destruction of the world's archaeological heritage*". In: Brodie, N., Doole, J., Renfrew, C. (Eds.). 145–153, Mc Donald Institute, Cambridge, UK.

Eurostat: *Culture Statistics*, 2017 Edition.

Favaretto, I., Bodon, G., 1999. Proposta per una programmazione informatica delle collezioni veneziane di antichità, in *Collezioni di antichità nella cultura antiquaria europea*, Fano Santi, M. (Ed.). 108–117, G. Bretschneider, Roma, Italy.

Favaretto, I., 2000. Origini del collezionismo nel Veneto, in *La curiosità e l'ingegno. Collezionismo scientifico e metodo sperimentale a Padova nel Settecento, pp.*51–67, Università degli Studi di Padova, Centro Interdipartimentale di Servizi Musei Scientifici, Padova, Italy.

Favaretto, I., 2001. Ceramiche antiche nelle collezioni venete. Lo stato del problema e il punto sulla questione, in *Hespería. Studi sulla grecità di Occidente* 14, pp.157–169, L'Erma di Bretschneider, Roma, Italy.

Favaretto, I., 2013. Un problema aperto? La ceramica italiota nelle collezioni venete tra XVI e XVII secolo, in *Eidola. International Journal of Classical Art History* 10, pp.111–119. Fabrizio Serra editore, Italy.

Frank, B. E., 2007. Ceramics as testaments of the past: field research and making objects speak, in *Museums in the Material World,* in: Knell, S. J. (Ed.), pp.60–64, Routledge, London, UK.

Ghedini, E. F., Colpo, I., Favaretto, I., 2002. *Iconografia 2001. Studi sull'immagine*. Edizioni Quasar, Roma, Italy.

Ghedini, E. F., Colpo, I., Favaretto, I., 2006. Iconografia 2005. Immagini e immaginari dall'antichità classica al mondo moderno. Edizioni Quasar, Roma, pp. 544.

Ghedini, E. F., Colpo, I., Favaretto, I., 2007. Iconografia 2006. Gli eroi di Omero. Edizioni Quasar, Roma, pp. 296.

Ghedini, E. F., Rinaldi, F. and Kirschner, P., Tognon, M., 2007. Tess. La banca-dati online per i rivestimenti a mosaico, in *Archeologia e Calcolatori* 18, pp.13–43, CNR, Dipartimento Scienze Umane E Sociali, Patrimonio Culturale, Istituto Di Scienze Del Patrimonio Culturale, Roma, Italy.

Ghedini, E. F., Annibaletto, M., 2009. *Intra Illa Moenia Domus ac Penates (Liv 2, 40, 7). Il Tessuto Abitativo nelle Città Romane della Cisalpina*. Edizioni Quasar, Roma, Italy.

Giudice, F., Barresi, S., 2003. La distribuzione della ceramica attica nell'area mediterranea: dai dati Beazley alle nuove acquisizioni, in *Griechische Keramik im kulturellen Kontext*. In: Schmaltz, B., Söldner, M. (Eds.), pp.280–286, Scriptorium, Muenster, Germany.

Greco, C., 2016. Museo Egizio: la ricercar come chiave di un rinnovamento costante, in *Impresa Cultura. Creatività, partecipazione, competitività,* pp.215–226, Gangemi Editore, Roma, Italy.

Hilgert, M., 2016. "Definitely stolen?": Why there is no alternative to provenance research in archaeological museums, in *Museums, ethics and cultural heritage*, Murphy, B. L. (Ed.), pp. 210–217, Routledge, New York, USA.

Istituto Nazionale di Statistica: I Musei, le aree archeologiche e i monumenti in Italia - anno 2015, Roma 2016, Italy.

Istituto Nazionale di Statistica: I Musei, le aree archeologiche e i monumenti in Italia - anno 2017, Roma 2019, Italy.

Kim, S., 2018. Virtual exhibitions and communication factors, in *Museum Management and Curatorship* 33, 3, pp.243–260, Taylor & Francis Group, UK.

Kirschner, P., 2008. Progetto ADaM - *Archeological DAta Management Progetto per la creazione di una banca dati relazionale per la gestione dei dati di scavo*, PhD Thesis dissertation, *XX ciclo*, Università degli Studi di Padova, Italy.

Kurtz, D., 2009. www.beazley.ox.ac.uk. From apparatus of scholarship to web resource: the Beazley Archive 1970-2008, in *Archeologia e Calcolatori* 20, pp.37–46, CNR, Dipartimento Scienze Umane E Sociali, Patrimonio Culturale, Istituto Di Scienze Del Patrimonio Culturale, Roma, Italy.

Laga, H., Guo, Y., Tabia, H., Fisher, R. B., Bennamoun, M., 2018. *3D shape analysis: fundamentals, theory, and applications*, John Wiley & Sons, Hoboken, New Jersey, USA.

Luby, E. M., Lightfoot, K. G., Bradshaw, V., 2013. Archaeological Curation and the Research Value of Archaeological Collections. A case study from California, in *Collections: A Journal for Museums and Archives Professionals* 9, 3, pp.255–282, SAGE Publications Inc., New York, USA.

Luigini, A., Panciroli, C., 2018. *Ambienti digitali per l'educazione all'arte e al patrimonio*, Franco Angeli, Milano, Italy.

Ministry of Education, University and Research: Declaratorie dei settori concorsuali, Roma 2012, Italy,

Murphy, B. L., 2016. *Museums, ethics and cultural heritage*. Routledge, New York, USA.

Nørskov, V., 2002. *Greek vases in new contexts. The collecting and trading of Greek vases - An aspect of the modern reception of antiquity*, Aarhus University Press, Gylling, Denmark.

Phelan, M., 2016. Stolen and illegally exported artefacts in collections: key issues for museums within a legal framework, in *Museums, ethics and cultural heritage*, Murphy, B. L. (Ed.), pp.113–120, Routledge, New York, USA.

Salvadori, M., Scagliarini, D., 2014. *TECT. Un progetto per la conoscenza della pittura parietale romana nell'Italia settentrionale*, E-book. Padova University Press, Padova, Italy.

Sena Chiesa, G., 2006. La collezione Banca Intesa. Dalla raccolta Caputi alla nuova valorizzazione, in *Ceramiche attiche e magnogreche: collezione Banca Intesa,* Sena Chiesa, G., Slavazzi, F. (Eds.), pp.11-25, Electa, Milano, Italy.

Sena Chiesa, G., 2008. *Vasi immagini collezionismo*, Cisalpino Editore, Milano, Italy.

Srinivasan, R., Boast, R., Furner, J., Becvar, K. M., 2009. Digital Museums and Diverse Cultural Knowledges: Moving Past the Traditional Catalog, in *The Information Society* 25, 4, pp.265–278, Taylor & Francis Group, UK.

Stylianidis, E., Remondino, F., 2016. *3D Recording, Documentation and Management of Cultural Heritage*, Whittles Publishing, Dunbeath, Scotland, UK.

Voss, B. L., 2012. Curation as research. A case study in orphaned and underreported archaeological collections, in *Archaeological Dialogues* 19, 2, pp. 145–169, Cambridge University Press, UK.

Voss, B. L., Kane, M. S., 2012. Re-establishing Context for Orphaned Collections. A case study from the Market Street Chinatown, San Jose, California, in *Collections: A Journal for Museums and Archives Professionals* 8, 2, pp.87–111, SAGE Publications Inc., New York, USA.

Wingfield, C., 2017. Collection as (Re)assemblage: refreshing museum archaeology, in *World archaeology* 49, 5, 594–607, Taylor & Francis Group, UK.

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Digital museums: meaning, use, phenomena and ideas for the virtual twins adventure

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Abstract

In our time, the progressive digitalization of "everything" is moving the society to new behaviors and new paradigms in finding information, learning, visiting a museum, understanding artworks, and taking choices. The transformation is a part of the Industry 4.0 evolution and of the progressive advent of the Society 5.0, even if these definitions may appear a little rhetoric, it is impossible to Ignore, negate or neglect the expansion of the digital layer all over the cultural environments, the built heritage and on any kind of collections from those made of simple items, to those grouping rare masterpieces. At the base of any process of digital communication, creation of catalogue, development of a virtual environment and so on, there is the creation of a digital version of the real. The progressive increment of the accuracy of the digitalization process, even if yet far from perfection, brought the formulation of a very practical definition, the one of the "digital twin".

The digital twin is obviously the digital version of something real, existing, or just designed/imagined and next to be real in the following processes. This term seems to fit well any operation creating a digital copy of any manmade artefact, from the building to the artwork, creating the needed base for study, analysis, simulation, optimizing the level of details and the communication accordingly the aims of the project in which the digital twin production is included. In the museums, the recent development of very affordable ways to pass back from the digital twin to a physical copy has opened a series of possibilities that are worth of attention to any designer and cultural exhibition planner/manager, while they offer wide opportunities in presenting and communicating the collections as well as single items. In this contribution, a series of case studies, from the direct use of virtual digital models to the reproduction with scale variations of large statues and architectures will be explored in the intention of creating a taxonomy and some main guidelines in the use and development of the digital twins for cultural heritage and artwork collections.

In this process a specific attention will be due to the digitalization strategies, considering both the active solutions (i.e., the classic 3D laser scanner) to the passive ones (i.e., Photogrammetry), evaluating not only the accuracy and the massive data gathering, but the overall workflow and its compliance with professional and practical needs.

Keywords: digital modelling, digital copy, digital survey, multimedia, digital humanities

1. Introduction

Underlining how much the digital revolution has “flooded” the whole human society, changing behaviors, and integrating any process is almost a superfluous act, it is clear wherever anyone may take a look, and the depth of the transformation comes from an expansion growth in time. The age of development of many solutions talks by itself: first CAD interface and hardware + software in 1963 (Sutherland, 1980), first GIS system 1963 (Fazal, 2008), metaphor of the “desktop” interface 1970 (Baecker et al., 1995), first Mobile Phone 1973, first Personal Computer 1974. Starting from these early steps the evolution of technology at first walked, then it run. At the present state of these continuous digital innovations, museums have seen a great transformation in terms of content and the way of being understood and managed; the almost total diffusion of personal devices and the possibility of connecting to the global data network from almost anywhere, have been added to a large growth in variety and richness.

The recent pandemic event has pushed in the direction of moving online and enhancing the access to digital version of the museums. But this is just an occasional acceleration in an ongoing process. The digital evolution has led to a complex revision of the way of thinking about the museum, the permanent and temporary exhibitions. Significant effects took place regardless of whatever size and layout of the exhibition space, whatever the material on display, whatever the topics. From the specific museum to the larger one, the transition from static forms, marked by observation, to interactive forms is always present and visible. The scope of contents and how to present them has expanded enormously, the museum has become an exhibition and didactic machine, facing one of the most significant transformations since the birth of its concept.

The need to duplicate the museum has emerged, also by creating its digital double, possibly usable online, directly accessible from any computer device. The artworks, the masterpieces, the elements of attraction, have remained a central aspect, but the quality of the communication tools and the importance of the dissemination contents have become an extremely important and present element. The possibility of showing the visitor the intrinsic characteristics of work and the potential to represent non-visible elements have led to the development of specific and efficient communication solutions and have highlighted the importance of representation as a fundamental form of the transmission of concepts, theories, hypotheses, and anything else that can be associated with the reality of the place visited or the work observed. The representation, conducted through current digital media, therefore becomes an important communication tool: it allows the vision of what is not present, of the same work when it is far away, of the appearance of a place before its transformation, of a monument, work, city or single architecture, before its alteration or even destruction; it allows to represent works and architectures never realized, the fruit of the genius of artists and architects, but never materialized in their completeness.

The cases and combinations can be very numerous and multiple, but the centrality of the quality of the representation remains the element around which everything is articulated, not necessarily from an "artistic" point of view, but from that of the right balance between abstraction and concreteness, based on the extent of the level of imagination that is left to the visitor and based on the level of wanted communication completeness. However, it is a process for which the drafting of rules and the definition of procedures are still fully underway, and the cases of the solutions adopted, of course, can be very varied. The factor linked to innovation involves all the parties concerning about the planning of the museum or exhibition, poses large risks of rapid obsolescence and requires a solid knowledge of the relationship between potential and result on the part of who realizes the solution, but above all by those who commission and request it. This latter condition is not always present and potentially causes cost increases and possible missed opportunities. However, some basic examples can be identified for a minimal taxonomy of situations in which the digital contribution integrates and expands the museum's "real" exhibition function. These examples will be listed below, without claiming to be complete, but as a partial listing of application possibilities in which the factor of representation is very present in the definition of the result.

2. A new, more “expanded” concept of museum

Since its definition as a type of building, the museum presents, from an architectural point of view, two main elements that distinguish it. The first is its external configuration, necessarily capable of underlining the entrance

and denoting the appearance and importance of the place based on its relevance, as well as its relationship with the general project to which it belongs. The second aspect of greater importance is the internal architectural space, based on the same project will, but aimed at exhibiting, guiding, suggesting, and exhibiting works and contents. The internal space can also abandon the scheme of the outside. It can create spaces, volumes and paths that divert the visitors' orientation and which, in a positive sense, isolate them from the real context of the place from which they entered.

The visitors pass from an urban area surrounding the museum to the space of the visit, an environment and context different from the usual one, displaced in time and place from surroundings.

The exterior architectural apparatus becomes a sort of filter, a passage space that is the envelope of fascinating content. These two architectural areas overlap and integrate the exhibition apparatus, both in the overall form and in the single exhibitions. An apparatus more and more integrated by digital solutions, by multimedia that act robust interchanges between the virtual and the physical world. The ability to express effective communication becomes a fundamental element in all the situations where digital integration becomes an important and predominant element. Just few digital screens are capable of expanding spaces influencing the perception of the visitors, the clutter of a monitor can give access to spaces and volumes of information that do not correspond to the real size of that place.

This condition is favorable to teaching and concentration, however, requires appropriated and articulated environments, they should be strictly linked to the exhibition logic that is mediated and composed with the "museum machine". The whole system is then completed by secondary but fundamental service and storage spaces, and those of plant engineering. These articulated spaces are most of the time out of sight and access for the visitors, but they pump all the functions needed by their users for practical and comfortable needs.

The structure of these service spaces may be newly designed or an integration and expansion of existing structures, like historic buildings born as exhibition spaces or adapted to this role starting from a certain point of their existences. The coordination of these plants to the general efficiency of the exhibition system is something new, that open interesting and yet quite unexplored opportunities to the design of museum, influencing the sensations in certain rooms or even the behaviors of the visitors. Obviously, such a system strongly needs a digital/informatic control of all the features and probably moves the next step in museum design in changing it into a real "machine".

But today the concept of museum mostly appears closely linked to its exhibition system, to its contents, sometimes very focused on single items or artworks. When setting up specific rooms or exhibitions is needed, the aspect of digital tools becomes a strategic element. This happens because this is the time of IT revolution, and the attention of the users is positively oriented in the use of digital tools, a condition that supports the creation of the illusion that a digital display system may perform the magic of altering space and time.

A screen can present thousands of images in the same space, an interactive object can increase attention towards a real one, so that the visitor will dedicate more time to it; a virtual reconstruction can bring the eyes and mind back to an age far in the past.

In all the cases of permanent exhibitions, a design of new digital integrations should never be too exclusive or decisive, the whole exhibition system should not depend only on the presence of a digital layer and it should never super-impose itself over the artworks or original items. Any technological solution chosen, will certainly see evolutions and transformations, with new alternatives, within few years; an exhibition that is too rigidly anchored to spaces dimensioned on specific fruition procedures could soon be outdated or even inadequate.

The solution of adopting access procedures to the IT part based on the use of each visitor's devices is certainly interesting; it has often been proposed in recent times for the development of display solutions, to cope against the risk of obsolescence of the IT equipment made available to the public and with some significant effect in trying to contain the costs of an exhibition.

Using their tablets or smartphones, the users may have an additional guide and additional learning options, receiving data directly on a device of their own. It is a very practical solution, well capable of exploiting personal devices, making them even more useful and appreciated by their user. But at the same time, relying excessively on solutions of this type may prove to be in the medium and long term not such a brilliant choice, unless planning the necessary updating of contents and procedures based on the instruments available among

users. This involves a planning of activities - and investment - extended over time and capable of progressively adapting the options present in the exhibition to the technological development.

At the same time, those who organize an exhibition based on personal devices must always keep in mind the potential "discriminating effect" caused by the system requirements: if these are all pushed towards the most recent models, a part of the public will not be able to participate, with the risk to produce potential disappointment and ineffectiveness of the experience, especially in medium-sized groups, such as tourists' groups and students' groups.

In parallel to this, if every exhibition or museum today may integrate and enrich itself thanks to the digital contribution, it is at the same time true that for many of these richly complex spaces it is possible to create highly versatile and valuable digital versions. In this sense, the cases can be traced back to two main cases: exhibitions and museums that base their online digital twin on a model that closely resembles the physical form of the real architecture or exhibition, and those who prefer to create a different duplicate, independent from the aspect of the places, an "alternative" solution that can be very varied and then concentrates on the highest level of realism on the reproduction of the collections or on a multimedia variation on the elements of the collections. Some solutions are today very interesting, both for those who design the digital twins of the exhibitions and for those who are interested in the set of knowledge preserved therein.

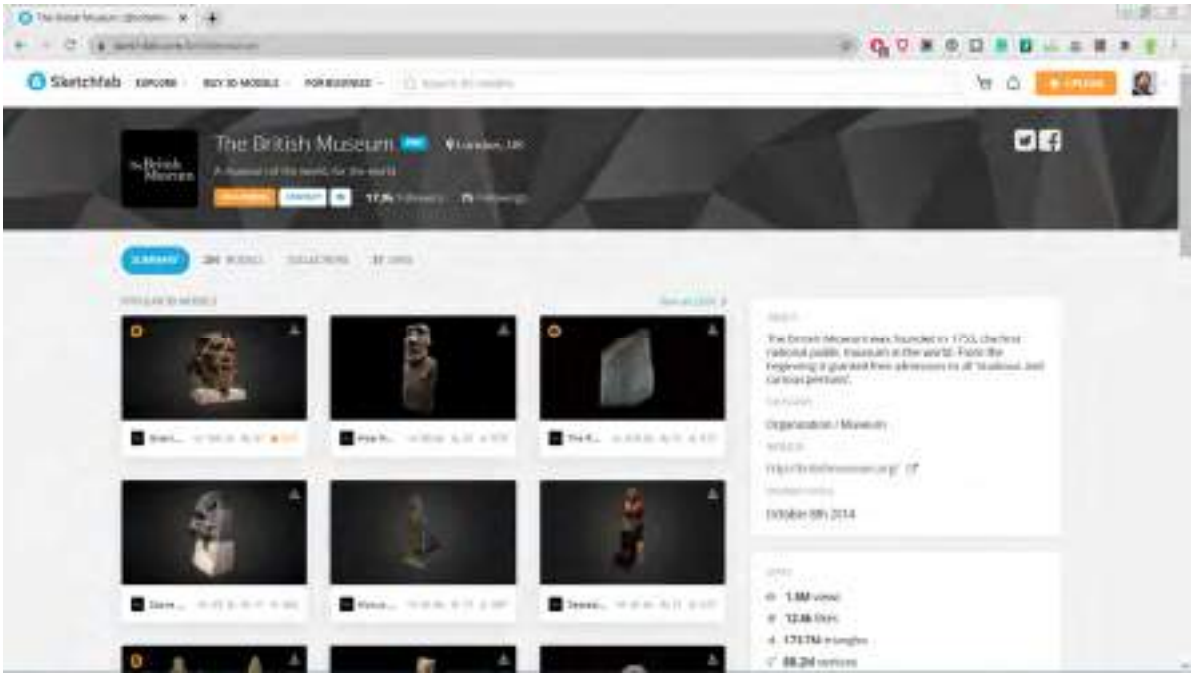

Fig. 1 . The British Museum profile in the Sketchfab system, www.sketchfab.com/britishmuseum.

The development and diffusion of the Sketchfab platform (www.sketchfab.com) starting from 2011 and its initial opening to museums with safe and cost-free data sharing offers, has generously relaunched the presence of digital 3D models that can be consulted by remote visitors. An example above all, is the British Museum, which on Sketchfab has started an extensive migration of digital pieces from its collections.

Other Museums, like the Smithsonian (https://3d.si.edu/), have preferred to use similar but different solutions for sharing the digitalization of their collections, sometimes making most of the models freely available at full resolution.

The evolution of digital surveying, especially in the field of photogrammetry, has been certainly an accomplice of this process, which has brought rapid and highly effective tools available to operators from different disciplinary areas. As a result, exhibitions, collections, and entire museums have accelerated the digitalization of their collections.

Thinking about this scenario, it is possible to organize a minimal shortlist of the Museum in the present digital age according to the following:

- Traditional Museums
  - Basic website (mostly to present the contents)
  - Social media profile (mostly to promote the activities)
- Museums with basic multimedia presenting/teaching solutions
  - Short videos,
  - Projections
  - Classic interactive displays
  - Simple online catalog of the collections
- Museums with advanced multimedia presenting/teaching solutions
  - Virtual and/or Augmented realities solutions
  - Complex projections
  - Physical interactive models
  - APP for the visitor's device
  - Advanced online digital twin of the whole museum or of large parts of the collections
- Museum with a complete online digital twin (Architecture space+collections)
- Museum with a digital online version (not strictly conformed to the real architecture or contents)
- Online only Museums

The real solutions may move from one element of the list to the other with a variety of declinations, thus this subdivision may be easily checked in many Museums all around the world. They all share the same orientation towards enhancing communication and capacity of spreading information, making the contents they present more and more capable to deliver knowledge and comprehension about the place (Arslan, 2021).

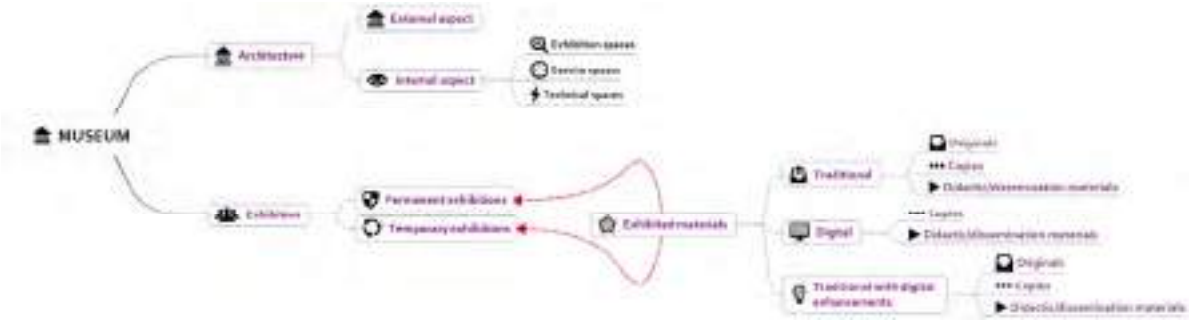

Fig. 2 . The museum and exhibitions in our time, an essential scheme of the architectural aspects and digital expansion of the exhibits.

3. Introverted and extroverted perspectives

The digital reconstruction of architecture or of urban parts is still a constructive operation and at the basis of its definition, there is the same logic operation that could create the foundations of any traditional, real reconstruction. Virtual reconstruction may perfectly work side by side to digital integration to the Museums, the creation of a 3D model on screen or in a physical maquette can be an excellent additional part to any exhibition, resolving uncertainties from the visitors and working as a perfect direct communication tool. However, there are substantial differences between every single reconstruction, to the extent that, as the number of available clues, required deductions, the determination of the result increases, while the request for abstraction from the user is reduced.

The will, often very strong and easily verifiable, of wanting to provide "certain" visualizations, significantly increases the demand for the solution of uncertainties by those who scientifically guide the reconstruction and this both in terms of references to other elements that still exist, and in terms of actual ideation, often necessarily forced by mere intuition and deductive process. The operation of "solving" and virtually recreating

what is missing therefore compares the idea derived from the clues recognized in existing buildings and projects over time, styles, and influences. For example, the apse of a church, present only in the archaeological trace and visible in its entirety only in a series of pictorial representations, even when these representations are idealized and/or "disrespectful" of the current rules of representation, can gradually be brought back to a "credible" entity through the comparison with existing buildings of the same period but also understanding how the perception of space has influenced the old representations.

The past process of drawing may differ from the rules of contemporary perspective, making more difficult to have accurate reference elements. Most of the time, starting from few drawings, those who carry out the reconstruction first develop a sort of "introverted perspective", they collect tangible and direct ideas, defining and then selecting the terms of reference, making use of their own visual and cultural heritage experience.

They are called to compare theories and textual and graphic suggestions, coming from pre-existing archives and studies, applying a metrological analysis to what is available and trying to extend a possible layout to the missing parts.

This step can take on a real aspect of reverse design, the one aimed to going back to the reasons of the original project, a retro-designing process starting from the traces and such as to restore the built heritage in a form that, if not properly identifying, at least will show a deep understanding of the past, or, at least, will present a happy intuition. This last step is not particularly original; numerous authors from the past two centuries have ventured into this kind of identification.

Often, they reached a “vision” more than a clear understanding of their predecessors, sometimes operating in order to "restore" and reconstruct the places, not in virtual forms, but often with the materials taken from the reality and working directly on the sites. But this process took place with a profoundly different attitude compared to the options available in the present time.

Even if, wishing to see it in a poetic way it looks possible to assert that time itself proves to be elusive on this topic, almost changing its duration according to the cultural transformation: the restorers of the nineteenth and early twentieth century operating on built and archaeological heritage seem able to operate a special passage, moving their intervention procedures to a position culturally close to their ancestors, they can mimic their choices and read and interpret processes in a way that is difficult to implement in the present, they seem closer in thoughts to the ancient authors, centuries and centuries away from them, than what operators today looks if compared to these past engineers, architects, archaeologists, distant, in time, only a few decades.

The available clues, according to their degree of reliability and according to the level of transformation with which the architectural space has reached the present time, define the obtained model, giving support and mediating intellectual speculation, defining a very complex interweaving of elements, from which the resulting proposal will come out in more than one single solution. But an excessive indeterminacy can never benefit the visitor of a museum, just few people visiting an exhibition collecting the various versions of a reconstruction may really appreciate the possible variables in the various cases.

If telling the story of this uncertainty can be an engaging narration, its communicative ability can support the reading and interest of any visitor, but if the uncertainty is only due to the loss of traces, or the tangle of clues, it is often preferable to present to the public only what is considered the best option between the range of possible ones. The in-depth analysis and the many variables may just remain available for scholars in proper contexts.

The multiplicity of possible solutions will have to be traced back to a preferential choice, something subject to further possible variations, but the chosen solution must be presented with the right level of comprehensibility to the observers, it must be capable of transmitting extended contents, like the design will and the meaning of the place in its ancient/original aspect.

The choices about the form of presentation becomes a fundamental moment. In example, a single representation, in axonometry or perspective, however detailed, will leave a lot to the imagination of the observers who will complete the hidden parts.

A map with all the level of accuracy, properly mapped, may be a good companion to every reconstruction exhibition; different colours will identify the various level of accuracy in the resulting model. At the same time extremely realistic and scenographic representation may sacrifice to spectacularity too much of the possible choices from the visitors. In other words, virtual reconstruction is a work of teaching by images and balancing the graphic message according to intentions. Until the graphic choice does not influence the honesty of the reconstruction.

Considering some case studies that apply these concepts may help to better describe the way this process works.

Fig. 3 . Preparation of the physical models of the Montecastrese fortifications and setting up of the Civic Museum of Camaiore.

3.1 A lost fortification nearby Camaiore, Tuscany, Italy

The operation carried out for the reconstruction of the Montecastrese fortification near Camaiore, destroyed in 1224 and presented in the form of a virtual reconstruction at the Civic Museum of Camaiore in 2016, fits into the previously described procedure.

The representation, based on a large view of the digital model of the reconstructed, is accompanied by two simplified touchable physical models of the present state and a hypothesis of the original state, a solution that, graphically and with a significant reduction in the level of detail, manages to transmit the transformation from a fortress to an agricultural area with terraces, trying to communicate the strong and dominant aspects of the ridge in its medieval state.

In this way the models suggest a clear reading of the relationship between the landscape part and the fortifications, supported by explanatory drawings, videos about the exploration of the area with an aerial camera and leaving, various copies of architectural fragments and leaving the rest to intuition.

3.2 The destroyed citadel in Arezzo

In front of the previous this is a more complex case, most of all because the complete destruction to the basements of a whole citadel. The ancient Cathedral of San Donato al Colle del Pionta in Arezzo was destroyed with all its settlement in 1561.

The investigation here has required completeness of details and the resolution of all the architectural spaces, supported by various data gathering methods, included visiting other real context with well-preserved and potentially similar architectures, so to capture every possible evidence for the reconstruction. Only minimal traces of the whole citadel remain.

A medieval Cathedral of extreme reconstruction difficulty, for which interpolating between data from the digital survey of the area, multidisciplinary analysis, study of the available iconographic repertoire and identification of comparable elements, it was possible to develop between 2014 and 2016 a first reconstruction that can be completely visited with immersive visualization (based on an Oculus Rift system)[1].

The whole set of reconstructions and digital contents connected to the research was used in the exhibition “Sacre Macerie, Arezzo torna al Pionta” (Holy ruins, Arezzo goes back to the Pionta Hillock) which took

[1] The cultural association Academo, "R. Pellegrini" (www.arezzoperlastoria.it) has promoted the research and supported all the phases of the intervention project for the Colle del Pionta. The research unit for the Department of Architecture, University of Florence is composed of G. Verdiani (Coordinator), F. Tioli (topographical survey), A. Pasquali, A. Mancuso, M. Pucci, I. Giannini, G. Chiti, A. Frascari. Data processing: G. Verdiani, M. Pucci, A. Mancuso, I. Giannini, G. Chiti, C. Gira. Geological survey and materials analysis coordinated by dr. S. di Grazia. In collaboration with Dr. S. Vilucchi of the Archaeological Superintendence of Tuscany and prof. A. I. Volpe.

place in Arezzo in December 2017-January 2018, a selection of digital materials assembled in a video was later hosted at the National Archaeological Museum "Gaio Cilnio Mecenate" in Arezzo.

Fig. 4 . Virtual reconstruction of the Cathedral of San Donato on the Pionta hill, Arezzo (C Gira, 2016).

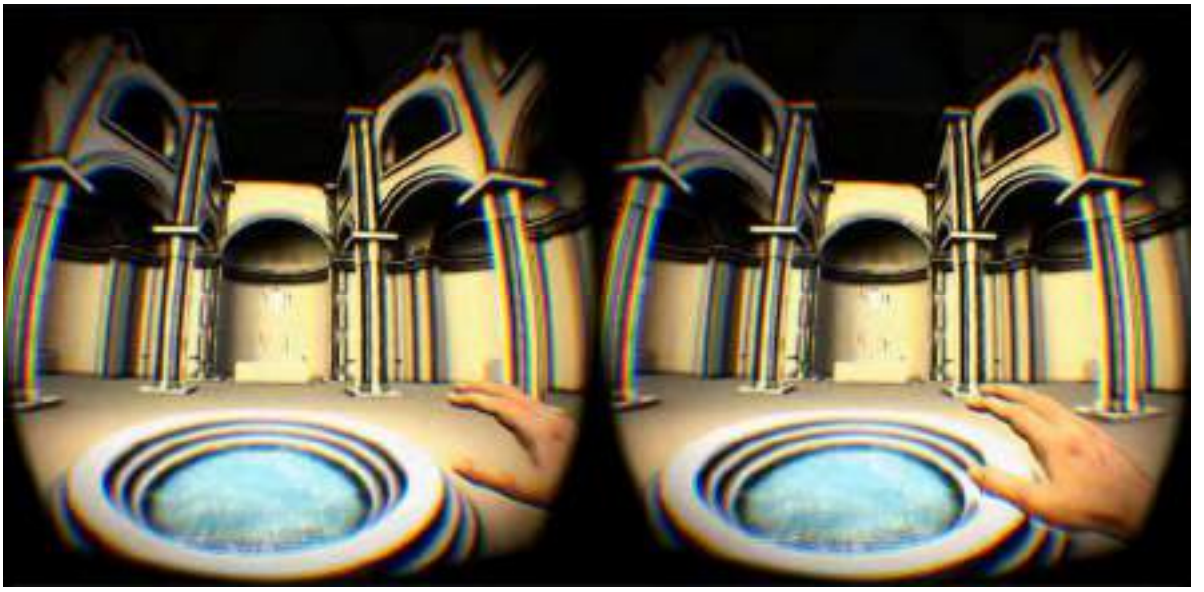

Fig. 5 . Visualization through Oculus Rift SDK2 with Leap Motion of the virtual model of the Cathedral of San Donato at the Pionta hill, Arezzo, internal view (C Gira, 2016).

The relationship between digital reconstructions and exhibition spaces highlights a fundamental characteristic of the set-up and presentation based on virtual spaces, which is the need to present, above all, the quality of contents that should be always a priority factor. The preparation of the operators who perform the virtual reconstruction, therefore, becomes fundamental, both from the point of view of the technical and cultural aspects necessary to define the appearance of the lost place and from the understanding of the technological solutions

available to visualize the result, with a multimedia direction able to understand the didactic act as well as the will and the pleasure of creating surprise in the observer. This requires a type of training of its multidisciplinary nature, which must coordinate very different aspects, rarely (and not necessarily) available in a single figure, but possible and desirable in the coordination of projects of this type. The result of this process will, in any case, be directed towards the users, will bring out the results of the individual operator or research group towards a more or less wide audience, will place the result in an "extroverted perspective" aimed at the observer and intended to convey a summary of what is understood, and which has reached sufficient completeness to be defined and presented. A condition which, however, it would be erroneous to consider always as fixed and stable. The model produced, even if represented according to only one of the methods listed above, encounters an important test bench in the same virtual implementation phase, sets up a comparison with the real "realization" of the hypothesized model and, placing it in a public context exposure, may receive interesting ideas and be able to introduce further alternatives and variables.

4. Some reflections on the context

The virtual reconstruction of a place requires an appropriate context; this is most often well defined by the designer of the installation but must always be consistent and facilitate understanding of the proposal. Conditions change, even radically, according to the tools used: the use of a static image, a video, an immersive space, or an interactive element requires different spaces and moments of perception. A physical model, a representation of the reconstruction, will have its footprint and the people who stop to observe it will take a space and further space must be reserved for the passage of visitors not interested in this stop. A large, illustrated panel will be best viewed from a specific distance, but at the same time, the design of that space must contain and mitigate the presence of other visitors, who must not be able to become an obstacle to the visit of others. Similarly, it will happen for a monitor that presents a video, and herewith even more important, given the potential risk of missing a passage of interest.

The presence of solutions animated by sounds and music must always be positioned and calibrated concerning the general layout of the exhibition, avoiding confusing, distracting, and interfering with other sectors of the above. Sounds and music can draw a visitor to a room, but if the sounds are too permanent for the entire space of the visit, this could easily be unwelcome. The production of appropriate multimedia, however, opens up an extremely complex front. The spectacularity of graphics and animations often does not derive strictly from the Cultural Heritage themes, but from cinematic and videogame contexts that have redefined many concepts of antiquity in a "pop" version. The general visitor -not a scholar- perhaps does not seek the spectacularity of a film as an end in itself, but often he is certainly not disappointed by it, and a lively, dynamic sequence, which shows reconstructions of a past time supported by music, something with the "Cut" of an epic film, inevitably favours the taking of the theme. Even if in indirect form, a remarkable ability to catch the public attention of a place, an archaeological site, a castle, or a set of particular finds, now a day, may pass from this order of products and with an increased ability in attracting the attention.

Obviously, the hope is that this variation in communication may help in obtaining more resources for scientific activity and not only conveying them in building more and more spectacular shows. However, it is preferable that this product is developed with consistency and positive commitment, so that all the present elements are correctly represented and well balanced, not the victim of excessive scenic effects. While avoiding excessive spectacularity can produce more reasoned products, at the same time the attempt to attribute an excessive "scientific nature" to the virtual reconstruction process may produce equally limiting effects. The number of variables, the level of approximation and the complexity of the choices to be made during reconstruction are very often of such magnitude and articulation that talking about repeatable and verifiable processes is risky; it can be understood as a process to be developed according to clear rules, but the level of personalization for each specific case makes the empirical factor important. On the other hand, those processes of interpretation and structuring of repeatable rules for reconstructions and those which are still under development (London Charter 2009, Sevilla Principles 2011). Last but not least, it is important to remind the importance that any reconstruction should have a support drawing where all the parts are classified by their level of accuracy, a subdivision that may help, especially other scholars, to understand the complex of choices and the degree of reliability of each part presented.

These are procedures mainly based on the attribution of different colour levels based on the level of abstraction

exercised and still being defined according to a single standard. These mapping criteria will allow, if adopted, to increase the readability of the reconstructive process, facilitating the transition between different studies and allowing a gradual growth of certain models (Apollonio, 2016).

5. Designed hypotheses and realized hypotheses

Any architectural reconstruction always starts with clues, which can be of various entities: sometimes they can be certain documentary evidence, such as the presence of ruins, drawings and representations, photographs, archive documents, written descriptions. Sometimes the digital reconstruction takes place with one or more reconstructions made previously behind it. This whole set of traces, however evident and complete, may still require deductions aimed at reconstructing missing parts. In other cases, the traces are minimal, only the concept or a few historical traces of the building are present, the ruin is missing, detailed descriptions are lacking, the location of the building is missing. In other cases, the very idea of the building may also be missing, there are only some parts of it, perhaps even dismembered, but no further traces other than a few architectural elements. Still, the building may never have existed or, better still, have only been designed, so there are only a few drawings of it, sometimes even a single representation. These situations do not necessarily require very ancient contexts to materialize. Situations of war, seismic events and other disasters, inappropriate use and neglect, the dispossession after abandonment, the evolution of the city that requires space and new structures, have led in the past and will continue to lead to the disappearance of architectural structures for which, later, virtual reconstruction may be of interest. This image of the present should remain a clear vision for every operator who faces the themes of the hypothetical reconstruction of transformed or abandoned places. Our present is populated with abandoned and disused buildings, unfinished structures, and construction sites. This is likely a permanent human condition, not a phenomenon of our time. It may have increased due to the greater size of cities and urbanized areas, but the coexistence of structures in use with abandoned areas and areas under construction is necessarily a possible coexistence in all periods. The large archaeological sites, the vast areas populated by ruins of various types, do not necessarily indicate a single phase in which the entire area visible today as a ruin was vital and active; on the contrary, the image of the ruins can convey the impression of a system that despite having developed over a multiplicity of years has been completely used in the same period. The vast rocky areas can be a very clear example of this concept, the incredible number of churches and settlements, such as those present in Cappadocia, Turkey, can suggest a very large and exceptionally devout population, but at the same time, there are no demonstrations. of the coexistence of such large populations or simultaneous use of entire settlements. It is credible to imagine that with the progressive expansion of the settlements, the parts subject to degradation were simply abandoned, or "downgraded" to ancillary uses, in favour of the new ones (G. Verdiani 2013). But the image that is received is nevertheless that of the vast settlement, the story received on the spot tends to lead to astonishment, not necessarily to reasoning. Those who carry out the reconstruction process must read and listen but must keep their logic and interpretative capacity attentive: the most widespread belief can often contain both concrete factors and potential deceptive elements.

Wanting to give a logical structure to the virtual reconstruction process, considering an architecture or a site of which visible traces remain, this can be developed, not in order of importance, but in a logical and operational order, as follows: 1) collection of information about the specific theme; 2) any survey of the state of affairs when this type of documentation is not already available or not sufficiently detailed/reliable; 3) definition of a set of graphic drawings useful for the development of the reconstructive proposals: 2D drawings and 3D model for surfaces; 4) analysis and in-depth study of the historical context, of the construction phases, of the comparable elements, of the units of measurement of the time to which reference is made, of all the specific and unique elements of reference for the study carried out; 5) development of a reconstructed model starting from the 2D and 3D bases, developing the proposal from the first or second ones according to the procedure recognized as necessary for the specific case; 6) phase of comparison and analysis with other skills, testing the result, any corrections and variations in the reconstruction choices; 7) definition of the final model, single or multiple result of the previous process; 8) definition of the form of presentation to the public of the reconstructed product, improvement of the model based on exhibition needs; 9) development of secondary analytical and presentation models useful for fixing the process and sharing it with other scholars; 10) disclosure and dissemination of all the research products.

In the case, on the other hand, of architecture or urban part that is completely lost or never built, the process

remains the same, but with the replacement of point two with a significantly different approach which will be: the study of the area of presumed or ascertained construction of the work and collection of all the material useful to allow the definition of a plausible basis for the reconstruction. Wanting to give an example of a case where the "collection of materials" takes on a specific aspect, consider the now "historical" intervention (as it was developed over ten years ago, a very long time for digital media) implemented for the Buddhas of Bamiyan, in Afghanistan, disastrously destroyed in 2001 by the Taliban. For this lost monument, the reconstruction was carried out by photogrammetry starting from the set of documentary and tourist photos available globally. An appreciable digital solution to recover, at least in part, a criminal social and cultural disaster (Grün et al., 2004).

Both for the intervention in a context of pre-existences and fragments, and in the case of the non-existence of visible traces, for point five the procedure, as already mentioned, is very varied and dependent on the object itself and can often require a real process of "retro-design" or "reverse design". This particular approach asks the reconstructor for a clear understanding of the architectural language, of the technical issues, but above all of how the architects of that specific time thought about the project. A very complex work in which the use of contemporary digital tools is essential, but where an elastic and intelligent way of thinking about architecture will be the basis of any significant achievement. It will be necessary to reach a meaningful abstraction to capture the thoughts and logic of a bygone era, but a creative approach and any lucky insights will only help. In the interpretation of the missing architecture, all the certain and concrete references will be fundamental, not subject to variation concerning their evidence, while, for everything that must necessarily be left to the imagination, the identification of design schemes, practical choices, the relationship with the ancient natural territory, the construction techniques of the time, will lead to configure the operational scenario as a kind of journey to rediscover the past. This process may require a well-organized group of skills, but at the same time, it will also need a strong ability to eliminate all influences to rethink the reason for the project from scratch, identifying from scratch the problems and ideas that have moved the design choices.

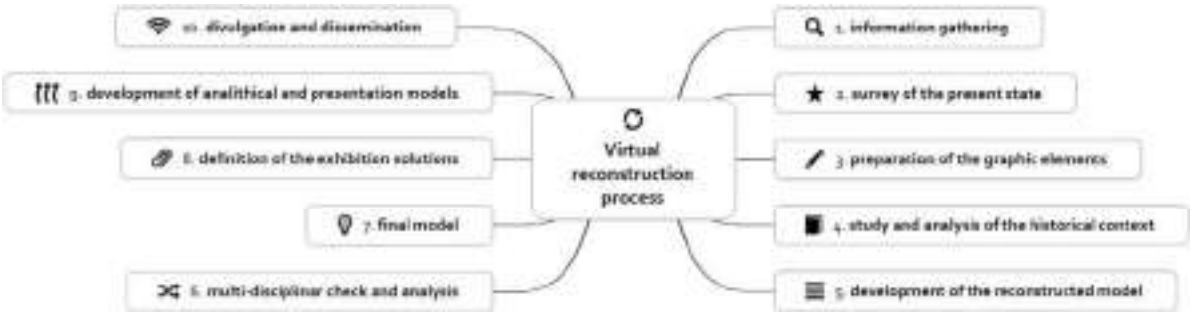

Fig. 6 . An efficient process hypothesis for virtual reconstruction procedures.

Once the reconstruction is complete when the model that concentrates all the theories and reasoning developed will be completed, we will proceed to the definition of the solution in which it is to be presented, defining the most suitable solution for the exhibition project. In the more complex case among those already illustrated, namely that of presentation through an interactive digital model, two quite different cases will arise based, first of all, on the real dimension of what must be presented.

First case: small and medium-sized objects, "manageable" objects (such as pottery, tools, accessories, weapons, etc.) or even only "inspectable" under the virtual condition and free from physical problems of the digital model (such as vehicles, statues, statuary groups, small architectures, constructive elements, etc.); for this category of elements, the model consultation procedure will inevitably refer to the classic interaction operations, namely linear movement, rotation, a variation of the point of view (Habakuk Israel, 2016), possibly supplemented by additional solutions, such as, just to give some essential examples, the variation of the lighting, the variation of the applied texture, the consultation of descriptive cards of the specific characteristics of parts of the object, etc. (Guidi et al., 2015).

For objects of architectural scale, the interactivity may be based, in addition to previous operations, also on processes that allow credible access and visit the architectural space, with the consequent need to define the rules of interaction between architectural elements and visitors. Consequently, you will choose the degree of freedom

you want to give to the visitor in the virtual space, or if you want to offer him an experience that simulates the real (mainly: movement bound to the ground with a human-sized point of view, the impossibility of passing through the objects) or if you want to make the visit surreal (possibility of flying, falling from high points, passing through obstacles). The elements of the interaction can be very varied. Since this is a first-person visit, the possibility of interaction with elements capable of interacting such as movable, interrogable objects, virtual actors, events subject to variation depending on the visitor's behaviour will be limited in complexity and articulation only by the choices and the will of the programming. The opening of models of this type towards a system of "serious games" (adopting a very widespread term in the context of interactive computer graphics for cultural heritage) is very immediate and once again mainly depends on the will and possibilities of those who coordinate the multimedia presentation project (Hale and Stanney, 2014).

6. Conclusions

Our age is characterized by the digital revolution and this involves and transforms procedures, methods and forms of communication and understanding, how much the way of representing what is not there has changed can be seen watching movies and video games or multimedia applications. Any cultural heritage operator or common visitors find themselves moving in an expanded context of great complexity, where the technological preponderance imposes rules that are not always easy to grasp by all the operators of a multidisciplinary group, but for which, often, the boundaries and the real possibilities of use can still be something to discover. Although obvious, this broad and rich context highlights a fundamental need that at times still seems at risk of neglect, namely that of coherence and content, of the realization of reasoned and coherent projects that allow effective adoption. and a real and profitable benefit in the adoption of the multimedia presentation project for Cultural Heritage, a scenario in which digital reconstruction inevitably plays an important and strategic role.

References

Apollonio, F.I., 2016. Classification schemes and model validation of 3D digital reconstruction process, in *Proceedings of the 20th Cultural Heritage and New Technologies*, Museen der Stadt Wien – Stadtarchäologie, Börner, W., Uhlirz, S. (Eds.), Vienna, Austria.

Arslan, P., 2021. A Museum in between: Troy; Past, Present, Future, in Verdiani, G., Brodini, A., Collotti, F.V. (Eds.), *Proceedings of the first ArCo Conference, Art Collections 2020, Design and Museum Design, Digital Heritage, Historical Research, Posters*, Didapress, Firenze, Italy.

Baecker, R. M., Grudin, J., Buxton, W. A. S., Greenberg, S., 1995. *Readings in Human-Computer Interaction: Toward the Year 2000*, Second Edition, Morgan Kaufmann Publishers, Burlington, Massachusetts, USA.

Fazal, S., 2008. *GIS Basics*, New Age International Pvt Ltd Publishers, India.

Habakuk, Israel J., 2016. Mixed Reality as Design Space, in *Kultur und lnformatik, Augmented Reality*, C. Busch and J. Sieck (Eds.), Verlag Wemer Hülsbusch, Berlin, Germany.

Hale, K. S., Stanney, K. M., 2014. *Handbook of Virtual Environments: Design, Implementation, and Applications*, Second Edition, CRC Press.

Grün, A., Remondino, F., Zhang, L., 2004. Photogrammetric Reconstruction of the Great Buddha of Bamiyan, Afghanistan, in *The Photogrammetric Record* 19(107): 177–199, Blackwell Publishing Ltd. UK.

Guidi G. et al., 2015. 3D visualization of cultural heritage artefacts with virtual reality devices, in *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, Volume XL-5/W7, 2015 25th International CIPA Symposium, Taipei, Taiwan.

London Charter (2009). From: www.londoncharter.org (accessed May 2020)

Sevilla Principles (2011) da: www.arqueologiavirtual.com (accessed May 2020)

Sutherland, I. E., 1980. *Sketchpad: A Man-Machine Graphical Communication System*, Garland Publishers, New York, USA.

Verdiani, G., 2013. Il vuoto e la sostanza: breve visione sul paesaggio della Cappadocia. In *Network in Progress*, vol. 13, Italy.

Verdiani, G., Pucci, M., Gira, C., 2016. A special eyesight to a lost past: Oculus Rift, Google Cardboard and SketchFab to support the digital reconstruction of the St. Donato cathedral in Arezzo, Italy, in *Kultur und lnformatik, Augmented Reality*, C. Busch and J. Sieck (eds.), Verlag Wemer Hülsbusch, Berlin, Germany.

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Technology and religious architecture: a virtual reconstruction of the *tramezzo* at *Santa Croce* in Florence.

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Abstract

This conference paper aims to demonstrate the effectiveness of digital survey and virtual visualization technologies as tools that can be successfully applied both to the research and to the communication of the Cultural Heritage. The chosen case study for this paper is the lost tramezzo of the basilica of *Santa Croce* in Florence, the current subject of my PhD research at the University of Florence. The *tramezzo*, or 'rood screen', was an architectural partition structure that separated the area dedicated to the clergy from the area dedicated to the laity in medieval Italian churches.

The *tramezzo* in *Santa Croce* was a tall structure, richly carved and decorated with frescoes and panel paintings, and played a crucial role in respect of the liturgy, the use of internal spaces and the aesthetics of the church. Like the majority of the other similar structures in Italy, it was demolished in the 16th century as a result of major changes in style, aesthetics, and liturgy. Since the 1970s, a growing field of studies tried to investigate these lost elements, in the attempt to understand their original appearance, function, and architecture. At present-days, scholars have at their disposal a wide array of new technologies that could be fruitfully implemented within the research process to gather new datasets. Also, digital visualisation technologies can help disseminating and communicating the results of the research to a wider audience.

Keywords: Florence; Santa Croce; Tramezzo; Rood screens; Medieval architecture; Virtual reconstruction; Mixed reality; Augmented heritage.

1. Introduction

Digital Heritage is a rapidly expanding area of research, with multiple contributions from a wide range of areas, and quickly developing forms of multidisciplinary approach. Within this broad area of enquiry, the topic of the digital reconstruction of the Cultural Heritage is gaining a considerable attention, testified by the sheer number of conferences, publications, and research projects that have been dedicated to this topic over the course of the last decade. Also, due to its possible applications for communication and audience engagement in the industry of tourism, a key economic asset of the "old continent", the Digital Heritage is slowly creeping outside of the academic spectrum, and gaining a much more media-oriented public face. Museum and galleries visitors around the world, on the other hand, are much more accustomed today than ten years ago to be confronted with digital interpretation as a natural complement of any museum visit. Interactive touch-screen panels, hand-held tablets, wearable devices, apps and smartphones etc., gradually, but systematically, settled within museums, collections, and monuments all around the world (Mandarano, 2019).

Within this multi-faceted context, scholars have repeatedly pointed out the lack of an international, well-established standard for the documentation, the representation and the visualization of digital heritage research. Many teams have tried, over the course of the last decades, to bridge this epistemological gap with varied types of interventions, from the creation of web-based tools for documentation and dissemination (Grellert et al. 2019), to the fine-tuning of general principles in the field (The London Charter; Seville Principles), to the planning of ontologies designed for the purpose.

This paper will analyze in great detail a very specific context and try to trace links between all the different problems related to digital cultural heritage research and communication. Firstly, we will try to briefly outline the art-historical, architectural and documentary problems associated with this kind of research. Secondly, we will explore how digital technologies could help uncover new datasets that were inaccessible to previous generations of scholars.

Finally, we will take into account the contradictions and the problems that such methodologies rise, ranging from the necessity of achieving academic robustness, to the challenging task of disseminating the research results to a wide public through a user-friendly experience, while retaining richness and philological transparency of information.

This paper is focused on my doctoral research at the University of Florence, currently in its second year. The study aims to display the present state of research, drawing attention to the most problematic aspects that emerged during the first year of work. Therefore, the research results and the 3D models published in this article must be intended as temporary, rather than final research outcomes. I will articulate the future steps that are necessary to gather sufficient data, and how this data could be and implemented within a broadly accessible and user-friendly digital dissemination structure. I will also outline what are the most promising virtual interpretation technologies that could be useful for communication and educational tasks.

2. The historical context

The *tramezzo* in *Santa Croce* was an architectural partition structure that divided the church cross-wise, separating the areas occupied by the clergy and by the laity. With a series of articles and publications, Marcia Hall (1974; 1978) gave birth to the area of research dedicated to the reconstruction of these lost elements. In her publications, Hall focused on the two most important mendicant churches in Florence, the Dominican basilica of Santa Maria Novella and the Franciscan basilica of *Santa Croce*. Since then, many scholars have deepened the knowledge about these fascinating medieval structures (De Marchi, 2009; Giura, 2011).

The distinct lack of extant visual, material, and archival evidence makes the study of the form and functions of this lost structures a very complex task. Marcia Hall herself combined, in her studies (Hall 1978; 2006), several different research methodologies, involving architects and paleographers in her research, gathering insights from a varied array of archival, documentary, iconographical, and archaeological sources. In this respect, Marcia Hall pioneering studies already conformed to the multi-faceted and multidisciplinary approach that characterises modern Digital Art History research.

A comparative, typological study of the *tramezzi* in the Italian peninsula is hindered by the fact that the majority of these architectural elements were torn apart in the 16th century. In Italy, less than a dozen survive in their complete form, and none of them are found in grandiose mendicant churches like *Santa Croce*, offering elements of comparison that are hardly useful for this research.

Many rood screens survive in northern Europe, especially in modern France and Great Britain, but, despite several scholarly contributions on this topic in the last decades, the relationships between the Italian *tramezzi* and their north-European counterparts are far from being well-understood (Cooper, 2017).

Built between 1332 and 1338, the *tramezzo* in *Santa Croce* was a richly carved and decorated structure, spanning the entire width of the church, boasting four private chapels with stone cusps up to 14 meters high. It had an immense visual impact within the interior of the church, being also the exhibition stage for painted panels, crosses, and even special sacred representations held during religious festivities. The vast majority of the *tramezzi* in Italian mendicant churches, including the one in *Santa Croce*, were demolished as a result of profound changes in taste, religious aesthetics and liturgy, to some degree reflected by the dictates of the Council of Trent.

An accurate drawing of one of the chapels that were part of the *Santa Croce tramezzo* survived to the present-days and is now preserved in State Archive of Florence (Fig. 1). It is a single parchment sheet drawn with pen, ink, and watercolour.

Most importantly, it shows a scale with the unit of the "arm", the most common unit of measure of length during the Middle Ages all over Tuscany. This allows to take measurements from this design. This is the most important historical visual source about the *tramezzo* in *Santa Croce*. It is a very rare artifact, as there are no other known examples of a design project for a part of a rood screen in Italy (Ascani, 1997).

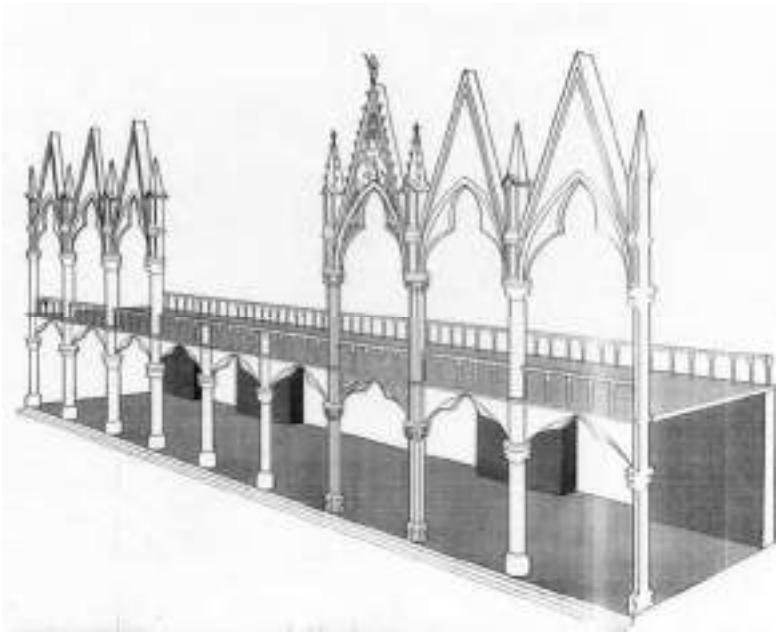

Fig. 1 (left). 14th century parchment drawing with the façade of the Baroncelli chapel of the *tramezzo*. 80,5 x 29,1 cm. © Giovanni Martellucci, SAGAS – *Università di Firenze*.

Fig. 2 (right). Marcia Hall's 2006 reconstruction of the *tramezzo* in *Santa Croce*.

Marcia Hall's 1974 and subsequent reconstructions of the *tramezzo* (Trachtenberg 1997) are mostly based on two pieces of evidence: the project design of the Baroncelli chapel and the foundations of the structure, uncovered through archaeological excavations in the 1960s. There are several other sources that have been used, and we will discuss them in the following paragraphs. Advanced digital technologies allow present-day scholars to gather new datasets that were inaccessible to previous generations. By means of these digital surveys, the model can be emended and improved. Modern tools like LIDAR scanning, photogrammetry, or GPR were not just available at the time of the first research on the *tramezzo* of *Santa Croce*. Therefore, the error in the acquisition of data through traditional analogic means of survey is considerable, and always subject to a non-neglibile degree of subjective interpretation operated by the scholar.

3. Organizing the data

To proceed towards the definition of the best digital practice to acquire new data that could be useful for the reconstruction of the tramezzo, a fundamental step is to gather and classify the sources and evidences that we possess into different classes. This process is fundamental, as it provides key insights for choosing the appropriate digital investigation technique for each class of information. It is useful to enumerate the different created classes of sources, complementing them with a brief description of the typology of the information conveyed:

- Primary sources: all sorts of archival documentations directly or indirectly including information about the tramezzo. Burial logs, inventories of chapels, accounts, loans, and proof of payments all figure in this category;
- Secondary sources: direct or indirect descriptions of the structure found within art history books, descriptions, and various forms of texts; Giorgio Vasari and Lorenzo Ghiberti's accounts all fall into this category;
- Visual sources: graphic depictions of the structure, such as drawings, sketches, projects, or photographs of survived elements;
- Survived elements: all kinds of physical entities that made part of the structure or that were physically linked to it and that survived up to the present date. This includes marble reliefs, fragments of frescos, underground buried foundations, and painted panels originally displayed on the *tramezzo*.

Having properly classified the material at our disposal, it is possible to classify the typology of the information that we can extract from every class of data.

	Location	Structure and dimensions	Decorative elements	Chronology
Primary sources	✓			✓
Secondary sources			✓	
Visual sources		✓	✓	
Survived elements	✓	✓	✓	✓

Table 1. Taxonomy of the typology of information related to each class of sources.

Just from a quick overview of the resulting diagram (Table 1), it is difficult to underestimate the importance associated with the survived elements of the structure in regard to its final digital reconstruction. All these elements have been surveyed in the past in varied forms, but always with analogic means, such as traditional measure-taking and design, and always relying on interpretation to bridge the gaps of knowledge gradually encountered.

Based on this classification, it is possible to define the best possible digital investigation approach for each class of data. Visual sources and survived elements could uncover largely unexplored data assets if analyzed with the appropriate technology. The parchment design of one of the *tramezzo* chapels contains a large amount of structural and decorative information accountable for modeling and static information. Survived elements, on the other hand, as structural, decorative, or accessory parts of the complete ancient structure, are strongly tied to the final digital reconstruction, and must line up with every other remodeled

section of the whole micro-architecture. The following sections of this paper will present the digital survey work that has been carried out over the course of my first year of doctoral research, with particular attention towards the methodology applied in every case. Also, the survey operations that have been planned, but not yet realized, will be briefly introduced, to give a sense of what will be the next phases of the research.

4. Digital surveys

4.1. LIDAR scans

A 3D model of the interior of the church is needed in order to recontextualize the structure of the remodeled *tramezzo*. To fulfill its dividing function, the rood screen must have been joined up with the lateral walls in the side isles and with the pilasters in the nave in some way, either directly, with walls or vaults, or indirectly, through extensions, such as metal railings, or wooden enclosures. Therefore, knowing the exact absolute and relative position of each and every one of these elements is an unavoidable necessity. Laser scanning of the interior of the basilica and of the convent of *Santa Croce* has been carried out thanks to the help of Prof. George Bent and David Pfaff from the Washington and Lee University in Lexington, Virginia. This operation was made as a part of the *Florence As It Was Project*, an online, open access platform, aiming to digitally remodel monuments of the city the way they appeared at the end of the fifteenth century (*Florence As It Was*).

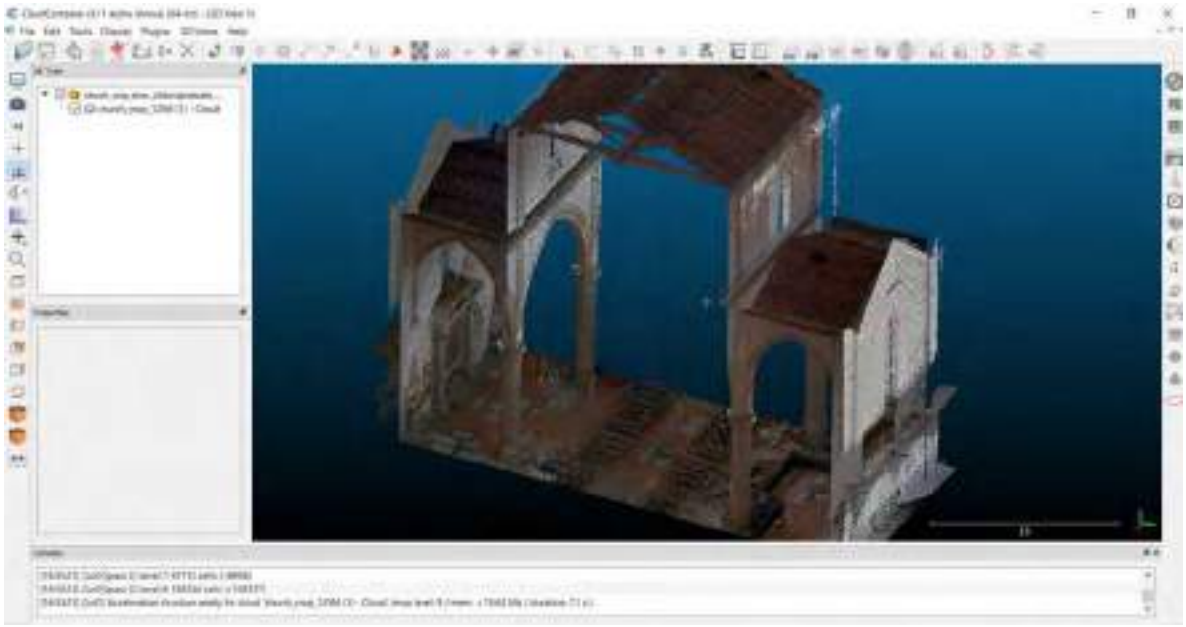

Fig. 3. 10 million point subsample of the Lidar point cloud, showing the fifth bay of the church, where the *tramezzo* originally stood. Software: Cloud Compare. © David Pfaff and George Bent, Washington and Lee University, VA (USA).

The survey operations have been carried out using a Leica BLK 360, a device composed of a 3D laser scanner equipped with digital optical cameras, combining the metrical precision of a point cloud to the chromatic richness of digital imaging.

A total number of 520 scans have been made, mostly made with medium density settings, and some (less than 10% of the total) with high density settings. The alignment and the stitching of every point cloud have been carried out using the Autodesk Recap Pro software running on a Apple iPad Pro device. We did not used targets, to maximize the number of scans in the shortest possible time, and over the course of one week in

February 2019 we collected a total number of 4.16 billion points, with the complete lossless point cloud weighing approx. 150 Gb in PTS format.

A three-dimensional point cloud created with this standard is very useful not just for visualization purposes, which potentially include dissemination, communication, and education practices, but also for getting new structural data (Fig. 3). Thanks to the gathered point clouds, it will be possible to obtain the exact positions and spatial relations of the side walls of the basilica and their relative distance to each other with a precision never reached before with any means of analogic survey.

While the model of the church is still in its raw, point-cloud form, nonetheless it allows us to take measurements from it, and in its future completed, post-processed form, it will provide a very useful digital environment, in which the model of the *tramezzo* itself could be re-contextualized. The two 3D models, *tramezzo* and church, will form a fully digital reconstructed medieval environment, suitable for both remote and onsite visualization experiences, such as, for instance, web browser viewers, or applications for virtual reality headsets.

4.2. Photogrammetry: the St. Martin relief

Photogrammetry has been used extensively to create 3D textured models of all the surviving elements of the *tramezzo* still on-site, or currently displayed in the *Opera di Santa Croce* museum or deposits. All these 3D models will be embedded within the final digital model of the *tramezzo*. I and Dave Pfaff got the opportunity to make a photogrammetric model of the current only known fragment of sculpted decoration of the Baroncelli chapel that survived the demolition of the *tramezzo* in the sixteenth century: the triangular low relief of St. Martin dividing his cloak with the beggar, currently in the deposits of the *Opera di Santa Croce*.

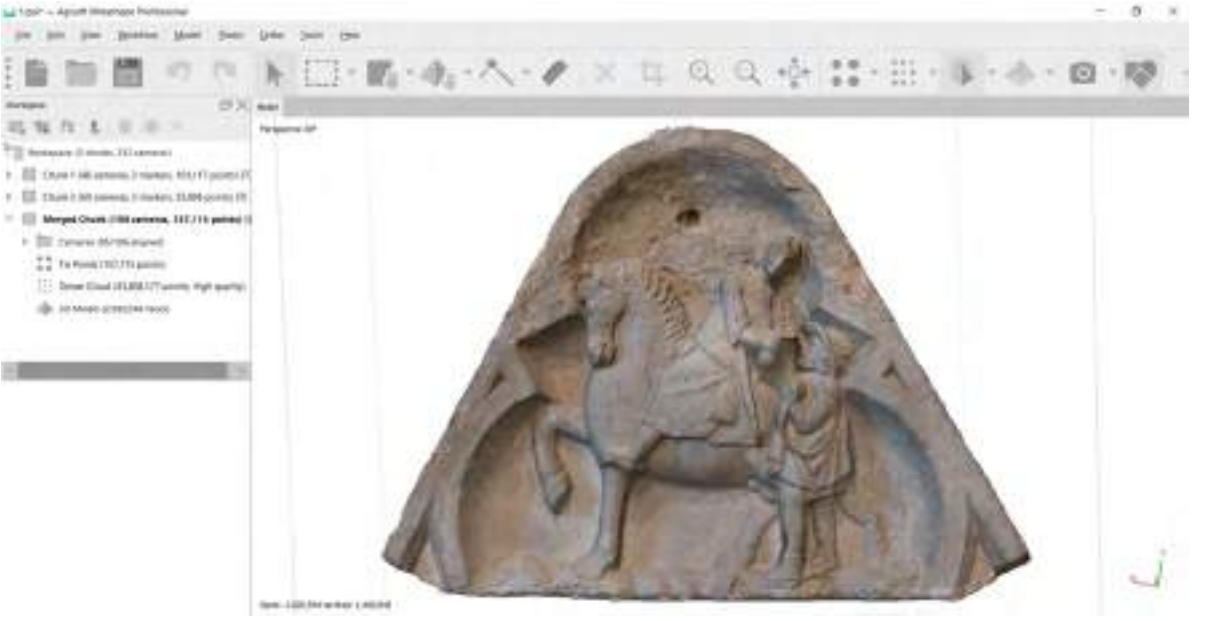

Fig. 4. Photogrammetric model of the only surviving stone relief decoration of the *tramezzo*. Software: Agisoft Metashape Pro. David Pfaff and George Bent, Washington and Lee University, VA (USA)

For the operation we used a Nikon D610 DSLR Camera, with a AF-S Nikkor 24-85 mm lens. We fixed the settings to an aperture of F5.6 a focal length of 44mm, a time of exposure of 1/15 sec., and ISO 100. A total number of 136 photographs have been taken. A subsample of 115 photographs was then the base for the photogrammetry, giving a successful first alignment. To create the photogrammetry model, the

software Agisoft Photoscan Pro version 1.51 has been used. The model has been assembled by combining two smaller chunks, one representing the front of the stone slab, showing the relief of Saint Martin dividing the cloak with the beggar, and the other showing the back of the piece.

The resulting 3D model obtained using the aforementioned photographs is composed of 2,920,544 faces and 1,460,848 vertices, making it quite high-poly. This model can then be subsampled and rendered in a lighter poly for future dissemination applications.

Measurements have been obtained by placing a reference meterstick along the three axes of the object, and including it in a subsequent series of photographs, then used in the Photoscan environment to give correct proportions to the model. This 3D photogrammetric model will be embedded within the overall digital visualization of the structure. It represents the section with the most accurate level of detail, geometric precision and chromatic texturing, being the only physical surviving fragment of the structure that can be used as a dimensional reference model for the mesh of the *tramezzo*. This fact is crucial, as the three-dimensional model of this low-relief carries a high-detail geometric information that can be cross-referenced to the model created on the basis of less solid information, such as the drawing portrayed on the Baroncelli parchment, or the spatial information that can be drawn from other classes of evidence, such as the primary and secondary sources (see Table 1).

4.3 Photogrammetry: Taddeo Gaddi's fresco fragment

The fragment of fresco on the northern wall of the church, according to the most recent studies, is the only surviving pictorial decoration of the *tramezzo* still *in situ* within the church. On the basis of stylistic comparisons with mural paintings in the Baroncelli chapel in the right transept of the church, it has been attributed by Andrea De Marchi (2011) to the painter Taddeo Gaddi, and the same scholar hypothesized that it portrayed *The Stigmatisation of St. Francis.* Therefore, this fresco, now severely damaged, plays a major role in the economy of the digital reconstruction of the *tramezzo*, as we are able to use it to redecorate the upper storey of the structure, a space defined by the walkable balconade represented in the Baroncelli drawing, and also to deduce structural measurements from it. These observations lead to the conclusion that an in-depth photographic campaign of this painted decoration was much needed (Fig. 5).

Fig. 5. Orthophoto in visible light (left) and raking light (right) of the fresco fragment in the left isle of the basilica. ©Vanja Macovaz.

There is no time to describe in detail the process of the creation of this imagery. Firstly, a 3D photogrammetric model of the fragment of the fresco has been created using the Photoscan Pro workflow, already described for the creation of the model of the *St. Martin*'s relief. Secondly, the resulting mesh has been

used as a tie surface for two textures created with high-resolution imaging campaigns, the first with ambient light, and the second with raking light. The help of the photographer Vanja Macovaz has been decisive for this phase of research. Furthermore, a high quality and high resolution set of images of this painting is also very useful for two other complementary purposes.

The first is the optical study of the scene with an art history approach and methodology to evaluate its pictorial quality and attribution. The second is the conservation and preservation data that can be extracted from diagnostic photography: in this case, the photographs with raking light were very useful to easily detect, with a non-invasive approach, the restored areas of the fresco, the uneven surface of the plaster, and possibly de-cohesion of the pictorial layers.

These photographs, just as every other piece of digital data produced during the operations in the basilica, have been shared with the *Opera di Santa Croce*, and so they might be useful for future conservation practices and examinations of the solidity of the support.

4.5 Photogrammetry: pilaster bases

In addition to the analytical photography of the frescoes, an extensive photogrammetric campaign of the two bases of the fifth couple of pilasters was carried out. This operation had the aim to create a full photogrammetric 3D model of the structure of the two pilasters (Fig. 6). This operation was crucial because the two bases of the pilasters, with their east and west sides showing different heights, are some of the very few physical entities relating to the structure of the *tramezzo* that we can still see *in-situ* inside the church.

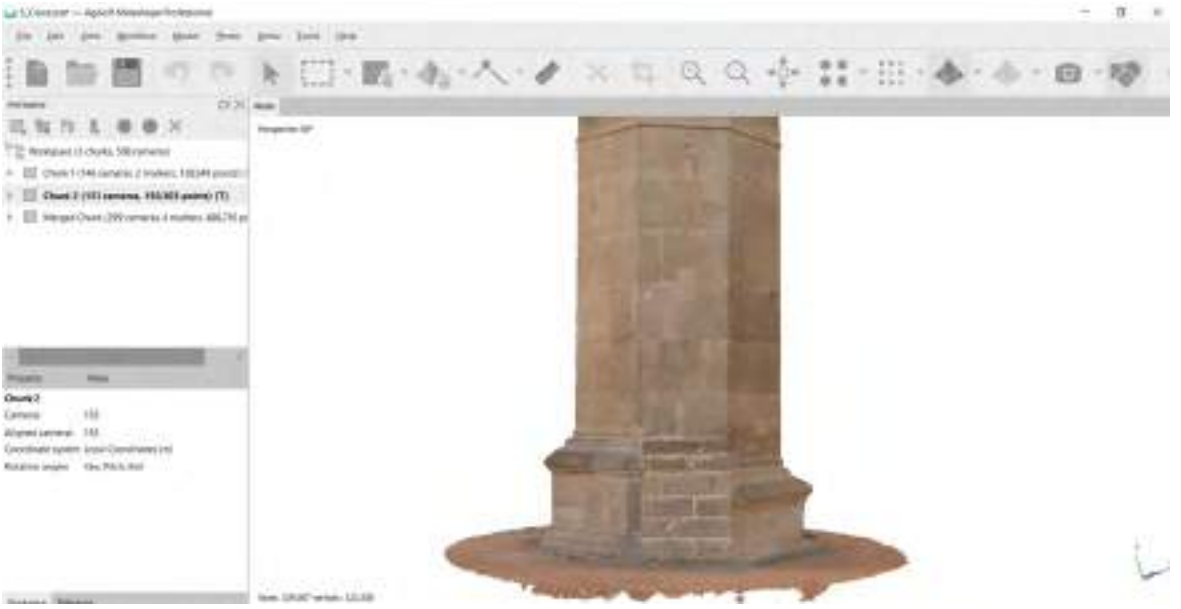

Fig. 6. Photogrammetric model of fifth western pilaster base. The difference in height between the west (left) and east (right) base is clearly visible. Software: Agisoft Metashape Pro. ©Vanja Macovaz.

Therefore, it was absolutely essential to create a 3D model that was not only geometrically precise, but also richly textured, as it would carry precious information about the construction materials used for the lost architectures. This photogrammetric model can be stitched to the existing point clouds, combining the richness of the texturing provided by photogrammetry with the geometric solidity associated with laser scanning. The photogrammetry process has been realized thanks to the help of the photographer Vanja Macovaz, with a similar pipeline described for the other two photogrammetry works, using a

DSLR camera mounted on a tripod for taking photographs and the Agisoft Metashape Pro software to elaborate the data.

5. Modeling and representing uncertainty

To create a virtual visualization of the *tramezzo*, modeling is an unavoidable step, as the data obtained through digital survey methods is insufficient to define every dimension and component of the structure. Therefore, a high degree of critical interpretation is needed in order to fill the gaps of knowledge.

This can be achieved by cross-referencing the available data, gathered through a wide range of techniques and methodologies.

This necessity rises the problematic of the academic solidity of the final product. Today, the debate over these paradigms is compelling and well open, as our technological potential grows higher, and worldwide access to technology becomes progressively easier. Modeling software are powerful tools, and the risk is of telling more than what we know.

Visualizing the degree of uncertainty associated with each parameter and component of a digitally represented structure is now a well-explored area of research, with notable contribution by many scholars across a vast range of fields of interests (Apollonio et al., 2013; Maiocchi et al., 2016).

The first model of the *tramezzo* has been created as an experiment to assess the different degrees of uncertainty associated with each element of the built structure. Also, as pointed out by Emanuela Ferretti (2017), three-dimensional modeling is a powerful and revelatory exercise, that can help the scholar to find answers to unresolved questions, or even, at the opposite, to identify problems (such as contradictions between the sources or imperfections in the data acquisition) neglected by the academic discourse. The model that I have created, using Sketchup Pro, an efficient 3D modeling software, tried to answer these questions.

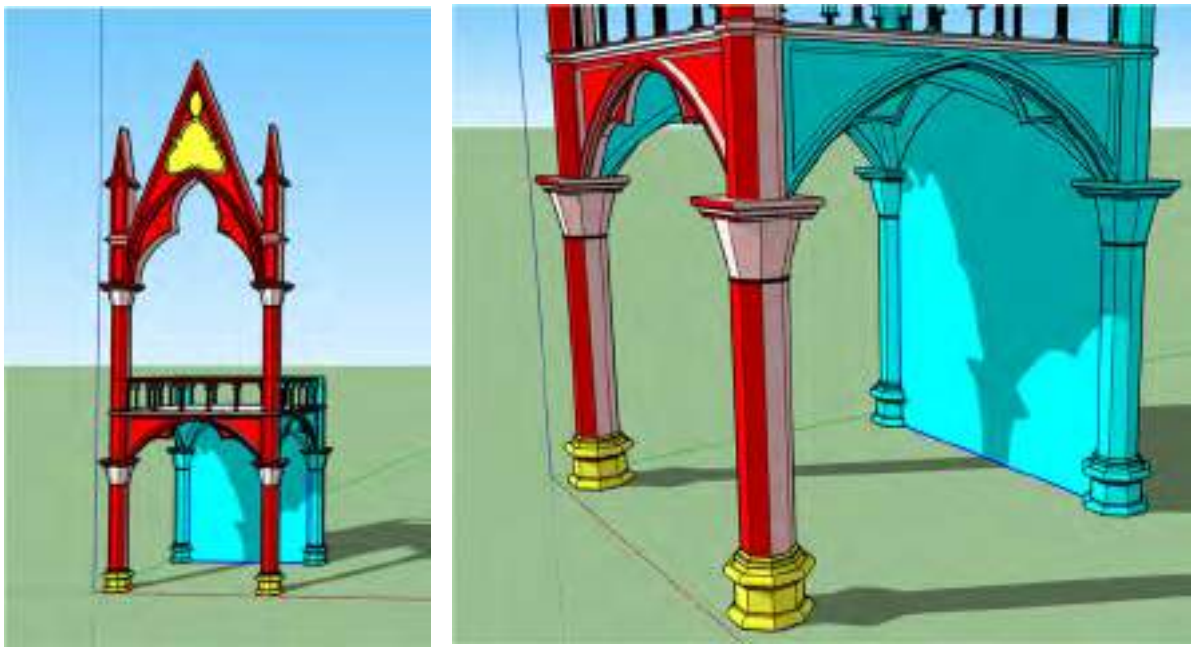

Fig. 7. 3D model of the Baroncelli chapel from the *Santa Croce tramezzo*, full view (left) and detail (right).
Software: Trimble Sketchup Pro. © Giovanni Pescarmona.

The main source used to create this model was the Baroncelli drawing. Without this extraordinary piece of evidence, such kind of regressive design, based on traditional measure-taking, would not have been possible (Verdiani, 2019). The model of the *tramezzo* presented here (Fig. 7) is not scaled according to a defined unit of

measurement, but retains the proportions between all the different elements represented in the drawing. Decorative carved elements, such as the crockets on the sloping edges of the gable and the foliated capitals, have been voluntarily omitted or simplified in a low-poly shape. This solution was chosen as both these decorative elements do not carry any structural function, and their modeling will be achieved through 3D-sculpting on the basis of analogies and references with other coeval monuments.

One of the most popular techniques to visualize the relative uncertainty associated with each component of a 3D model is to use different colours to create a texture for the mesh. Each colour is associated with a different credibility rating. The three primary colours have been used to give a sense not only of the variable difference in the reliability of each component of the structure, but also to declare the class of the sources that was used to obtain structural information.

In the Fig. 7, the three primary colours have been used to distinguish three main areas of the model. Yellow indicates that data used to model that section is deduced from surviving elements: in our case, the relief with Saint Martin dividing the cloak and the bases of the fifth couple of pilasters.

Different shades of red, in decreasing intensity, are associated with information derived from the Baroncelli parchment drawing. Therefore, only the frontal faces of the mesh have been associated with a higher degree of certainty, and are represented in a brighter red colour, as it is impossible to gather information about the depth of the structure from the drawing. Finally, light blue faces indicate structural elements (such as vaults, rear walls, pilasters, handrails, etc.) that aren't represented in the Baroncelli drawing, showing only the façade of the chapel. Therefore, the position, the dimensions and the configurations of these light-blue elements are hypothetical, and are underpinned mostly by references to other similar medieval structures.

Fig. 8. One of the 1967 photographs of the foundations of the *tramezzo*, uncovered during archeological excavations.

Color-coding the meshes to convey references to the sources used in the interpretation phase of research, and to declare the philological reliability of the model is just the first step to create a fully interactive and transparent virtual visualization of the built heritage.

More complex and effective solutions to this compelling communication challenge will be explored during the following phase of research, when the re-created 3D entity will be implemented within an extended reality environment focused on the experience of the viewer.

6. Future operations

The digital operations that have been carried out during the first year of research have provided the first three-dimensional data for the reconstruction of the *tramezzo*. There are many more possible technical survey methods that could be applied to the chosen context, and that could gather possible new datasets to shed light on the layout of the medieval church.

Scholars do not agree on the precise location of the foundations of the *tramezzo* that were uncovered during the archeological excavations following the flood of 1966 (Fig. 8). Only the central nave of the church has been excavated, and the foundation pilasters located in this section have been photographed and then demolished. In a well-documented study, Luca Giorgi and Pietro Matracchi (2011) conducted architectural surveys of the underground settings of the church, and proposed a new position for the pilasters, conflicting with the previous Marcia Hall reconstruction of the groundwork.

Using this new archeological data, Andrea De Marchi (2011) hypothesized a new structure of the *tramezzo*: not a continuous porch, but four self-sustaining separate chapels, connected to the lateral walls and pilasters with non-tectonic iron railings.

The information about the precise location, dimensions, and construction technique of the foundations of the tramezzo is crucial not only for the understanding of the placement of the structure within the interior of the church, but also for many other essential features of the construction, such as its shape and size, the materials it was made of, the height of its gables, and in general every physical parameter that defines its tectonic quality and overall weight.

Two typologies of technical analysis could help us uncover new data about the lost foundations of the *tramezzo*. The first operation consists in creating a photogrammetric model of the foundations using the 1960s black-and-white analogic photographic material, realized by the *Soprintendenza Architettura* of Florence over the course of the archeological excavations in the basilica.

Given the modest number of photographs, their poor overlapping, and the fact that they were not specifically produced to be elaborated by photogrammetry software, it would be hardly plausible to expect to obtain with this methodology a full, high-quality 3D model. However, state-of-the-art photogrammetry software could at least identify a modest quantity of overlapping images and determine a number of tie points, defining a sparse point could, enabling to calculate secure relative distances between the pilasters.

Similar operations of photogrammetry carried out using old black-and-white analogic photographs have been explored by Franco Niccolucci (2012) on Egyptian cultural heritage, with convincing results.

The second promising operation is GPR scanning, acronym for Ground Penetrating Radar. GPR devices, using electromagnetic fields, can detect and map buried structures such as tombs, ruins of demolished buildings, or foundations.

The technology has already proven to be very effective in producing three-dimensional views of underground foundations. Studies conducted by Lucas Giles (2018) analyzed the output of GPR scanning in medieval Neapolitan churches to identify buried remains of rood screens, then geo-referenced to the plan of the building and used to create 3D models of the lost structures.

While a similar operation could be experimented fruitfully in the basilica of *Santa Croce*, it must be noted that only the right side isle and a small section of the left isle haven't been altered by invasive excavations during the 20th century. Therefore, the data that is expected from this technical investigation won't probably clear every uncertainty about the original position of the groundworks of the rood screen.

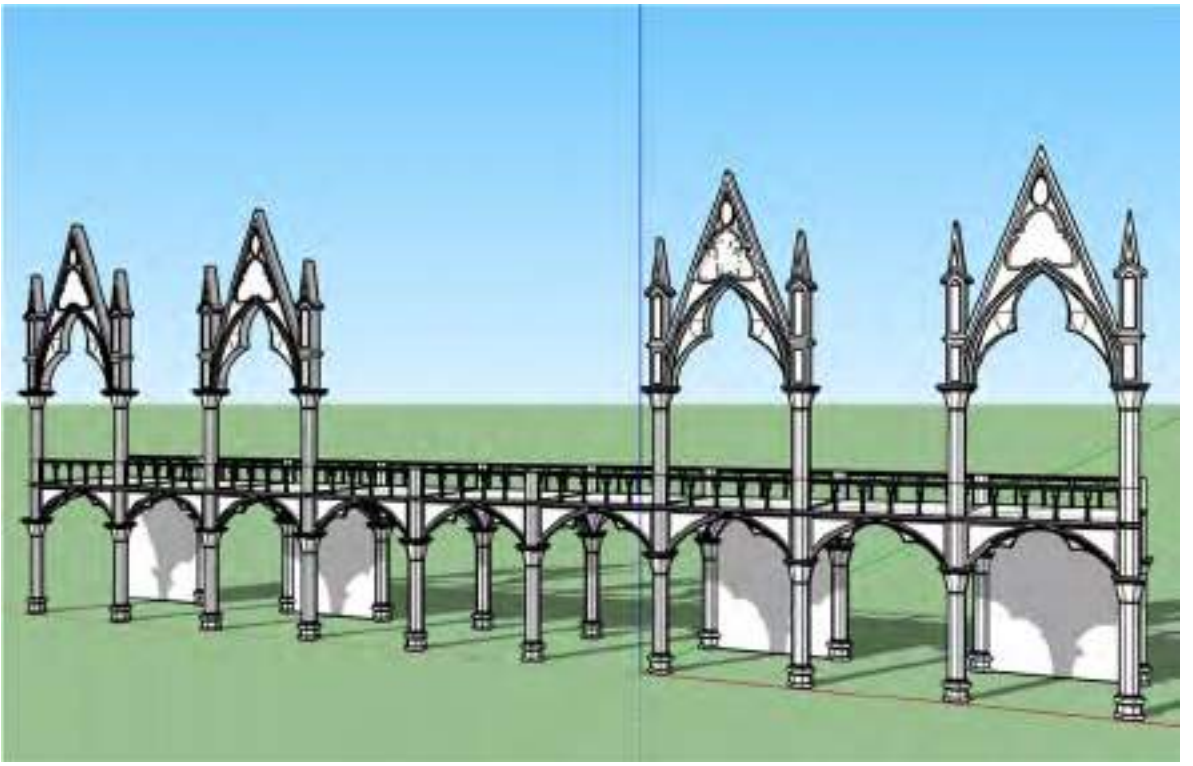

Fig. 9. Provisionary model of the *tramezzo* of *Santa Croce*, following Marcia Hall (1974) and Marvin Trachtenberg (1997) reconstructions. Software: Trimble Sketchup Pro. © Giovanni Pescarmona.

7. Conclusions

This paper briefly tried to outline the current state of research around the *tramezzo* in *Santa Croce*, discussing all the technical surveys that have been carried out over the course of the author's first doctoral year. The answers for many questions concerning the original setup of this fascinating architectural partition structure still need to be found. To bridge this knowledge gap, Ground Penetrating Radar technology and photogrammetry processing of old analogic photographs could offer unexpected insights and uncover precious unexplored datasets.

In the following phases of the research, all the collected data will be merged into a single digital 3D environment, to verify the correspondence between all the elements that compose the ensemble. This step will be crucial, as it will allow to identify flaws in the data acquisition, and to highlight at the same time possible inconsistencies between the different sets of data. The first merging experiments between the photogrammetric models of the survived elements (Fig. 4) and the 3D model obtained using the proportions portrayed in the Baroncelli parchment drawing (Fig. 7) showed a lack of correspondence in dimensions that can be hardly the result of an error in the data processing.

Only when all the surveyed and remodeled elements will be joined together it will be possible to present and disseminate the work. This task can be accomplished through a variety of different techniques and related devices (Ricci et al. 2019). The most promising dissemination strategy, given the chosen context, could be a mixed or augmented reality visualization, rather than a fully virtual digital environment. Augmented Heritage projects from many research groups around the world are playing a major role today in closing the gap between the scholarly research and public knowledge, giving accessibility to a largely unknown set of facts (*Hidden Florence 3D*).

A mixed reality experience, in particular, could provide an immersive recontextualisation of the structure within its original setting, the basilica of *Santa Croce*, which over the centuries hasn't changed in its essential structural elements. Creating such a complex extended reality experience will be a challenging task that will require a collaborative and multidisciplinary approach.

References

Apollonio, F. I., Gaiani, M., Zheng, S., 2013. Characterization of uncertainty and approximation in digital reconstruction of CH artifacts, *Proceedings of Le vie dei Mercanti, XI Forum Internazionale di Studi. Napoli*, pp.860-869, La scuola di Pitagora editrice, Napoli, Italy.

Ascani, V., 1997. *Il Trecento disegnato: le basi progettuali dell'architettura gotica in Italia*., Viella, Roma, Italy.

Cooper, D., 2017. Recovering the lost rood screens of medieval and renaissance Italy, in Bucklow, S., Marks, R., and Wrapson, L. (Eds.), *The Art and Science of the church screen in medieval Europe. Making, Meaning, Preserving*, pp. 220-245, Woodbridge Press Publishing Company, UK.

De Marchi, A., 2009. Cum dictum opus sit magnum. Il documento pistoiese del 1274 e l'allestimento trionfale dei tramezzi in Umbria e Toscana fra Due e Trecento, in: Quintavalle, A. C. (Ed.), *Medioevo. Immagine e memoria, atti del convegno internazionale di studi*, Parma (23-28 settembre 2008), pp. 57-75, Mondadori Electa, Milano, Italy

De Marchi, A., 2011. Relitti di un naufragio: affreschi di Giotto, Taddeo Gaddi e Maso di Banco nelle navate di Santa Croce, in De Marchi, A., Pirazzoli, G. (Eds.), *Santa Croce oltre le apparenze*, pp.33-71, Gli Ori, Pistoia, Italy.

Hall, M., 1974. The "Tramezzo" in Santa Croce, Florence, Reconstructed, in *The Art Bulletin*, 56, pp. 325-341, Taylor & Francis Group, UK.

Hall, M., 1978. The Italian rood screen: some implications for liturgy and function, *in Essays presented to Myron P. Gilmore, vol. II. History of Art, History of music*, pp. 213-218, La Nuova Italia Editrice, Florence, Italy.

Hall, M., 1978. *Renovation and Counter-Reformation: Vasari and Duke Cosimo in Sta. Maria Novella and Sta. Croce, 1565-1577*, Oxford University Press, Oxford, UK.

Hall, M., 2006. The tramezzo in the Italian Renaissance, Revisited, in Gerstel, S. E. J. (Ed.), *Thresholds of the Sacred: Architectural, Art Historical, Liturgical, and Theological Perspectives on Religious Screens, East and West*, pp. 215-232, Dumbarton Oaks, Washington, DC, USA.

Giles, L., 2018. Medieval Architecture and Technology: Using GPR to Reconstruct the Choir Screen at Santa Chiara in Naples, in *Peregrinations: Journal of Medieval Art and Architecture* 6, 4, pp. 123-160, USA.

Giorgi, L., Matracchi, P., 2011. La chiesa di Santa Croce e i precedenti insediamenti francescani. Architettura e resti archeologici, in De Marchi, A., Pirazzoli, G. (Eds.), *Santa Croce oltre le apparenze*, pp. 15-34, Gli Ori, Pistoia, Italy.

Giura, G., 2011. Il Crocifisso di Donatello e la cappella del Beato Gherardo da Villamagna in Santa Croce: indagini per una ricostruzione, in De Marchi, A., Pirazzoli, G. (Eds.), *Santa Croce oltre le apparenze*, pp. 73-111, Gli Ori, Pistoia, Italy.

Grellert, M., Apollonio, F., I., Martens, B., Nussbaum, N., 2019. Working Experience with the Reconstruction Argumentation Method (RAM) - Scientific Documentation for Virtual Reconstruction, in *Proceedings of the 23rd International Conference on Cultural Heritage and New Technologies 2018* (CHNT 23, 2018), Museen der Stadt Wien – Stadtarchäologie, Vienna, Austria.

Maiocchi, A., Mambriani, C., Roncella, R., Zerbi, A., 2016. Il restauro virtuale della ex-cappella ducale di San Ludovico a Parma. in: Disegnare con…, IX, 17, Università degli Studi dell'Aquila, L'Aquila, Italy.

Mandarano, N., 2019. *Musei e media digitali*, Carocci, Roma, Italy.

Niccolucci, F., Spearman, M., Pitzalis, D., 2012. Documenting Abu Simbel: The 3D-COFORM Approach, in *Electronic Imaging & the Visual Arts: EVA 2012 Florence, 9-11 May 2012*, pp. 46-50, FUP, Firenze, Italy.

Ricci, Y., Verdiani, G., Pasquali, A., 2019. A Petrified Petrifying Eyesight: A Story for the MEDUSA'S HEADS from Istanbul, Turkey. In: Proceedings of the 23rd International Conference on Cultural Heritage and New Technologies 2018 (CHNT 23, 2018), Museen der Stadt Wien – Stadtarchäologie, Vienna, Austria.

Smalzi, D., Ferretti, E., 2017. Storia dell'arte e nuovi approcci alla musealizzazione dei dipinti: il recupero dell'Ultima Cena di Giorgio Vasari e la narrazione multimediale, in Niglio, O., Visentin, C. (Eds.), *Conoscere, conservare, valorizzare il patrimonio culturale religioso. Atti del convengo di Verona e Vicenza*, pp. 174-180, Aracne editrice, Ariccia, Italy.

Trachtenberg, M., 1997. *Dominion of the eye. Urbanism, Art and Power in early modern Florence*, Cambridge University Press, Cambridge, UK.

Verdiani, G., 2017. *Retroprogettazione. Metodologie ed esperienze di ricostruzione 3D digitale per il Patrimonio Costruito*, Didapress, Firenze, Italy.

The London Charter for the computer-based visualisation of cultural heritage, Draft 2.1, (7 february 2009), retrieved on http://www.londoncharter.org/index.html (accessed 6 January 2020).

Florence As It Was, the digital reconstruction of a medieval city, http://florenceasitwas.wlu.edu/ (accessed 6 January 2020).

Hidden Florence 3D, https://hiddenflorence.org/hf-3d/ (accessed 22 January 2020).

Seville Principles, http://sevilleprinciples.com (accessed 22 January 2020).

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Contemporary Architecture rising from Tradition. San Francesco in Pitigliano

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Abstract

Ruins are all that is left of the San Francesco church in Pitigliano, a convent designed by Antonio Sangallo the Younger at the beginning of the XVIth century. The building, envisioned in the early years of the architect professional life, represents today a fundamental and valuable evidence of the first steps of one of the most atypical figures of the XVIth century.
Redeveloping the ruins of a building, whose origin is thus tied to a personality such as Antonio Sangallo the Younger, implies an extensive knowledge of the author, essential for the designing research. Through an overall overview of the period when the Sangallo lives, we define the cultural climax. We thus outline the fundamental tensions of the XVIth century that affect Sangallo and his conception of architecture, ultimately identifying his *forma mentis*. Once defined the cultural background and the author, the research deepens the knowledge of the object under examination through the contemporary architect lenses, in the attempt to grasp the guiding principles of the original project and take charge of them in a contemporary version. Therefore, we analyse the original Sangallo's sketches on the Pitigliano convent, preserved at the Department of Prints and Drawings of the Uffizi Gallery, and we outline the geometric matrix of the drawing, pivotal tool for the spatial definition of the generating idea of the building. The archival and documentary research on Sangallo and the building under examination represents a necessary step to identify the guiding lines of a project methodology, able to integrate the new built parts with the style and the mindset of the architect of the XVIth century. The key element to safeguard the church of San Francesco in Pitigliano does not stand solely on the physical state of the building but on the spatial idea conceived by Sangallo.
To collect the data necessary to the planning of the building, the study follows with the survey of the current state of the ruins, never produced until now. This way, we examine, thanks to the design concept of the architect, the geometric study beyond the original project and the present state of the church, ultimately delineating a common thread that defines the spatial principle of the structure. Following the analysis of the reasoning that determined the spatial characteristic of the convent, the contemporary project pivot on the same assumptions in order to give back to the ruins under examination, the fundamental purpose of every architecture: being inhabited. The contemporary project therefore has to understand tradition in order to continue its themes, at the same time, the project must achieve its own expressive power, aspiring to become classic in its own terms. The study of Sangallo offers us a starting point to ponder how to come to an agreement with his planning style and how to conceive a new project idea able to preserve the spatial values and the figurative eloquence of Architecture.

Keywords: Ruins; Antonio Sangallo the Younger; Redevelopment; Roman Foot; Study Center; Pitigliano

1. Inhabiting ruins: The church of San Francesco

A few hundred meters from the town of Pitigliano, ancient and fascinating place, where human settlement and natural conformation of the tuffaceous spur get together endlessly, we find, in partial state of decay, the Convent of San Francesco, a religious building designed by Antonio da Sangallo the Younger (Fig.1).

Over the history of the town of Pitigliano, the compound of San Francesco has never had a direct relationship with the town, the religious building indeed articulates on a closed scheme, it is therefore private, dedicated to the Franciscan friars that lived it and therefore it is never a part of the town life.

Abandoned in 1810 due to the Napoleonic suppression of religious structures, the convent is definitively excluded from the life and the relations of the town; accordingly, it became subject to a slow yet constant process of deterioration that finally leads to a total decay.

Unused for the last century, the Diocese decided in the second half of the XXth century to divide the compound and to keep only the church, also deteriorating and in dire need of a requalification intervention to complete its parts (Fig.2, 3, 4).

Hence, the general idea is to redevelop the building with a contemporary project, able to open the church to the town, even by changing its purpose in a balanced way and by allowing citizens to enjoy the building at the service of the community.

Fig. 1. CTR of Pitigliano, with the highlighted position of the San Francesco Convent at Nord of the town.

Looking at the "city" as a system of buildings in their mutual interactions and at the service of men, a ruin and more generally a building cannot not be part of the town without being inhabited by people. The city, in essence, is *"a man with other men"* (Michelucci, 1972) and the contemporary project on the preexistent represents an occasion to reaffirm once again that *"the tension towards the future is not demolition of the past, but is the summoning of the past to participate in the present to prepare the future"* of a city for men (Michelucci, 1972).

Proposing a project about a Sangallo-attributed church in Pitigliano is a unique opportunity to ponder on the relation between the contemporary project and ruins and to outline a methodology of intervention with non-arbitrary foundations.

Fig. 2. Photo of the Church ruin street, Fig. 3. Frontal photo of one of the church side-chapel, Fig. 4. Photo of the central nave.

The project proposal is certainly the result of the personal perspective and perception of today's architect, nonetheless, it arises in this case from the listening of Sangallo, from the history lesson, from tradition and from the territory specific features. The result is a contemporary intervention that can exists on the ruins of San Francesco in Pitigliano and in no other place.

The study starts from the analysis of the Sangallo persona, thus defining a planning guideline fitting the design concept of the former author and not in contradiction with Sangallo's idea of convent.

2. Antonio da Sangallo the Younger and practical Architecture

Historical research often attributes to Antonio Sangallo the Younger the reputation of skilled master yet unfamiliar to the pursuit of the "*true beauty of Architecture"* (Bruschi, 1986), achievable, according to the tradition of the Florentine school of the time, only to those mastering the arts of sculpture and painting.[1]

Vasari himself, in his treatise "Le Vite", praises the technical expertise with which Sangallo solve difficult engineering problems. A pragmatic man, "*able to connect walls*" but not an artist (Vasari, 1550)

Sangallo's personal study of Architecture starts with his moving to Rome, where he crosses his experience of engineer, drawer and architect with the ones of some of the most influential personalities in architectural research of the early Cinquecento, Donato Bramante, Raffaello Sanzio and Baldassarre Peruzzi. Likewise, it is in Rome that Sangallo gets close to Alessandro Farnese, future Pope Paul III, and his large company of literates and humanists.[2]

His strong interest for antique architectural works and writings lead him to reinterpret the "De Architectura" Treaty of Marco Vitruvio Pollione through original sketches of the oeuvre. In 1531, in fact, Antonio writes an

[1] Antonio was born in Florence in 1484. When he was fourteen, he attended the apprenticeship as "master of wood", taking over his father profession. This is how he develops since the early years of his life the practical perspective of an artisan, that tackles the operational problems of his works. Sangallo's training is already directed to the solution of practical problems.

[2] One of the most important events of Sangallo's life was the meeting with Alessandro Farnese, future Pope Paul III, that introduces Sangallo in his entourage of scholars and artists. It is thanks to this connection with the future Pope that, at the death of Baldassarre Peruzzi(1536), Antonio is appointed, by Paul III, superintendent architect of all the pontifical construction yards. Position that he keeps until his death (1546).

introduction to the book that his brother Giovanni Battista is preparing for him on the topic, abundantly accompanied with drawings and papers. Ultimately, the treaty will never be finished, however thanks to the willingness of Antonio to put his idea into writing, we retain a copious number of Sangallo's drawings that allow an analysis of the author and his associates.

We believe that through his personal and professional connections, Sangallo becomes acquainted with of the architectural scenario of his time, namely of the teachings of the master Bramante on the pursuit of the perfect proportion in the development of buildings with a central plan, such as *San Pietro in Montorio*, maybe his most successful realization. According to Bramante every building is part of the city. Rome in particular, where he works in the last period of his life and where Antonio Sangallo assists him, should aspire to resemble the Almighty, perfect in its every part.

For two years, Sangallo works together with Raffaello and he does certainly know the artistic thoughts behind his oeuvres, rich in theological and philosophical references. It seems however that in spite of his connections of his forty years-long career, Sangallo prefers to think of buildings as problems to be solved, a sum of technical, distributive and functional elements, not an opportunity for the pursuit of "beauty" in Architecture.

"Thereby, venustas is a secondary factor of the structure, downgraded from the original position conceived by Vitruvio, it is to some extent assimilated into the utilitas, lowered at the level of the dignitas, of décor […] it thus takes on ultimately utilitarian, instrumental values, that cannot enhance its importance" (Giovannoni, 1958).

Antonio Sangallo the Younger is an uncharacteristic figure for his time, whose works appear consistent being in Architecture, Engineering, Urban planning, or Military Art. Sangallo research of alternative applied solutions to well-established themes is continuous, even though it never strays from his long-established personal way to sort out an architectural intervention. Antonio Sangallo is one of the few architects of his time that holds technique as center of gravity.

"The complete architect is, according to Sangallo, him who combines the expertise of drawing with that of the construction site. Best example of his time of what can be achieved in architecture through a mental order that treasure ideas instead of surrendering to improvisation" (Giovannoni, 1958).

3. Religious Architecture of Sangallo

Religious architectures hold a significant relevance for the architectural development of Sangallo's works, it is enough to consider that before as assistant then as an architect, Sangallo spends his entire life in the realization of the Fabric of San Pietro.

Amongst Religious Commissions entrusted to Sangallo, notably in the first period, such as the church of San Francesco in Pitigliano, *"We glimpse not only a development of the design concept but also the teachings of the Master Bramante on the pursuit of the perfect proportion using the central plan, that affect not only Sangallo the Younger but all architects of the time. The penchant of Sangallo towards usefulness, however, seems to prefer a vision of the project that takes into consideration longitudinal characteristics of churches, a more suitable solution to the gathering of believers, in references to the classical world and to the historical development of basilicas"*. (Giovannoni,1958)

For this reason, as we will see later, in this period, the architect Antonio conceive building of hybrid spatiality, where the hierarchy of parts is unclear and less rigorous.

My personal and general reflection on religious architecture is that space is, in such cases, determined by the harmonious sequence of the parts. Every architectural detail has to maintain hierarchical ratios with the sequence of elements approaching the altar, in case of a building with a longitudinal floor plan, or during the contemplation of the Tabernacle in a central plan construction, in order to give due weight to the space and to its elements that have to follow a very specific idea, namely that of arranging an Architecture able to put in communication the believers with God. Therefore, the religious structure is not merely a series of compartmentalized and respectable rooms, *Domus Dei* is a place where the *venustas* of a space, aspiring to a higher dimension, is central to the project. Probably in such structures we notice the limits of the design thinking of Antonio Sangallo, at times too bound by reality.

4. Case Study: the ruins of the San Francesco church in Pitigliano

Having analyzed the fundamental events and feature of Sangallo's life and works, the study focuses on the subject under examination, the ruins of the Church of San Francesco, part of the namesake Convent. The ruins of the church are located in a peripheral area of Pitigliano, town of rich past, whose roots are to be found at least in the Etruscan era and where the urban stratification in time is still tangible in its impact on the settlement.

Pitigliano is born perched then developed, for defensive reasons, over the tip of a massive and sharp tuffaceous spur. The borders of the settlement remain the same for centuries, for this reason we can consider the rocky component as an impressive *"base"*, common denominator to all the buildings prior to the XXth century.

Besides the spectacularity of such position, the structure of the town is the most fascinating feature of the urban plan. In every age, in fact, the development of the town tries to adjust to the morphology of the spurr through the use of different techniques, notably by digging the tuff in ancient times and later by building urban agglomerations over the tuff. Such conurbations create a full to empty ratio, that privileges the empty, as we gradually move away from the historic core of the town.

It is indeed due the lack of space on the spur and the willingness to expand the fortified structure of Palazzo Orsini, residence of the count at that time head of the city, that the Convent of the Franciscan friars is placed outside Pitigliano and later on relocated to Poggio Strozzoni, a few hundred meters North of the center, for the need of building a larger religious ensemble.

The convent was finished before 1522, when the wedding of Ludovico Orsini and Giulia Conti of Montalcino was celebrated, as recalled by the writing above the former main door, today preserved at the diocesan museum of Pitigliano.

At the beginning the compound is connected with the former Parco Orsini, today almost totally lost, before the same friars decided to interrupt all connections with the parc and make the convent an essentially autonomous structure, as pointed out by the visit of clerk of the court of Pitigliano in 1731:

"[…]at the Bridge of Porchio to set off, I took the path towards the San Francesco and once arrived at the door, through which we enter in Strozzoni, I found the very same locked"

The ancient diocesan records of the city point out that the cloister maintained a good state of preservation until at least 1788.[3] Already in 1810 however, with Napoleon's suppression of monasteries and religious places, the church was abandoned by the Franciscan friars and kept in good condition by a hermit, thanks to alms. Every year, the 2nd of August in the church, the mass for the holiday of Porziuncola was celebrated.

Once abandoned by the hermit, Carolina Allegretti obtains the convent as inheritance from Monsignor Barzellotti, and thanks to a benefit fundraiser, can carry out some renovations of the church. In 1855 the church is, for the last time, used as lazaretto due to the cholera epidemic of those years. In the early XXth century, a big fire, with unknown causes, produces serious damages to the entire church, reducing it at the current state. The compound lies abandoned since then.[4]

In the second half of '900, the church undergoes partial renovations and stabilization interventions, rather invasive and noticeable operations especially in the front part of the church. Today, the convent is divided into two different areas, the one of the church properties of the Diocese and the one of the dormitories and cloister privately owned.

In the light of the history of the convent and without an architectural and stratigraphic survey of the present state, upon which we could read the sequence of construction stages, it would have been impossible to elaborate a redevelopment project balanced on the ruins of the San Francesco complex. Nonetheless, to date the original drawings of Antonio Sangallo are still available, which he himself meticulously preserved.

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[3] Information provided in the Diocesan Archives of Pitigliano
[4] Ibidem.

Such material can be found at the Department of Prints and Drawings of the Uffizi Gallery, also thanks to the accurate classification of Gustavo Giovannoni of the first part of last century (Fig.5).

The study thus proceeds with the analysis of those drawings, from which we deduce a compositive interpretation of the convent.

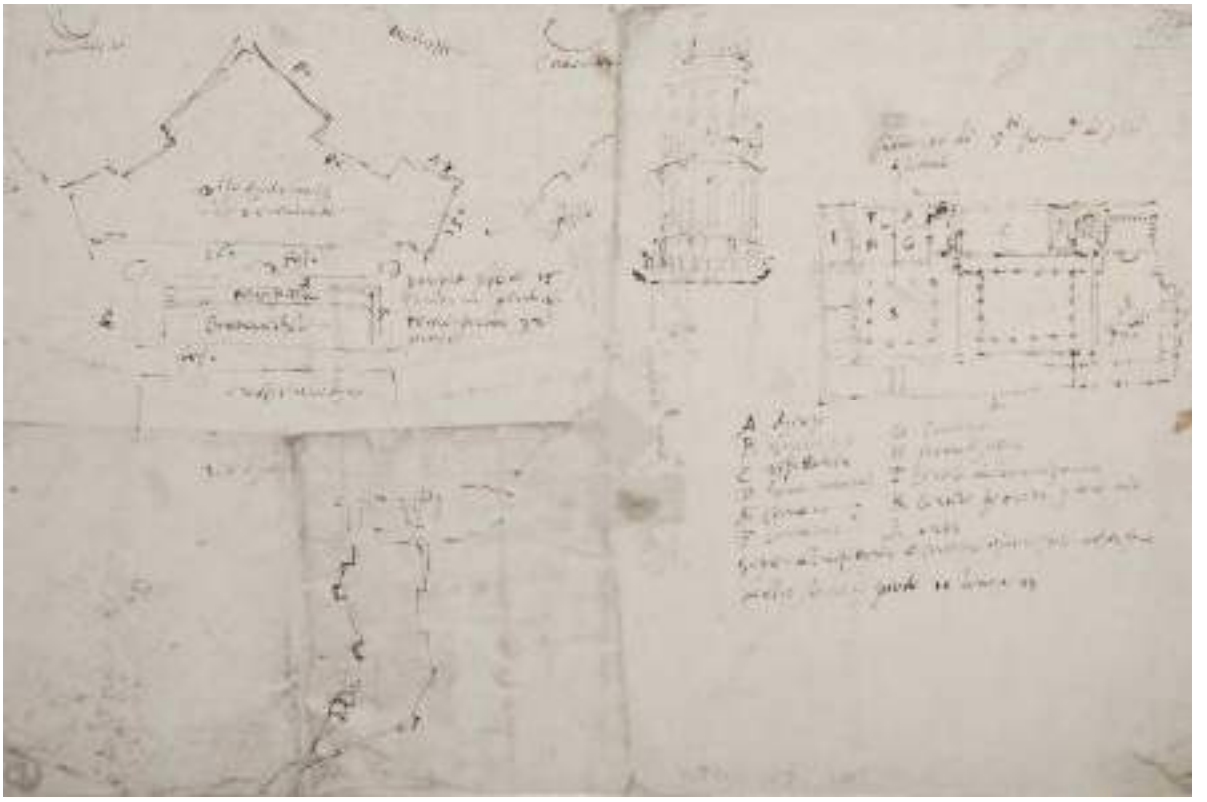

Fig. 5. Photo of Sangallo's sketches on Pitigliano, to the left we find the idea for the enlargement of the fortress of the historic city centre, in the centre, the bell tower of the Pitigliano Cathedral and to the right, the drawing for the San Francesco Convent.

5. The origins of the sixteenth-century project of San Francesco in Pitigliano

The building was conceived by the architect starting from the planimetric scheme. The composition of the architectural complex/ensemble revolves around two main poles, the one of the dormitory courtyard and the one of the cloister.

Outside these perimeters, the only two open-air areas, we find the bodies of the buildings. Imagining a central symmetry axes between the two courtyards, the complex is structured in a rectangular way with a 1 to 2 ratio, where the long side is the axis and the church and the dormitory are the two ends.

The disposition of building follows a well-defined rationale. What may seem at first glance a sketch of a plan idea in its initial stage, represents already a proportioned scheme that carefully controls the spaces of the project.

The doubt arises, looking carefully at the sketches, whether the rigor and precision of Sangallo's drawings are the results of the use of a rule, necessary geometric tool to translate the idea of a building in measured space. Analyzing the drawings, indeed, a specific proportionality is noticeable. The very side notes on Sangallo sketches point out a unit of measure.

Through a quick assessment, we identified the use of the Roman foot as unit of measurement. Antonio Sangallo, great scholar of classicism and an architect that works for the Pontifical State, uses a classic unit of measure to trace in his works the right proportion and the right harmony among the single parts and the whole, clear evidence of the knowledge of the architect (Fig. 6, 7, 8, 9, 10).

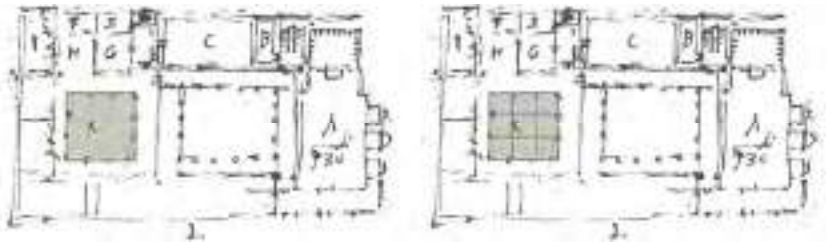

Fig. 6. Extraction of the geometric matrix of the dormitory courtyard on Sangallo's drawing.

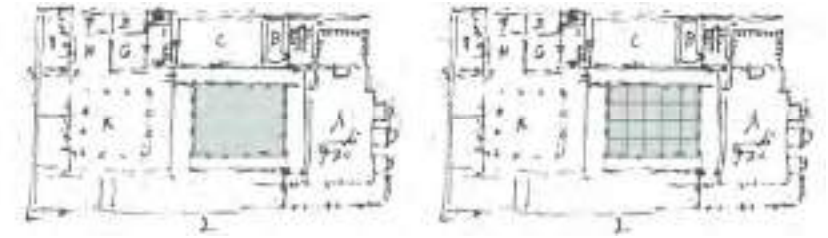

Fig. 7. The application of the geometric module to the entire convent generates a grid, from which it is possible to identify the plan's alignments and the area destined to the functions of the project. The base model of the grid is five Roman Feet.

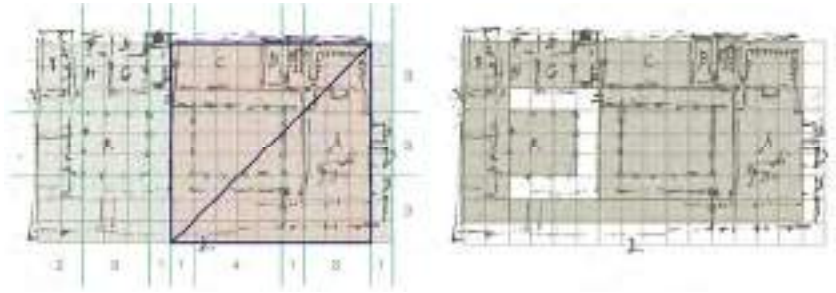

Fig. 8. Extraction of the basic geometric matrix on the cloister of the convent.

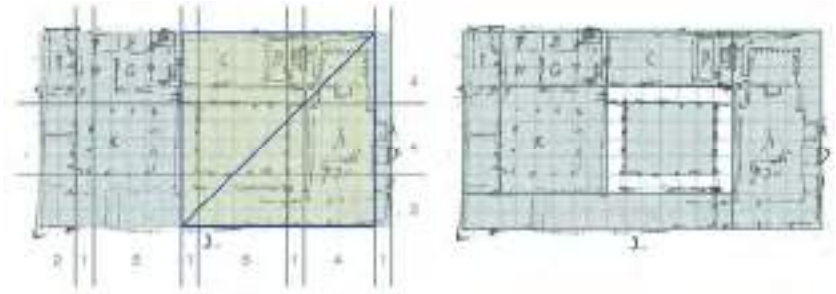

Fig. 9. Application to the whole drawing of the cloister base module. The extracted module is exactly four Roman Feet. The two defined grids, from the courtyard and then from the cloister, are therefore in relation between them thanks to the Roman Foot.

Fig. 10. Interpretation of the project idea of the convent, deriving from the analysis of the geometric matrix.

6. Survey of current state: a method to read the space

Once analyzed the archival material, the next step of the study implies direct contact with the ruins of the church of San Francesco, the only part of the convent owned by the Diocese, whose survey is made for the following project.

This stage is crucial to the study, the goal of the survey is, in fact, to verify if the archival research on the geometric composition and on the planning idea of the convent are confirmed, in such a way that they will become an irreplaceable reference source for the planning stage.

The survey campaign has been mostly organized in five steps, on-site investigation, plan of survey, photographic campaign, data collection and drawing of the findings.

In order to collect the data necessary to the description of the ruins, the survey of the San Francesco Church was made by photo-modeling, using an indirect detection technique that returns the geometric model of artifacts on the basis of collected photos. While being an indirect method of survey, it is necessary, to complete the process of restitution, to measure with direct detection and to give the 3D model the exact scale and orientation of the buildings. Before the photo taking phase, it is necessary to set the camera for properly balanced photos, taking into consideration the focal length, the ISO value and the iris opening.

Having decided the set-up, we move forward to the photo taking phase. The images must be collected from an approximately constant distance to the object under examination and must include not less than 30% of common photographed parts between themselves. Thereafter, we proceed with data elaboration. In this case, we employ a 3D recreation software, able to elaborate a virtual model from photos. The final stage of the survey process requires the extrapolation of bi-dimensional data from the 3D model, needed to check the study and do the project. The final result is that we achieved reliable metric data (Fig.11).

Fig.11. Examples of sections extracted from the survey.

7. From Sangallo's drawings to the survey and vice versa

Comparing the Sangallo's drawings with the photo campaign, we can observe that the indecisiveness, distinctive of the early years of the planning career of Sangallo for what concern religious buildings with central and longitudinal plan, leads to a not-exactly balanced solution. The church, indeed, is planned out by adding to a central longitudinal nave three lateral chapels that compete in volume with the first one. Thus, the space created puts on the same level the experience of the walk towards the altar and that of the lateral chapels' contemplation. The result is a non-hierarchical space, where the liturgical purpose of the nave is held in a space not adequate to its significance.

7.1 Geometrical analysis of present state of the building

Extracted from the survey, the bi-dimensional drawings of the church in its present state, the study focused once more on the research of the geometric matrix at the basis of the project. From the new geometric analysis, carried out this time on the plan of the ruin, we definitively verify what we were trying to confirm with the survey: the measurement unit employed by Antonio Sangallo The Younger for the project of the church and consequently for the convent is the Roman Foot, 29.6 cm (Fig.12).

All information, that we learned from the critical reading of the Sangallo's drawings, are thus validated. We can now use these findings for the new project. The hitherto study, through the examination of the Sangallo's persona and the San Francesco church ruins, has identified the key elements that the redevelopment of the remains should put to system, in order to adjust to the pre-existing building and unleash, in the most coherent way possible, its witness.

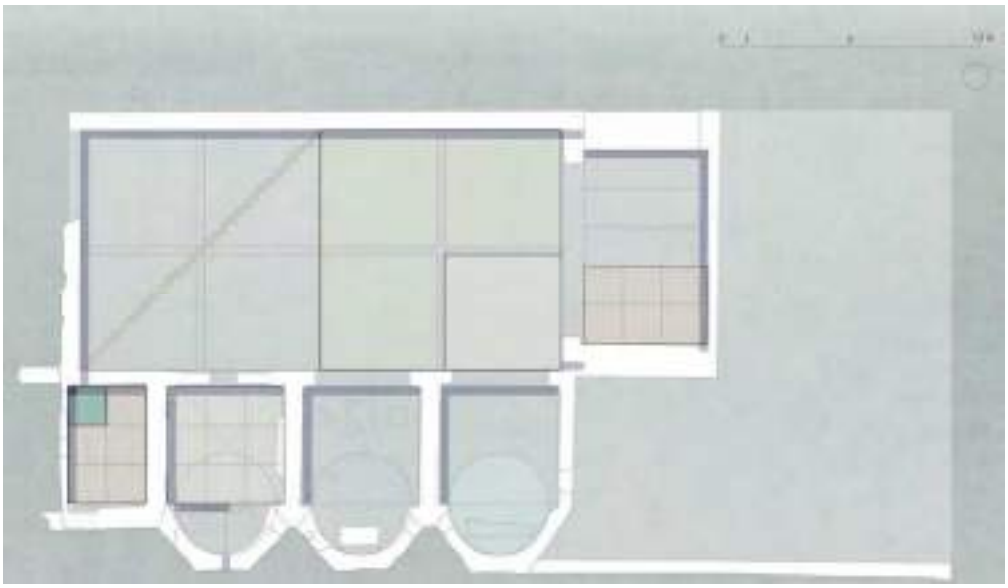

Fig.12. Geometric analysis of the current state of the building, useful to confirm the hypothesis that Sangallo's sketches are indeed drawn in Roman Feet.

8. From the survey to the contemporary project: a building at the service of men

The current culture of restore offers a preservative method that takes into account the material dimension of the building and freezes its present state, or in alternative it tends to rebuild the missing parts of the structure in its original state, partly forgetting of the purposes for which the building was conceived.

Instead, an architect usually conceives a building as a metaphor of another language, as a physical realization of an abstract concept, of an idea. If we carry this consideration to the extreme, there is no distance between a book and an architectural structure, if both are considered as proof of the action of a man, the writer or the architect, that offers another person a form of benefit. According to the architect, therefore, the physical state of the matter is not the only important aspect, it is fundamental however for such state to be the translation of an idea, main, vital and founding element of Architecture.

Hence, the consideration that we offer on the redevelopment of ruins, but probably relevant even in the field of architectural restore, is as follows, a building and a ruin are worthy to be maintained and preserved in their current state if as parts of the city, meaning an integrated system at the service of men and communities, they still fulfill their fundamental purpose, that of being inhabited.

Vitruvio, indeed, already proposes in his treaty "De Architectura" the *utilitas* as one of the three main focus

of a building. Today, the *utilitas* is usually translated in "functionality" and therefore bent to the distributive character of architecture, even if, it probably means useful for an end in a wider way.

If a ruins, for instance, has lost role of historical witness due to its pitiful state and its founding idea is no more traceable, the structure is stripped completely its usefulness, a man ,in fact, cannot draw any teachings or benefit from it. If there is something useful in a ruin, it is indeed its witness of the past, and because of that it has to be preserved at all costs.

Conversely, in the case that a ruin still bears proof of the past, it is desirable to restore such evidence with a contemporary intervention, readable and understandable to the man that becomes once again able to use and inhabit it. In San Francesco specifically, the study of the ruins was not able to lead us back to the primordial state of the structure. The project, therefore, through the interpretation of the givens of the analysis, finds, with a contemporary expression, a form that attempts to give an additional sense to the sense of the preexisting.

Like a recollection, a ruin is a fragment of the memory, that describes partially the oeuvre to which it belongs. The incompleteness of the ruin can however be considered in every respect a transitory state of the building, that helps us understand its former splendor, as well as its temporariness as man-made artifice. The material state of the building, stripped of the unnecessary, "can at times disclose us the compositive essence of the space that it recollects, a tension usually buried by the entirety of geometry, or hidden by the power of the matter" (Fabbrizzi, 2016).

The ruin is still a place in waiting, frozen in time, of which we don't have to preserve only the material. A ruin is a place with which the project, as structured system of signs, must communicate to track down the values of which architecture has always been voice and metaphor. We use a vision that aim to understand first of all the idea generating the space.

The first trail of such idea is the "internal time" of the ruin, its rhythm, its spatial essence, that now can emerge from the construction devoid of its substructions, that prevented us, in the undamaged building, from embracing the true architectural composition in a single glance.

The second trail of the sense of the ruin is to be found in the close link with the place where it was originally built, with which it intertwined, in the past, significant relations, that continue today in the changed place.

All this makes it possible to consider the architectural ruin as a unique element, even more to value and redesign, bearing in mind the opportunities and potentialities that arise from its singularity and bringing out yet again its vitality. The project is the tool that allows the sensitivity of the architect to pro-ject, "throw forth", the present given with a language that speaks to the future.

Fig. 13. View of the building entrance from the street.
Fig. 14. Top view.

9. Study Center San Francesco in Pitigliano

The study centre thus becomes, similarly to the city, an overlapping of vertical and horizontal levels, along the path that from the first rooms of common use is articulated to reach the more specialized space of the central nave, near which, beyond the glass wall, we find Knowledge, represented by the apple tree, where it can be contemplated but not be achieved.

With this reasoning, we highlight again the liturgical character of the building, transposing however in a study centre the spatial essence of the old church.

The scheme of the new parts of the project uses the very same geometric matrix applied for the original project by Sangallo, so as to intertwine deeply the new reality with the old one, as well as respecting the alignments and the idea of the latter.

Nonetheless, it is not only through the public function that the building open itself up to the city.

Identified in fact the typical features of the constructions of Pitigliano, and the way in which such constructions relate with the topography, the territory, and the tuff of the spur, we attempted to establish a form of intervention able to make the church a fragment of the city (Fig.14).

The idea was to plan a base at the foot of the church, exploiting the land in front owned by the Diocese, in order to recall the way in which the historic settlement of the town relates with the spur.

The new base constitutes a new attachment to the ground, achieved by using the differences in altitude. Adjusting the building to the slope of the road in front of the church, it was possible to conceive an entrance at the basement level, in continuity with the street level.

Fig.15. Level one of the San Francesco Study Centre.

Fig.16. View of the main hall.

Fig.17. Cross-section cutting the entrance.

Fig.18. Cross-section cutting the exposition room and the main hall.

References

Anonimo, A., Biondi, A. (Eds), 2008. *Descrizione della contea di Pitigliano*, vol II, Pitigliano, Ed. Laurum, Italy.

Augé, M.,2004. *Rovine e macerie. Il senso del tempo*, Bollati Boringhieri, Torino, Italy.

Bruscalupi, G., 1986. *Monografia storica della contea di Pitigliano*, Multigrafica, Roma, Italy.

Butini, R., 2016. *Progetto contemporaneo nel paesaggio archeologico*, DIDA press, Firenze, Italy.

Caliari, P.F., 2003. *Museografia. Teoria estetica e metodologia didattica,* Alinea Editrice, Firenze, Italy.

Caliari, P.F., Peressut, L., 2014. *Architettura per l'archeologia. Museografia e allestimento*, Prospettive edizioni, Roma, Italy.

Fabbrizzi, F.,2010. *Tempo materia dell'architettura*, Alinea Editrice, Firenze, Italy.

Fabbrizzi, F., 2015. *Con le rovine*, Edifir, Firenze, Italy.

Fabbrizzi, F., 2016. *In_Situ*, DIDA press, Firenze, Italy.

Fabbrizzi, F.,2017. *Around the walls*, DIDA press, Firenze, Italy.

Franciosini, L., Casadei C., 2015. *Architettura e patrimonio: progettare in un paese antico,* Mancosu Editore, Roma, Italy.

Giovannoni, G., 1958. *Antonio da Sangallo il Giovane*, Tipografia regionale, Roma, Italy.

Ricci, A., 2006. *Attorno alla nuda pietra*, Donzelli Editore, Roma, Italy.

Michelucci, G., 1972. *Brunelleschi Mago*, Tellini, Pistoia, Italy.

Narcisi, L., 2013. *Museo dell'architettura di Antonio Sangallo il giovane,* Ufficio Cultura, Montefiascone Rocca dei Papi, Italy.

Venezia, F., 2012. *Introduzione al mondo etrusco*, Firenze Architettura, pp. 4-7, Didapress, Firenze, Italy.

Spagnesi, G. (Ed.), 1986. Antonio da Sangallo il Giovane la vita e le opere, in *Atti del XXII Congresso di Storia dell'Architettura, Roma 19 – 21/02*, Centro di Studi per la Storia dell'Architettura, Roma, Italy.

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CH representation between Monge's projections and Augmented Reality

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Abstract

The representation of complex architectures presents a strong connection with the increasingly massive use of 3D acquisition systems and virtual representations. These tools have changed the relationship between researchers and Cultural Heritage artefacts, deeply affecting their analysis and representation. In this evolutive framework, may orthogonal projections still play an effective role in the study of buildings, or are they can be entirely replaced by 3D virtual models? May these firsts be compared with the communication powerful shown in the field of Augmented Reality? Starting from a critical review on the concepts of "representation" and "complexity", the article aims to provide a possible answer to these questions, through the description of some case studies characterized by a similar spatial and functional complexity.

 Keywords: Complex architecture; Functional representation; Data communication; Drawings; Space interaction; Monge's projections; Virtual 3D model; Augmented Reality

1. Introduction

The representation issue of complex architectural shapes is a subject as much discussed as it is current and central within the path of knowledge and communication of Cultural Heritage. Over the last twenty years, the appearance and increasingly massive use of three-dimensional acquisition systems on the one hand and 3D modelling and virtual representation platforms on the other has made it possible to digitally translate complex architectural systems, suggesting increasingly realistic virtual representations. This latter leads to a double reality, traced along the path of representation, which tends to assume the virtual worlds as a "passage" and not the end of CH knowledge process. On the one hand the extended application of the double projections to represent architecture seems to be a prerequisite in many academic and non-academic contexts, showing an easy and understandable system accessible at different levels of users and cultures, thanks to its expressive potential combined with paper-based transmission. On the other hand, the visualization of 3D models through augmented reality defines a very interesting communication channel, an increasingly advanced tool for visualization and analysis that can bring back on paper some of the potential representative of the 3D model.
The consolidated use of projections for the representation of existing buildings or projects stuffs is mainly due to the easy generation of manual or digital drawings by anyone who owns and knows how to use the language of architectural representation, which define also the reading instrument of the final output. Alongside this undoubted advantage, orthogonal projections show the well-known limit of not being able to "solve" the visualization of complex distribution systems, unless proposing a very large number of drawings, a very time-consuming activity. This is one of the main bottlenecks of projective geometry applied to orthogonal projection, leading to a lack of 3D data and a strong limitation in spatial reading of articulated system.

Besides, augmented reality, in its different declinations and applications, allows a more immediate and complete experience, communicative and not necessarily mediated by a specific architectural vocabulary, then accessible to a wider audience. The possibility of preserving the potential of three-dimensional spatial representation allows to better understand the volumes, materials and interrelations between architecture and context. But the computer skills, needed to produce topologically correct 3D models for simulations at different levels, inevitably get away those who are responsible for creating and transmitting the digital content.

How these two expression instruments can coexist, if they are apparently at the antipodes from the historical and cultural point of view, as well as their process of construction and dissemination? Are they able to provide different useful information individually, contributing both to the knowledge of the Cultural Heritage, or do they remain antagonistic with a difficult coexistence?

The article tries to give an answer to this question through a critical comparison of different experiences conducted in recent years[1]. On the one hand, a particularly complex case study will be presented from a formal and distributive point of view, trying to suggest a possible solution that allows to go beyond the current limits of orthogonal projective geometry. On the other hand, two case studies of augmented reality applied to the visualization of Cultural Heritage will be discussed, showing their different potentialities and limits. At the end of the contribution, a critical conclusion on the role of these representation systems and their possible integration will be presented.

2. Complexity of representation

Are the consolidated methods of orthogonal projections, framed in the digital representation field, able to support at the same time the project and communication activities about Cultural Heritage? Besides, is it also necessary to use 3D models, providing more articulated and complete information for reading complex realities? In order to answer these questions, it may be appropriate to suggest some pro and cons of these representation methodologies after twenty years the introduction of the firsts digital survey systems, as suggested by Addison

[1] The article shows the results of case studies shared and discussed in recent years, while in the drafting of the article the attribution is as follows: M.R. wrote paragraphs 2-3-4-5, L.C. paragraphs 1-6.

and Gaiani (2000), after fifteen years of structured researches in the field of digital representation, reported in Bianchini (2003) for restoration application and in Fallavolita and Salvatore (2012) for modelling aspects, and 10 years after the descriptive geometry revolution, presented in Migliari (2009).

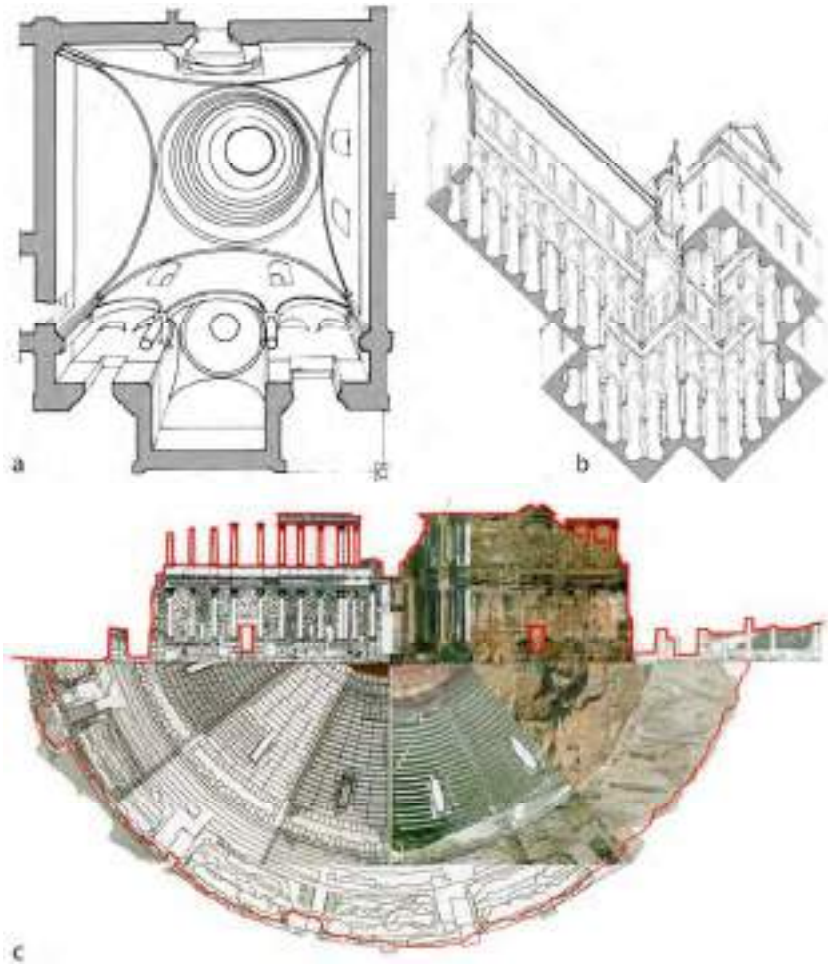

Fig. 1. Examples orthogonal projections with superimposed additional information: a) perspective plan of the Baptistery of Padua published in Battini (1989); b) Axonometry of the Holy Spirit published in Battini (1989); c) orthogonal views and integrated sections with clouds of coloured points or images of the Theatre of Merida, published in Bianchini (2013).

Monge's representations, framed within this critical-evolutionary process, support the entire process of CH knowledge, from its first cognitive step to the architecture restitution, from the system analysis to the project drawings. The initial knowledge is based on architectural survey, a system of complex operations with the precise aim to reach a dimensional, formal, material, structural, historical information on scientific bases about the artefact, carried out through the integration of different survey techniques and instruments.

This step allows to start a basic critical reading, analysis and interpretation for the enhancement, re-functionalization and restoration of existing building. In the CH field the communication must supply a precise documentation in order to transfer the multiple values of a monument in a unique and unequivocal manner. This knowledge path cannot be separated from a first important direct approach to the artefact, during which the operator is forced to observe it unmediated, grasping its spatiality, articulation, formal material and structural characteristics. They are translated into quick hand drawings drawn up mostly in orthogonal projections, creating the first graphic model useful for a correct representation and communication of reality. This graphic translation

obliges to a first level of selective simplification of the reality, defining a reciprocity relation between the real space and its relative representation.

The graphic models, obtained through an iterative refinement process based on continuous validation with real and acquired data, are translated into architecture plans, sections and elevations. These are abstract models, referring to a dissociated representation of the building obtained by a perpendicular projected on different planes. Plans and sections are representations of a not visible reality, contained in imaginary secant planes that partially communicate the interior/exterior spaces. The content subdivision process that is carried on during the orthogonal projection drawing, with the elevation's exception, inevitably leads to a lack of information, which can be integrated only in part through the insertion of integrative data beyond the section plan (Fig. 1).

The "subjectivity" and "discretization" characteristics, typical of Monge's projections and strongly related to the designer's graphic sensitivity and cultural education, assume a key role in the correct definition of these representations. If, on the one hand, a degree of subjectivity exists, on the other hand these representations are standardised graphic models, transmitting univocally objective information related to the space complexity. That's the reason why 2D drawings are still the most used representation tool in the executive project phase, being a clear and uninterpretable communication tool.

Although each orthogonal projection is in perfect correlation with the others, the spatial understanding of the building through this type of representation leads to an important effort depending on the reader skills. In fact, these representations should be a synthetic and codified result of the designer's cognitive and critical path, so the communication is not so immediate for people who has not the same architectural and graphic vocabulary as well as the ability to relate abstract to real environment.

The orthogonal projections define the framework for the generation of 3D models, from which new orthogonal, axonometric or perspective projections can be extracted, according to the most varied expressive languages for communicative purposes. The mediation role assigned to the virtual 3D model between different 2D representations must be carefully considered respect to the model's purpose and the application context. In fact, the virtual model represents an interactive instrument for representing a simplified reality, whose construction requires a cognitive completeness of the whole analysed building. Therefore, once these data have been collected, the model can be reconstructed, extracting additional vertical or horizontal sections.

The automatic definition of these latter represents a useful instrument to integrate the model analysis in an interactive way, but it can lead to the construction of poor representations, not based on these critical awareness and graphic regulations necessary for a univocal reading, according to the scale of the representation. This last aspect requires a critical review also from the didactic point of view, in which it is more and more evident and verifiable an intellectual laziness that leads to generate first the 3D model, extracting from it the 2D drawings.

Observing the decreasing habit in manual geometric construction, amplified using digital representation systems, the automatic extraction of axonometric and perspective views from the 3D model is particularly useful, with a clear predominance of the latter for their similarity to the perceptual reality and their communicative impact. This ability certainly fills in and replaces a practice, traditionally consolidated in the process of CH analysis and representation, based on the definition of very elaborate manual drawings in axonometric or perspective projection, able to highlight the complexity of the analysed system.

The 3D model is the only information system able to merge in an organized way the complex set of hierarchical information contained in a real architecture (Fig. 2).

Besides, the lack of standardized processes about 3D construction and geometric representation, often related to the platform used and the experience of the individual designer, leads to a considerable complexity in the access, use and interaction of these models.

In the last five years the increase in the Augmented Reality (AR) applications has clearly simplified the interaction with virtual 3D models through direct human gestures, overcoming many of the fruition limits due to "standard" 3D interaction. The possibility to visualize some parts or the whole 3D models with simple devices greatly amplifies its communicative capacity and accessibility, as described in Sdegno (2018). There are still some bottlenecks related to the generation and interactive simulation of models in the AR world, highlighted

also in Russo (2019), but there are several experiments aimed at overcoming these limits, progressively refining a valuable tool for CH reading, use and understanding.

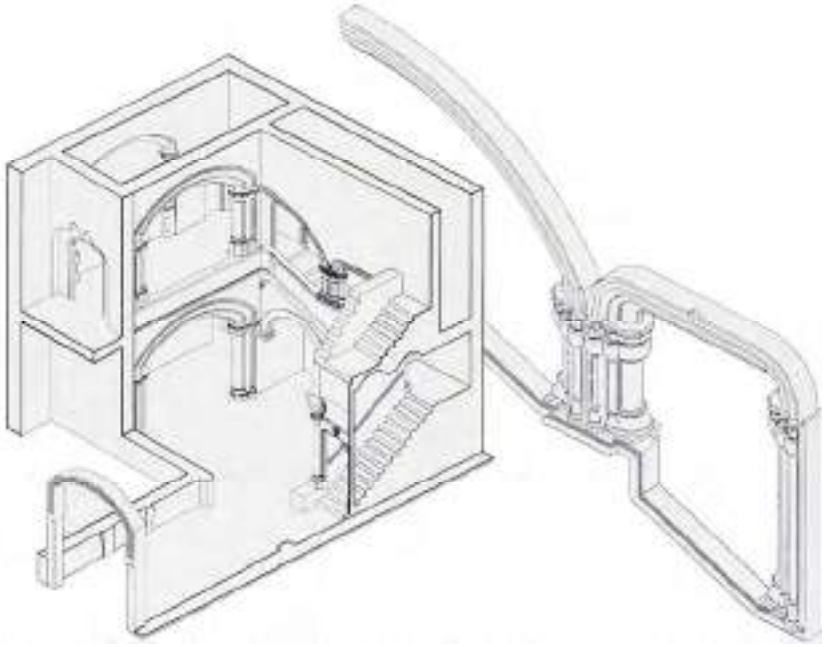

Fig. 2. In the image two axonometric splits taken from the three-dimensional model to show the complex spatial articulation of Palazzo Marzano in Carinola, 3D model and drawings by Francesca Tomassi, published in Cundari and Carnevali (2002).

3. Representation of complexity

A critical evaluation about instruments and methods for CH representation may appear too generic or not useful if the subjects analysed are not specifically expressed. For this, it's important to specify the meaning of "representation of complex Cultural Heritage" in this paper.

Fig. 3. In the example, the photograph is a section of Santiago Calatrava's Ysios Winery. The image shows how the section contains only the geometric information of a small portion of the real model that changes in space, published in Jodidio (2005).

The concept of complexity related to an architectural artefact generically may indicate a system decomposable into a set of indivisible portions which can present again complex characteristics, defining an articulated framework of reciprocal relations, not exclusively linear and static ones. This general definition does not consider the scale factor of an element, since it is well known that in the CH field a

small wall fragment may be considered equally complex as an urban context, depending on the component's identification and the scale of analysis.

In this research the CH complexity concerns with the network of spatial relations that can be expressed inside the monument, from the articulation of internal connections to the relationship between inside and outside spaces, up to the association between each space, the global building, and the system functionality. In this sense the attention is focused on some "families", well-aware about the presence of many singularities which cannot be assigned to precise typology. Moreover, dealing with a distributive-functional complexity, there is a close correlation between the scale factor and the level of complexity, affirming that a large size building often presents a higher level of distributive complexity.

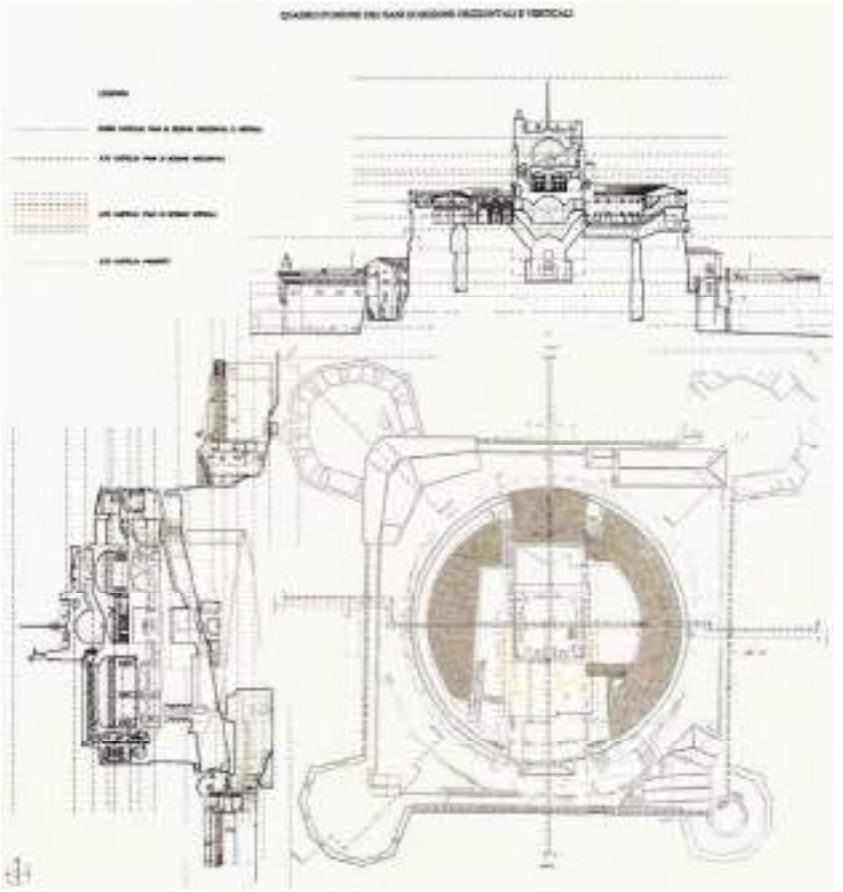

Fig. 4. Framework of union of the restitution project of Castel Sant'Angelo published in Cundari (2000).

The CH spatial complexity should not be confused with other complexities, such as geometric or material ones, more related to the characteristics of the artefact "skin". Besides, the boundary between these two different aspects may be very thin, since there's often a convergence of formal, spatial and functional complexity in Cultural Heritage examples. On the contrary, in modern and contemporary architecture the repetitiveness of technological-structural elements often leads to a conscious dissociation of these different features, proposing on the one hand geometrically simple but spatially complex systems rather than geometrically complex but spatially simple systems (Fig. 3).

A first critical consideration on the complex CH representation concerns the relationship between the actual survey methodologies and the process of graphic restitution.

The increasingly consolidated use of active and passive systems has certainly introduced a more in-depth level of knowledge of the architectural artefact, at the same time modifying both the relationship between the real object, the researcher and the restitution methods. If a precise and progressive knowledge of the direct survey is based on an "additive" data acquisition from the plane to the space, on the contrary a dense cloud of points already contains all the useful information for the restitution of the entire system, allowing to directly transformation to 3D model in space.

As far as the orthographic representation of complex distribution systems is concerned, it is necessary to achieve an important number of sections to allow an enough documentation and visualization of the building, using different scales of representation.

The discretization of a complex building description through a limited series of horizontal and vertical sections leads on the one hand to the hierarchical selection of significant elements, presenting in the meanwhile "information gaps" where reality is not represented. Besides, the production of many graphic representations is an activity that preserves the important process of cognitive, progressive and codified discretization, but it requires a great effort in terms of man/time compared to an unexpected communication result (Fig. 4).

This bottleneck in representation of complexity can be partially solved using 3D models, able to include and relate all the components of an architectural organism. The capability to be understood immediately, intuitively and interactively through human-vision representations, leads to be considered the most complete instrument in the representation of complex CH. The higher communicative impact respect to Monge's projections derives from the overcoming of an abstract and predetermined vision system. On the other hand, the construction and fruition of 3D models are still weak points, considering the required high level of specialization and the use of not easily accessible platforms for a wide audience. From the fruition point of view, the advent of AR has allowed a great step forward, democratising the use of 3D models through common and easier accessible platforms and systems. As follows some case studies are presented, quite similar from a spatial and functional point of views, on which different paths of representation have been experimented, in order to understand the advantages and limitations of each methodology according to its purpose.

4. Three case studies

The first case study, Delizia del Verginese, belongs to the suburban villa typology present in the Ferrara countryside, whose genesis is part of the complex system of suburban villas built by the Estensi Family during the Renaissance period, as reported in D'anna et al. (1984), Dosi (1998), Marchesi (2011). The origins of the building can be dated back to 1481, but it is only after 1533 when ownership is transferred to Alfonso I d'Este that the various architectural expansions begin, leading in the early 1600s to an admirable example of a building with a Renaissance garden. The main architectural transformations are commonly attributed to Girolamo da Carpi. Passing through some of the main noble Families of the time, the villa and the garden are preserved until 1932, when a decline start damaging both the building and the garden. Some important structural interventions in the 90s and the garden redevelopment in 2006 allow to recover the original Renaissance aspect (Fig. 5a).

The second case study, San Sebastiano Gate, is one of the main and best-preserved gates of Rome, located at the beginning of Via Appia. Its foundation date is estimated between 271 and 279 A.D. under the power of Emperor Aurelian. More details are in Giovenale (1931), Staccioli and Liverani (1970), Mancini (2001). The millenary history of the building can ideally be divided into seven periods, marked by relative external and internal transformations, as described by D'Ippolito (2017). The first three phases, concentrated in the first two hundred years, concern the transformation of the towers and their progressive raising, the closing of an archway, the construction of a counter-door with walls arranged in pincer form to increase controls and security at the entrance, the insertion of quadrangular ramparts as stiffening following some important seismic events, with the progressive replacement of the floors and the insertion of internal walls.

The fourth period embraces the medieval and modern age, with some reinforcement works, a raising of the two towers and several decorative enrichments. In the following fifth and sixth period, the gate does not present any evident external transformations, while important internal distributive changes are made due to the function changes, from the residence of people devoted to control entrance goods to the private residence of the Fascist

hierarch Ettore Muti, until to the Museum of the Walls. The last period, which arrives at its current state, begins following some works during the Jubilee, aimed at improving the accessibility of the Door. The Door is now in a controlled state of conservation, still housing the Museum of the Walls. From the outside it is possible to observe the monumentality of the work, which does not reflect the complex internal articulation (Fig. 5b).

The last case study is Palazzina Girevole, a building designed by Pier Luigi Nervi in the 1930s, which was never realized. Many information about the project and the historical context can be found in Nervi (1955), Milelli (1983), Nervi (2014), Antonucci (2014). The building, presented in a first version with a clear futuristic imprint and in a second version with a more conventional and rigorous structuralist approach, is defined by a cylindrical base and central core. The shape and dimensions of the house make it possible to create a double order of rooms, distribution and services, from which a design dynamism typical of the rotating architectural element can be seen. The structural scheme of the floors and elevations of the upper level consists of a series of reinforced concrete radial partitions connecting the two concentric cylinders. The internal one supports and connects the entire structure to the base, while the external one acts as a connection between the partitions and as a curtain wall. Looking at them frontally, the radial partitions are shaped like rectangular trapeziums with an oblique side corresponding to the intrados of the floor of the first level; the inclination of the floor characterizes the volume of the structure for the overhang of the continuous balcony (Fig. 5c).

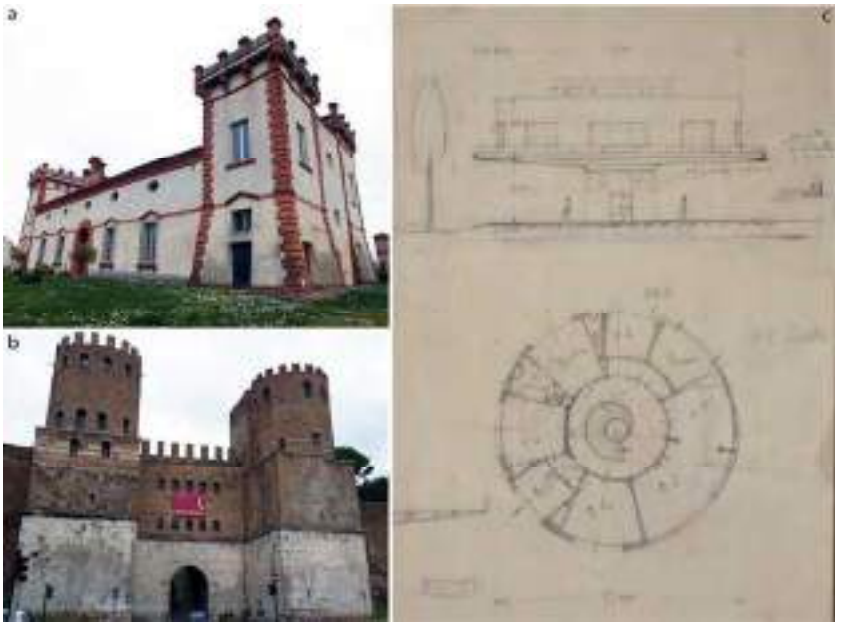

Fig. 5. Images related to the real three case studies: a) Palazzo del Verginese; b) San Sebastiano Gate; c) drawing of Palazzina Girevole.

5. Data acquisition and elaboration

The Delizia del Verginese was studied in 2018 through an extensive multi-scale survey campaign, planning a cognitive and interpretative analysis of both the building and the garden based on the geometric information acquired on a territorial and architectural scale. The integration of active and passive methods from the ground for the architectural survey with passive methods with RPAS at a territorial scale has allowed to acquire a complete geometric information of the entire Villa. More details on the complete survey and analysis process are reported in Russo (2018).

The data collected allowed to represent plans, elevations and sections of the building, through a process of analysis and reading in relation to its transformation over time, highlighting the relationship between the external and internal spaces. The orthogonal sections and facades drawings have allowed to create a virtual

3D reconstruction, suppling a usable model to promote the CH communication, showing this architectural asset off the main tourist routes (Fig. 6a). To achieve this last goal, a process of transformation of the existing parametric model into a digital data suitable for AR visualization has been carried on, facing different bottlenecks referred to 3D surface construction and transformation, as described in Russo et al. (2019). The result obtained can relate, through a simple fruition, the 2D information of the building and the context with the 3D model (Fig. 7a).

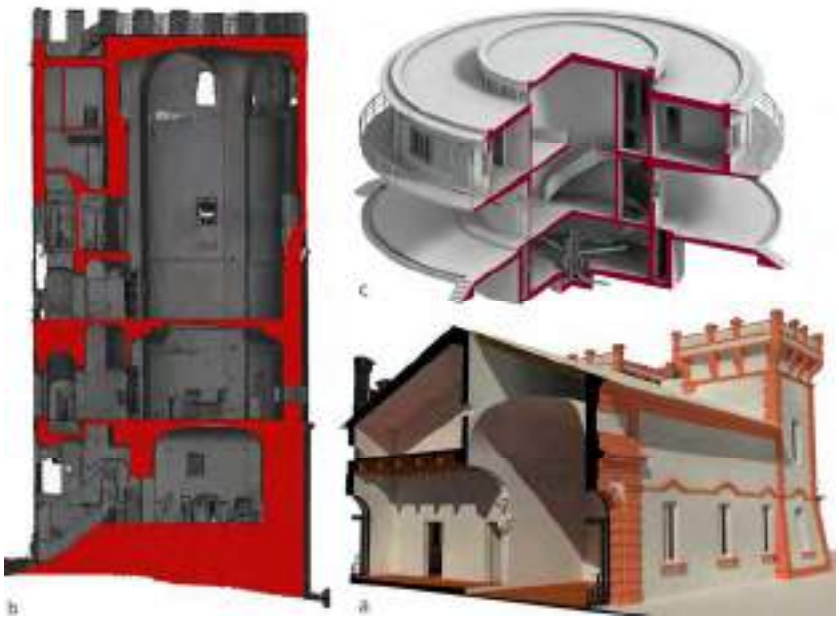

Fig. 6. a) Vertical prospective section of Palazzo del Verginese 3D model; b) Range-based point cloud and superimposed vertical section of San Sebastiano Gate; c) Double vertical section in axonometric view of Palazzina Girevole 3D model (rendering by S. Menconero).

The San Sebastiano Gate was the subject of an extended survey in 2019 by a 3D laser scanning campaign, described in Carnevali et al. (2020). The survey allowed the geometric acquisition of all the exterior and interior parts of the building. In this case the survey was planned to answer the concrete need of the Capitoline Superintendence to have some plans and sections passing through specific points of the monument, in order to produce a supporting documentation for a design intervention. This request defines one of the most interesting aspects of the case study analysis, because the complexity and articulation of the spaces made it extremely difficult to use traditional direct survey methods for the study of volumes and the production of detailed sections. The complex and dense cloud of points generated by more than 300 scans served as starting basis for the extraction of specific orthogonal sections passing through the most complex points, characterized by vertical connections (Fig. 6b). The effort in representing such an articulated system through a limited sequence of vertical and horizontal sections has showed on the one hand the complexity in defining the correct number of planes useful for the description of the monument, on the other hand the evident impossibility to communicate clearly and immediately through this kind of representation method the complex articulation of the vertical connections (Fig. 7b).

In the case of Palazzina Girevole the topic of existing drawing interpretation was addressed, aimed at the construction of a hypothetical 3D model. Starting from a first graphic fragmentation of 2D drawings, as described in Barlozzini et al. (2018), the different systems that contribute to the definition of the architectural building have been analysed individually, reconstructing homogeneous project representations. Then the 3D model was created through parametric modelling, filling in critically those "information gaps" in the drawing representations. Finally, the 3D model was used both as a tool for the representation of the project, through the generation of predetermined views and its AR communication.

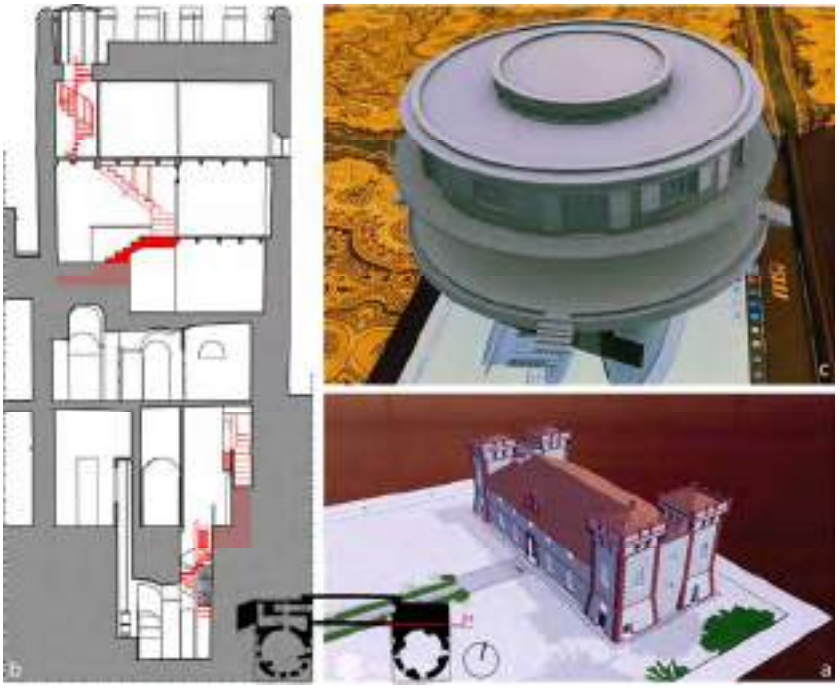

Fig. 7. a) AR visualization of Palazzo del Verginese 3D model; b) Vertical section of San Sebastiano Gate with red vertical connection and transparent red colour for the hidden elements; c) AR visualization of Palazzina Girevole 3D model.

Being a project never realized, renderings have assumed an important role in understanding the spatial relationships and the compositional issues (Fig. 6c). Experimentation through AR, on the other hand, made it possible to easily show the 3D virtual reconstruction building, introducing the functional aspect through the rotation of the artefact (Fig. 7c). The integration between 2D and 3D representations have highlighted the complex relationships existing between the load-bearing structure, the mechanical rotation system of the building, the technical systems, and the architectural details, acting as a powerful tool for project communication.

6. Conclusions

In the recent decades, the methods for CH representation have considerably changed, due to the presence of different instruments for digital acquisition and modelling, introducing a new cognitive approach to the architectural artefact and its relative restitution.

In this panorama, representations in orthogonal Monge's projections still have a fundamental role both for those who create and read them. For the firsts they represent an exercise of understanding and synthesis of the building organism, for the second they are an example of clear and uninterpretable communication of architecture. Their principal limits lye in being abstract and incomplete representations, requiring the ability to read the drawing and relate it to reality.

While these representation methods support the whole path of CH analysis, the 3D modelling is referred only to the last step, for the necessary global knowledge of the physical object combined with a high specialization of its creator. The 3D virtual model thus becomes the result of a convergence of external skills and CH knowledge, which are consistent and organized within a virtual hierarchical system, which in turn allows to generate endless new representations to support the artefact understanding. The current lack of rules that regulate 3D representation combined with the complexity of their use, often mediated by specialized digital platforms, leads to a preference for orthogonal projections in the representation of executive drawings, which can present a data limitation but clearer and immediately readable representation.

Through the case studies shown in the article, 3D models mixed with AR represent the only chance to describe and communicate an artefact in its complexity, going beyond the limits generated by the distributive-functional complexity of spaces.

The possibility to easily use these contents and linking them to the context can boost the use of 3D models in the process of CH representation and analysis. Currently, both the methods of representation based on orthographic projections and 3D models through AR are not alternatives, since each one has its own potential and limits. Their balanced use within the whole process of CH representation allows to face the problems given by the complexity of the system, providing the best answers for the understanding of the architectural element.

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References

Addison, C. A., Gaiani, M., 2000. Virtualized architectural heritage: New tools and techniques, in *IEEE MultiMedia*, vol. 7, no. 2, pp. 26-31, April-June, doi: 10.1109/93.848422, IEEE, USA.

Antonucci, M., 2014. Piero Luigi Nervi /Louis I, Kahn Estetica dell'ingegneria e Monumentalità architettonica, in *Pier Luigi Nervi Gli stadi per il calcio*, Antonucci Micaela, Trentin Annalisa, Trombetti Tomaso (eds.), Bononia University Press, Bologna, Italy.

Barlozzini, P., Carnevali, L., Lanfranchi, F., Menconero, S., Russo, M., 2018. Analisi di opere non realizzate: rinascita virtuale di una architettura di Pier Luigi Nervi, in *Rappresentazione/Materiale/Immateriale – Drawing as (in)tangible representatio,*. in: R. Salerno (ed.), Gangemi Editore, Roma, Italy.

Battini, E., 1989. *Filippo Brunelleschi*, Electa, Milano, Italy.

Bianchini, C., 2003. Il Modello Digitale Continuo applicato al progetto di restauro, in *Gli strumenti di conoscenza per il progetto di restauro,* M. Docci (ed.), pp. 140-145, Gangemi, Roma, Italy.

Bianchini, C., 2013. *Documentation of Mediterranean Ancient Theatres: Athena's activities in Merida*, Gangemi Editore, Roma, Italy.

Carnevali, L., Lanfranchi, F., Russo, M., 2020. The ancient Roman gate along Appian way: San Sebastiano, in International Conference on Fortifications of the Mediterranean Coast, Fortmed 2020, Granada, Spain.

Cundari C., 2000. *Castel Sant'Angelo. Immagini Rilievi*, Kappa, Bologna, Italy.

Cundari, C., Carnevali, C., 2002. *Carinola e il suo territorio. Rassegna dei Beni Architettonici*, Kappa, Bologna, Italy.

D'Ippolito, M. G., 2017. *Le fasi costruttive di porta appia e i risarcimenti altomedievali delle mura aureliane*, PhD dissertation Thesis in *Archeologia e Antichità Post-Classiche*, XXVIII *ciclo*, Italy.

D'anna, L., Massarenti, M., Montani, R., 1984. *Una delizia estense del XVI secolo: Il Verginese*, Edizione Arstudio, Ferrara, Italy.

Dosi, P., 1998. *Delizia estense del Verginese*, Essegi, Ravenna, Italy.

Fallavollita, F., Salvatore, M., 2012. Theory of Curvature Lines and Construction of Ellipsoidal Vault, in *Praise of Theory The Fundamentals of the Disciplines of Representation and Survey*, pp. 65 – 72, Gangemi, Roma. Italy.

Giovenale, G., 1931. *Le porte del recinto di Aureliano e Probo. Bullettino della Commissione Archeologica Comunale di Roma*, Vol. LIX, Arte della stampa edizioni. Roma, Italy.

Jodidio, P., 2005. *Architecture Now 3*, Taschen, Germany.

Mancini, R., 2001. *Le mure aureliane a Roma: atlante di un palinsesto murario*, Editore Quasar, Roma, Italy.

Marchesi, A., 2011. Palazzo del "Verzenese", in *Delizie d'archivio. Regesti e documenti per la storia delle residenze estensi nella Ferrara del Cinquecento. Tomo 1, Dimore urbane e extraurbane*, pp. 616-629, Le Immagini Edizioni, Ferrara, Italy.

Migliari, R., 2009. Disegnare nello spazio = Drawing in Space, in *Disegnare Idee Immagini*, 38, 1, pp. 22-29, , Gangemi, Roma. Italy.

Milelli, G., 1983. P.L. Nervi/verso l'architettura, in *Nervi oggi*, Luigi Romazzotti (ed.), Edizioni Kappa, Rome, Italy.

Nervi, P.L., 1955. *Costruire correttamente. Caratteristiche e possibilità delle strutture cementizie armate*. Hoepli, Milan, Italy.

Nervi, P.L., 2014. *Scienza o arte del costruire? Caratteristiche e possibilità del cemento armato*, Città Studi Edizioni, Novara. Italy.

Russo, M., 2018. *La Delizia del Verginese*, Sapienza Edizioni, Roma, Italy.

Russo, M., Menconero, S., Baglioni, L., 2019. Parametric surfaces for augmented architecture representation, in *International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, XLII-2/W9, pp. 671-678, ISPRS.

Sdegno, A., 2018. Augmented Visualization: New Technologies for Communicating Architecture, in *Computational Morphologies. Design Rules Between Organic Models and Responsive Architecture*, Rossi, M., Buratti, G. (eds.) Springer, Berlin, Germany.

Staccioli, R. A., Liverani, P. G., 1970. *Le Mura Aureliane*. Capitolium edizioni, Roma, Italy.

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Documenting cultural heritage in rural areas for its understanding and for a development perspective: a map for the Orsini Park in Pitigliano

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Abstract

The Italian territory is littered with artifacts and rock monuments that are an integral part of the place and reveal its history and culture. Sometimes these are brought into museums to preserve them and be able to communicate their history and relevance, sometimes this would distort their essence, or it is impossible for the type of artifact. The GIS technologies allow its localization respect to global reference system and through it is possible to create thematic maps useful for monitoring the assets and for understanding the territorial system, network, and relations between all the single elements. The present study analyzes the Orsini Park in Pitigliano, an example of a cultural heritage scattered throughout the territory and of which scant information is available, to create an overall framework of what is still legible today. A framework of knowledge is essential for subsequent recovery and project phases, but it is also useful for making public information available to know the park. The Orsini Park is made up of stone elements carved on the tuffaceous outcrops along the slopes of the wooded spur adjacent to the village: seats, sculptures and panoramic points that overlook the valley of the Lente river and towards the town. The park, defined mannerist and with clear links to the garden of Bomarzo, represents one of the rare examples of sixteenth-century gardens in the *Tuscia* area. There is a lack of archival, cartographic, and iconographic documentation that prevents us from knowing its history and the original boundaries and structures. It is known that the park was built by the Orsini family, probably around the middle of the 1500s; legend has it that the last god of the Orsini Count killed his wife for reasons of jealousy. The park was abandoned when the town of Pitigliano fell into the hands of the Medici family, at the beginning of the 1600s. Perhaps it was the park of a villa of which no trace remains today, and which was already destroyed in the nineteenth century. The value of this testimony is undoubted, but today it remains abandoned to itself on the hill Strozzoni, accessible through unmarked paths that are taken from a plateau to which one arrives from a secondary road that one takes from the road directed to Sorano. The creation of an adequate and themed cartographic representation is fundamental in a first phase of research. Thanks to the use of a GIS software and through a census and a GPS mapping, it was possible to create a first map of the elements of the park georeferenced that shows the real distribution of the finds. These are categorized by type and analyzed individually in detail by instruments that also allow digital representation. Furthermore, programs for geospatial data processing are useful to carry out interdisciplinary analyzes allowing the superposition of the data collected with the themed maps of the territory.

Keywords: GIS, interactive map, GPS, digital heritage, conservation

At the same time, these data allow the creation of an open access map, usable through smartphones, which facilitates visitors visiting the park by locating the elements. The map, which is interactive, contains descriptive and didactic contents to raise awareness of the significance of the place which will hopefully be the subject of future studies and interventions. The aim of this research, therefore, is to create an adequate and themed virtual cartography that constitutes a documentation of the current state of the park. It is a preliminary step towards the elaboration of a complete recovery project aimed at the enhancement of the cultural heritage present within the Orsini Park of Pitigliano and the implementation of a network at a territorial level.

1. Introduction

Protecting and promoting the Cultural Heritage has the purpose of developing the local culture and at the same time to perpetuate the memory of place. The definition of Cultural Heritage includes both of Cultural Monuments and Landscape Heritage (Codice dei Beni culturali e del Paesaggio, 2004). Cultural Heritage is a system of elements and relationships between the place, the history, the culture, and the environment. These are values that cannot be separated and considered individually because are deeply interconnected in a cause-effect relationship. The territory is a complex system in which protection and promotion can only start after a fundamental base of knowledge. It helps to find the most relevant aspects that should be highlighted. It is necessary to analyze the environmental transformations, caused by the social changes, the landscape use and how it is inhabited, to reach a correct and coherent comprehension of the territorial structure. Be aware of place means giving a sense to objects and signs of a territory (Turri, 2002), knowing the history, the culture. This consciousness permit to act respecting the local identity and resources. In the knowledge process, documentation and representation are important as testimony and as analysis and are useful to create an overall framework approached with an interdisciplinary methodology.

The information technologies let a fast and economic acquisition process for a study in architectural and territorial scale. The documentation acquired is used to collect the necessary information for comprehending the heritage. In this article is described the Orsini Park, dated in XVI century, in Pitigliano, south of Tuscany, in the area even called *Area del Tufo* (Tuff Area). The Park, today in a state of abandonment and hardly accessible, has been studied starting from the survey and the documentation of the elements still recognizable that has been mapped with GPS technologies. It has suggested a more general consideration of the inhabiting system and the relationship between man and environment.

Fig. 1. Study area.

2. *Area del Tufo*, a cultural landscape

The *Area del Tufo* is placed between the south of Tuscany and the North of Lazio and the Fiora River constitutes its upper border. The volcanic origin characterizes the geologic structure composed by layers among which there is the tuff. This brittle rock has been eroded from the water forming deep valley where flow rivers, leaving solid stony headland and tuffaceous plateau. Populations have settled the area characterized by that unique morphology since the antiquity, but were the Etruscans that have built the first territory structure of which we still can appreciate the traces and many archeological founds. The spurs have been exploited as settlement places for their strategic collocation and characteristics: are surrounded by rivers useful for the hydric suppling and as communications routes (Boitani et al., 1973). These places, protected from steep and rocky slopes can be easily defended and have been settled since the end of second millennium b.C. (Potter, 1985), transformed in castles for defending the boundaries and developed in medieval villages. The territory retains the traces of the passage of different civilizations, indelible add up and build what is called a cultural landscape.

Fig. 2 From top right to left: Entrance portal in St. Chiara Street (n°1); River God sculpture (n°4); *Pope*'s seat (n°12); Seat inside a niche with a semi-circular terrace (n°11); *Belvedere* towards the valley of the Lente River (n°21).

Pitigliano is a village placed on one of these spurs typic of the area, overlooking the Lente River, a tributary of Fiora River. The hamlet, which origins date back to the Etruscan age, sees one of the most significant periods and involved by strong transformations in the Renaissance. Many buildings, symbol of Pitigliano are dated to this period. Some of them, as the Orsini's Park in Pitigliano and the St. Francesco Church are placed outside of the urban area, and in state of decay are in danger of abandonment and being compromised.

3. Orsini Park, Pitigliano

The Orsini Park is placed north of Pitigliano on Poggio Strozzoni, in direction of Sorano, after the Procchio torrent. The Poggio has been urbanized on the south side: residence built in XX century are arranged along the St. Francesco road till the Borghetto, the oldest nucleus. On this hill, there are historical testimonies belonging to the sixteenth century: the St. Francesco Church, today at the entrance of the village at the east extremity of the Poggio, and the Orsini Park, on the north-west slope. From the Orsini Park remains only the rest of the access portal, a stone portal with two side niches in the current street of St. Chiara from which started a tree-lined avenue that, passing the Procchio by means of a bridge, reaches Poggio Strozzoni.

There lies the most known part of the Park: outcrop rocks are carved in the form of seats, pavilions, staircases, statues, and belvedere platforms offering spectacular views towards Pitigliano and the valley of the river Lente. The remains of another portal of access, of which there are only lacerations, are located near St. Francesco. Today the park is in a state of abandonment, totally distorted by neglect and urban transformations, it is accessed through an anonymous road that takes from Via St. Francesco. The Park is an important witness for the country of Pitigliano, a *monumentum*: it is an example of the Orsini family's artistic expression in which a Renaissance human–nature relationship can be guessed, and at the same time, it has its roots in the Etruscan expressivity typical of the *Area del Tufo*. It shows a growing state of degradation and it's placed in a difficult-to-access location. It is identified in the town planning regulation of 2015 among the Areas subject to unitary design and needs a recovery intervention.

3.1. Historical notes

The Orsini Park is generally traced back to the period when Niccolò IV dominated (Bredekamp, 1989), but there have no documents that confirm him as a client or that reveal the designer. In recent years, historiographical investigations have been conducted: some quotes of the Park have been traced in the documents that allowed to make an *ante quem* dating. It would trace the Park at least to 1563 (Biondi, 2018). The historical cartography of the area is also lacking: the first descriptive maps of The County of Pitigliano date back to the second half of the eighteenth century (Rombai, 1982).

he history of the park is surrounded by legend: tradition tells that the last Count Orsini had a mistress in Sorano, but was extremely jealous of his wife. One day, when he came back to Pitigliano, he met her in the park. He asked her how it was going in Pitigliano and she innocently answered: "More or less as it went to Sorano". He considered it a confession and he choked her and threw her headlong into the stream. From this moment the Poggio is called Strozzoni (Bruscalupi, 1986).

Today only a few elements of the park remain, but probably the state of abandonment has been going on for a long time: already in the nineteenth century, the English explorer George Dennis, in his book *Cities and cemeteries of Etruria* (1848), telling of his travels, refers to only of two figures, carved into the rock, that were called by the people Orlano and his wife. Moreover, he mentions that there is already no trace of Orsini's villa. Even in the twentieth century of the Park is made only a few hints: some photos published by E. Baldini (1937) of the best-known sculptures and seats testify to its state at the beginning of the twentieth century. In 1981, a project was made for the enhancement of Poggio Strozzoni (Dallari et altr., 1991), supported by the local Banca di Credito Cooperativo of Pitigliano and directed to safeguard architectural and artistic emergencies with more appropriate accommodation of natural vegetation, also with the inclusion of the remains of the convent church of St. Francesco, but it was not followed up.

3.2. Interpretations of the Park

To understand more of the Orsini Park, critics tend to compare the park with more well-known contemporary examples or tried to trace its matrices, deeply rooted in the local culture, and possible sources of inspiration. There are two main interpretations given to the Park: one that sees it as a place of delight and pleasure, another one as a Barco, hunting reserve.

The Park is often interpreted as a recreational place, where the Orsini Family could get lost in the woods,

among the intricate paths and find the characters such as the nymph, river god, joyful places to rest and meditate (Lazzari, 1990). The direct link is that with Bomarzo Park, also belonging to a branch of the Orsini family, conceived by the architect Pirro Ligorio on the commission of Prince Pier Francesco Orsini, called Vicino. There are numerous sculptures in the park that refer to mythological figures and compositions belonging to the classical and Etruscan tradition.

Some like the Psyche or Tiber are reminiscent of those found in the Orsini Park. The reference to classic is typical even of Renaissance culture: In Romans Renaissance gardens classical figures, belonging to the past, recreate the splendor of ancient times such as it happens in the Belvedere Courtyard (Masson, 2010). In the same way, the two statues of the Orsini Park can be traced back to the figure of the sleeping nymph and that of a river god. The dormant nymph is usually represented as a female figure lying near a sacred spring, representing the divine spirit of the place.

The origin of iconography is ancient, probably going back to the classical world, when nymph can be identified as Ariadne, Arianna. The statue of the Orsini Park today presents only the bust from which you can sense the pose, the sex from the breast sketches. The presence of a similar and better-preserved figure in the park of Bomarzo, suggests that the statue of the Orsini Park could be similar, but there is no other information about the original state to give a more certain interpretation.

The hypothesis that Park arises on an Etruscan necropolis discovered by the Orsini is not deepened, but the Etruscan heritage permeates the Orsini Park in an obvious way: one notices a similarity between moldings of the sculptural elements of the Park with archaeological remains of monumental Etruscan burials in Norchia or between some park seats and tombs in Sovana (Bredekamp, 1989). In the Tuscia area, there are other sixteenth-century parks less monumental and less known, but whose recurring characteristic in these is the presence of sculptures on the emerging rocks typical of the morphology of the *Area del Tufo*. These include the Orsini Park in Sorano, villa Chigi in Soriano, Villa Odescalchi in Bassano di Sutri, Villa Cornelia in Viterbo, remains at the spring of Nempe in Farnese.

In the interpretation of the Park as a *Barco* the forest becomes a scene of hunting jokes, observed by the Orsini as a spectacle, comfortably seated on the rock thrones. This type of activity was widespread among the accounts and the Grand Dukes who used to build large wooded compartments near their residences, in the Renaissance period. An example of this typology near the *Area del Tufo* is Ronciglione (VT), where the Farnese family owns a hunting park designed in the second half of the 16th century by the Vignola in a forest of *cerri* (Turkey oak) and *roverelle* (*Quercus pubescens*, a species of white oak), there are structures functional to the regimentation of the territory, including mills and hydraulic works, and hunting activities such as doves and the hunting casino, integrated with remains belonging to the Etruscan period. Also, in Marino there is a Barco of the Colonna family dated in XVI century whose access it is similar to the Orsini's one.

4. The survey

The first phase of documentary archival research consisted in the collection and study of existing documents about the history of the Orsini Park. Historical information about the park is few and often linked to local legends. The site lacks cartography that frames the study area to a scale of detail necessary to describe the park, or to delimit its extent. There is no detailed description of the elements present in the park, of which the first iconographic documents date back to the beginning of the '900. This has made necessary a phase of relief in order to document, catalog and place the rupestrian finds on digital cartography that could be of support to the analyses and the successive studies or uses cognitive and informative.

A site inspection preceded the survey phase, to understand the peculiarities of the Park and to be able to design the activity of relief most suitable for study. The site is located on a wooded and difficult slope and covered by dense vegetation. The morphological characteristics make it difficult to move with heavy instrumentation and the dense vegetation can hinder the detection by drone, so, as well as for economic reasons, we used a GPS (GPS etrex 20x Garmin, precision 3.5m). In addition, the location of the elements spread on the spur also suggested the use of this technology, suitable for marking spots on a territorial scale.

During the GPS survey, were made photos in order to document the work done and to catalog and describe the state and type of elements identified. Through an open-source GIS software, the geo-referenced data corresponding

to the finds has been inserted on a topographic map, in vector format, used as basic cartography. Have been used maps CTR available on the geoportal of the Tuscany Region (Data source: Regione Toscana – "X_333130_2010_3003-X_332160_210_3003-32003_1990-32004_1990). The vector map on which were placed the waypoints corresponding to the items surveyed, in scale 1:2000, was superimposed to the ortho-images relative to the area (*Data source: Regione Toscana* - 06N60_2016_i4 - 06N61_2016_i4). The final processing of the map is realized through digital drawing programs to make it communicative and clear.

Fig. 3. Panoramic view toward Poggio Strozzoni from *Palazzo Orsini*.

From the public Orsini park there is a path that runs along the plateau longitudinally and leads to the forest to the west and looks out to the east. Entering the woods there are the first remnants of the park: carved steps, a seat inside a niche with a semi-circular terrace in front (element n°11), a human seat (n°13), still descending along the stairs there's the Pope's seat (n°12) and the Nymph (n°14). The lookout (n°21) dominates the valley to the north, to the right are the thrones (n°22) in which there are traces of a coat of arms depicting a rose, symbol of the Orsini's family.

Continuing downstream, along the steep slope, a kind of canal carved into the rock that descends to the base of the rocky spur of the lookout is intercepted. This has a large circular recess with traces of stairs carved into the solid rock. The function is not clear, nor is it mentioned in the articles that mention the Park. The path continues down to the Lente River, with a constant slope; in some sections, a central channel resembles that of draining water present even in the most famous Cave streets.

Along the path, there is a cave (n°30) and a structure buried, with a circular plan and absence of coverage. Other sporadic seats and traces of stonework have been found even further up, to the east, near of the St. Francesco convent. Note an underground structure (n°34) that to bear some resemblance to that one along the path that leads to the river, but differing in the presence of niches and size. From the spur to the east, continuing at altitude, rocky outcrops have been intercepted that, although much more modest, have processes that can be traced back to the most famous lookout. Another noteworthy element is an underground space (n°24) of which you can barely see a gap from which you can perceive the presence of water and residues inside.

A large number of elements emerged, not limited to the best-known seats attributed to the Orsini Park. Moreover, numerous active hydraulic structures used until the nineteenth century located along the streams. Some are still easily identifiable: in some cases, they have been renovated finding a character in their historical origin, such as the ancient Molino Pinzauti; in others, they are hidden by vegetation or now destroyed.

From the historical cartography, we learn of the presence of a fulling-mill, a powder magazine, on the eastern side of the Procchio (Pitigliano, Ceccarelli Giuliano, Archivio di Stato di Grosseto, Antico Catasto Toscano - Pitigliano - Sezione B - Foglio 3, 1825), and several mills along the Lente River.

That distribution of these artifacts belonging different periods testify the settlement of Poggio Strozzoni and the surrounding territory.

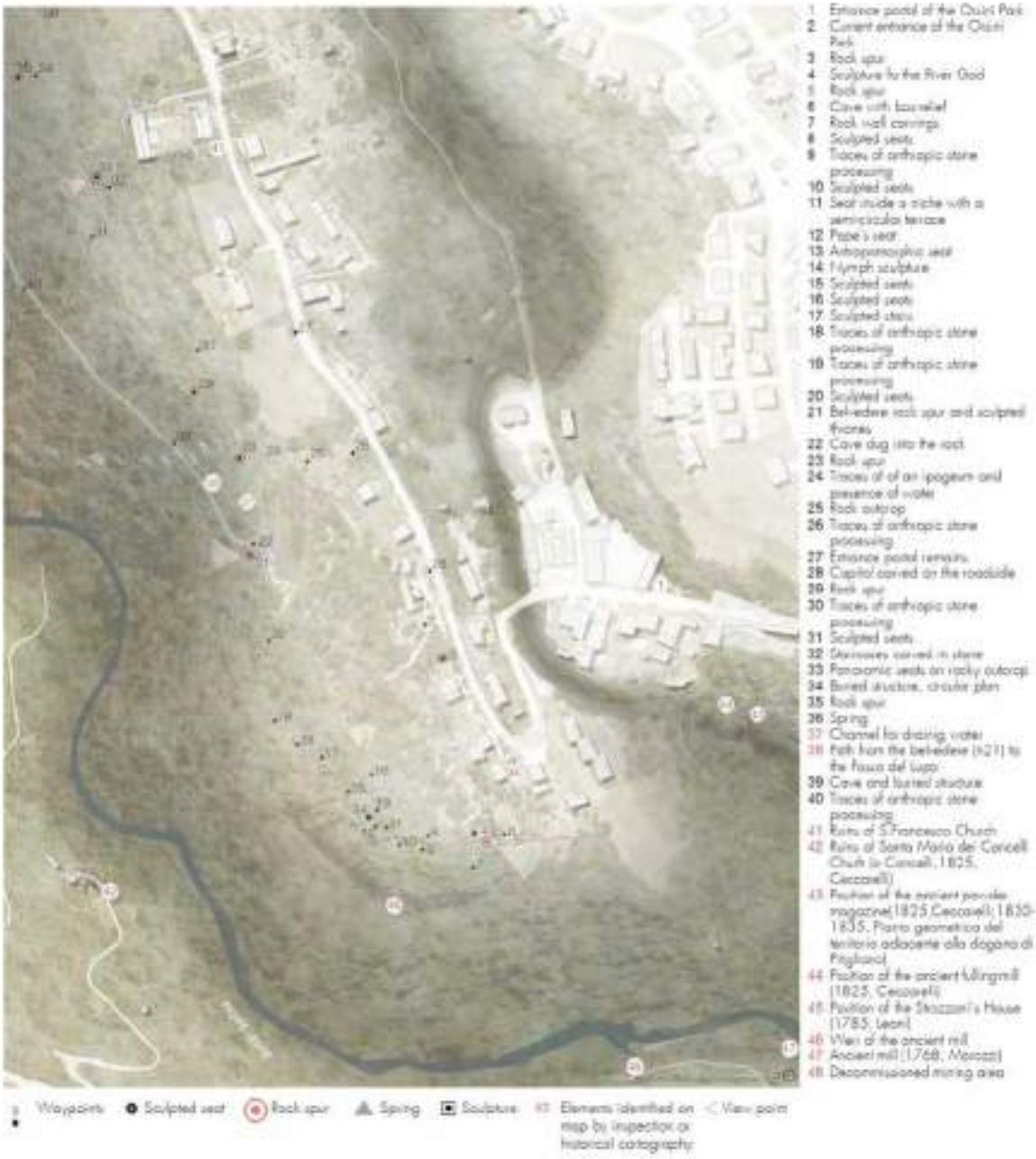

Fig. 4. Map of the landscape elements of Poggio Strozzoni.

5. Poggio Strozzoni, Pitigliano, a twin system, traces of a settlement structure

During the survey of the Orsini Park were identified sculpted rock outcrops not mentioned by previous studies on the Park and the structures surveyed are not all easily traceable to their function because the history of the Poggio turns out fragmentary and incomplete. Some hypotheses have been made based on comparison with other structures, and seeking confirmation in a known historical framework, in the place names and customs of the time. For example, following the hypothesis that the Orsini park had been a hunting park, the buried structures without roofing, well

camouflaged, are recognized as traps, probably built for the capture of wolves. This type of structure consists of a trunk-conic hole, dug in the ground, whose upper opening was covered with boughs and leaves so that the animal was lured to it with bait. Both structures are located on the slope and the downstream side there is the entrance: a gap in the tuff in which is recognizable the predisposition to a closing fixture.

Fig. 6. Scheme of the rock spur around Poggio Strozzoni.

This type of trap has very ancient origins and with variations is used until the nineteenth century. The place-name also agrees with this interpretation: the two structures are located on the side bordered by the "Fosso del Lupo" (wolf ditch). Also, as the historical maps (Pianta del Podere Strozzoni di proprietà di S.S.R. posto nella contea di Pitigliano Livellario, Paolo Leoni, 1785) show, the soil of the knoll was used as a hard-working pasture, a still traditional activity of the *Area del Tufo*, for the traps would have served to protect the sheep from the predators that populated the wooded slopes. Rock outcrops that resemble the famous lookout overlooking the Lente River valley, have also been identified. These are less noticeable because they are smaller than the main one and because they remain submerged and camouflaged in the thick vegetation, or have been processed and used by locals as depots. Their location, located during the GPS survey, seems to follow a logic: they are located at an altitude that differs by a few meters and well distributed over the entire perimeter of the spur. The path that connects them, which runs along all the slopes, recalls the lookout path along the walls, and the spurs, the broken towers of a defensive system of a city perched on the plateau, of which today there is no trace. The availability of water on the headland, found in the underground compartment and confirmed by the presence of the convent well, would support this hypothesis. Then it has been tried to understand if, in Pitigliano, there are traces of such settlement logic. Understanding the primary structure of the city is quite complex because over the centuries it has evolved and transformed (Boitani et altr., 1973). Despite it, the historical stratification, a result of continuous development over the centuries, has not erased its matrices. The system of viewpoint can be traced back to a defensive conformation of the urban center. In ancient times they represented strategic bulwarks as is evident by looking at the 1749 Map of the "Land and Fortress of Pitigliano County", where they are highlighted with color and with the letter S: "Baluardi and spacious places around the country". In a drawing by Antonio da St. Gallo *il Giovane* of the early 1500s, working at that time on fortification operas of the Palazzo Orsini and the city, the village is schematized highlighting the defensive bulwarks that protrude from the Tufa

base. Even today, some circular spurs are recognizable. The hillock on which Pitigliano and Poggio Strozzoni stand are part of the same territorial structure typical of the Tuscia area. They are particularly suitable for settlement: they have a position of control over the surrounding territory and are rich in raw materials and natural resources. The streams flow along the valleys, the woods cover the slopes and the material, of which the knoll itself is made, were until a few centuries ago very important resources for the local economy, just as they were of a great resource also flat land suitable for the cultivation like those of the tufa highlands. The historical settlements that have presided over this territory since antiquity present a similar structure, becoming a settlement type with a strong identity and recognizability, attributable to the original Etruscan settlement. The same twin structure of adjacent headlands on which the settlements develop, as the Poggio Strozzoni-Pitigliano, is also found in other villages originating in the Etruscan period. The hypothesis that Poggio Strozzoni was in ancient times a settlement that had no historical continuity would require further interdisciplinary studies and investigations aimed at investigating the structure of the territory more thoroughly.

Fig. 7. Scheme of the *Baluardi* in Map of the "Land and Fortress of Pitigliano County", 1749.

Fig. 8 From left to right: A circular spur still visible in Pitigliano; base part of the belvedere of P. Strozzoni (n°21); spur of P. Strozzoni used as garage (n°3); spur of P. Strozzoni (n°6).

The survey and study of the historical documentation has made it clear a framework in which not the individual elements emerge, but a territorial system. There is a deep historical stratification, sedimented over time, of which the sixteenth century is only the most evident. The spur of Poggio Strozzoni reflects the typical characteristics of the spurs of the *Area del Tufo*, which make it a strategically attractive place for a garrison; the structures found (rocky peaks, the compartment with water, the hollow road leading to the river) would confirm the hypothesis that in earlier times it had already been a place of settlement.

The Poggio Strozzoni, now apparently disorderly, hides a systemization. It reflects the activities and structure of the society that built and used them. Landscape as society evolves while maintaining a strong link with its

Etruscan origins with the territory so markedly wrinkled and dominant. We rediscover not only the history of the place but also the culture and resources of the territory, whose awareness of the value is regained, the first step towards conservation and enhancement.

6. Conclusions

On Poggio Strozzoni there are historical elements that reveal a different condition from the present. The most evident remains are the Convent of St. Francesco and the Orsini Park dating back to the sixteenth century, but during the survey have been mapped even elements apparently belonging to more ancient time. GIS technologies have enabled to create a documentary map of the elements that testify the history of Poggio Strozzoni: the seats and structures of the Orsini Park that narrate the Renaissance characters; the traps that remind us how the wooded slopes are and have always been a reserve of biodiversity, inhabited by wild animals, and the many other lesser-known tracks. The survey and the representation through a map are an important step for the knowledge of the area, preparing to a critic interpretation. The position of the rock spurs showed an ancient defensive system, analogue to the one in Pitigliano, that can be traced back to Etruscan landscape. Monuments and landscape cannot be separated, the two scales are necessary to understand the whole system and have a perspective of conservation, valorization, and local development, based on endogenous resources.

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References

Baldini, E., 1937. Pitigliano, in *Maremma-BSSM*, fasc.III, p.35, p.46, Coop. Tip. Fascista, Italy.

Biondi, A., 2018. Parchi degli Orsini nella Contea di Pitigliano. Originale creazione del Rinascimento, in *Accademia dei Rozzi*, Anno XXV/2, N. 49, pp. 95-118, Siena, Italy.

Boitani, F., Cataldi, M., Pasquinucci, M., 1973. *Le città etrusche*, pp.11-12, pp.50-51, p.117, Arnoldo Mondadori editore, Verona, Italy.

Bredekam, H., 1989. *Vicino Orsini e il bosco sacro di Bomarzo: un principe artista ed anarchico*, Pignatti F. (Ed.), pp. 384, pp.369-374, Edizioni dell'Elefante, Roma, Italy.

Bruscalupi, G., 1986. *Monografia storica della contea di Pitigliano*, pp. 388-389, Multigrafica, Roma, Italy.

Codice dei beni culturali e del paesaggio, D.Lgs. 22 gennaio 2004, n. 42, art.2., Italy.

Dennis, G., 1848. *The cities and cemeteries of Etruria*, pp. 475-476, I, J. Murray, London, UK.

Lazzaro, C., 1990. *The Italian Renaissance Garden. From the Conventions of Planting, Design, and Ornament to the Grand Gardens of Sixteenth-Century Central Italy*, pp.118-121, Yale University Press, New Haven and London, USA and UK.

Masson, G., 2010. *Giardini d'Italia*, pp.155-163, Officina Libraria, Milano, Italy.

Melardi M. M., 2018. Il parco di caccia degli Orsini a Pitigliano, Grosseto tra storia e leggenda, in *Bollettino della Società di Studi Fiorentini*, n 26-27, pp. 44-56, Altralinea Edizioni, Firenze, Italy.

Potter, T. W., 1985. *Storia del paesaggio dell'Etruria Meridionale. Archeologia e trasformazioni del territorio*, pp 59, La nuova Italia Scientifica, Roma, Italy.

Rombai, L., 1982. *Le contee granducali di Pitigliano e Sorano intorno al 1780: cartografia storica e storia di un territorio*, pp. 8-11, Istituto di Geografia, Firenze, Italy.

Turri, E., 2002, La conoscenza del territorio. Metodologia per un'analisi storico geografica, pp.14-19, Marsilio, Venezia, Italy.

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The archaeological survey for the conservation of memory, the first step of the Volterra in 3D Project

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Abstract

The New European Agenda for culture adopted by the EU in 2018 promotes the vision of a broader involvement of stakeholders in all the topic from acquisition to dissemination to the enhancement of cultural heritage.
In this framework the preservation of the cultural heritage is therefore understood also in its memory meaning, as we have conceived it in the Volterra in 3D Project aimed at documenting the archaeological heritage starting from roman remains of a villa, whose two big mosaics are exhibited in the old *Museo Etrusco Mario Guarnacci* in the Etruscan city of Volterra (Tuscany, Italy).

Since the finds are exhibited far from their origin context (and it itself is no longer visible today), it is very difficult for the visitor to imagine its original environment. Then the two mosaics have been measured, processed, and presented in traditional and new representations to proceed with the virtual reconstruction of the villa facilitating the understanding of their provenance and the architectural context.

Keywords: archaeological survey; archietcural 3D modelling; museo Guarnacci; Volterra; sustainable cultural heritage

1. Framework of the Volterra in 3D Project

Accordingly with the definition already present in the Italian Code of cultural heritage and the landscape since 2004, cultural heritage includes assets to be protected and enhanced to preserve the memory of the communities and promote the cultural development of territories. In addition to the main meanings, cultural heritage is therefore specifically defined by being one of the most powerful identifying elements of the community, especially those typically linked in historic Italian settlements and cities.

In the "Declaration of Paris on Heritage as a Driver of Development" (the "Paris Declaration" from the 2011 ICOMOS Symposium entitled "Heritage, a driver of development") heritage is defined a fragile, crucial and non-renewable resource that must be conserved for the benefit of current and future generations. The declaration includes an effort to address the role of cultural heritage in development and to identify the actions needed not only to protect heritage, but also to ensure that its use, its promotion and enhancement, and its economic, social and cultural value are aimed to the benefit of local communities and visitors.

Therefore, the New European Agenda for culture adopted by the EU in 2018 makes explicit in the "Work Plan for Culture 2019-2022" the vision of a broader involvement of stakeholders in all the topics from acquisition to dissemination to the enhancement of cultural heritage.

This vision it's divided into five priorities forming the public debate in a new, broader direction for which the Cultural Heritage is not only a way of preserving the memory of the past but part of an organic system projected into the future, where cultural policies must be linked in terms of competitiveness to the social cohesion and well-being, to the job policies, to the environment.

The preservation of the cultural heritage is therefore not to be understood only as the protection of material assets but it also constitutes itself the defense of the intangible values of identity, sustainability and resilience, making cultural heritage an important driver for the life of the communities.

This vision represents the framework of the Volterra in 3D Project, aimed at documenting part of the archaeological heritage of the ancient Etruscan city of Volterra (Tuscany, Italy), to reinforce its knowledge and preserve it from the rescue of a fruition in old approach, actually not completely deploying all its cultural potential in the territory.

The project is designed to apply the best practices of virtual archaeology on the relevant archaeological heritage of the city working on some artifacts of the Guarnacci museum and on the traces of archaeological area from which the finds came.

2. The context and the case study of the project

The Museo Etrusco Mario Guarnacci in Volterra is one of the oldest public museums in Europe and was born from a first collection in 1732, then it was formally founded by Pietro Leopoldo in 1786 as "Public Museum and Guarnacci Library". The most famous finds of the museum and the most significant of the whole collection are "Il coperchio degli sposi" (1st century BC) and the other symbol of the Museum and of Etruria in general, the elongated ex-vow of a boy known as "Ombra della sera", a bronze work considered one of the masterpieces of Etruscan sculpture of the III century BC.

The Guarnacci Museum houses an impressive collection of about 600 ossuaries, Etruscan sculptural masterpieces, important ceramic collections, bronzes, goldsmiths, coins, materials from the Roman Volterra and many Roman imperial mosaics from many surrounding archaeological sites (Fiumi, 1976).

A real systematic cataloging operation of the mosaic floors began only in the second half of the 1900s when was born the reawakening of the interest in the mosaic production of Central and Northern Etruria, an operation that brought to light the process of Romanization of the Tuscan territory and during which the geometric decorative themes spread to Lazio and Liguria.

The case study of this paper includes two mosaics from the museum coming from Villa Segalari, located near Castagneto Carducci (Livorno, Tuscany).

Both the mosaics came from the prestige domus and villa built in the roman Imperial age called Villa Segalari, which is no longer visible due it was re-buried, as it was in use in the second half of the 19th century, immediately after being brought to light during the archaeological excavation.

The only news of its existence has come down to us thanks to the drawing in an article published in the Gazzetta Ufficiale of 1876 by the archaeologist and numismatist Gian Francesco Gamurrini containing a drawing from which we can assume to reconstruct it as organized with a peristyle with columns around which the rooms with mosaic floor were arranged (Bueno, 2011).

The timeframe of the two mosaics (1st century AD for the first mosaic and 2nd century AD for the second one) is coherent with the periodization of the villa, which goes from the Augustan age to the Hadrian period.

The first mosaic is the one that in the Gamurrini plan may have covered the left wing of the "triclinium with two wings" of the villa and now exhibited in room XVIII of the museum.

The mosaic has a "rivestimento in tessellato a decorazione geometrica ornato da una composizione a reticolato di fasce suddivise in rettangoli e quadrati nei punti di incrocio. I rettangoli e i quadrati sono resi in nero profilati da una linea doppia bianca e decorati rispettivamente da un quadrato sulla diagonale e da una losanga sdraiata. Il reticolato individua quadrati bianchi più grandi, delineati da una linea semplice nera: questi presentano un quadrato delineato in nero inscritto sulla diagonale e decorato da tre motivi differenti combinati in sequenza sempre diversa" (Bueno, 2011).

The second mosaic is the one exhibited in room XIV of the Guarnacci museum and, according to the identification proposed by Ciampoltrini (Ciampoltrini, 1994), was connected to the room that Gamurrini calls "a rectangular room of 8x 3.60" ml.

The geometric decoration tessellation is "bordato da una treccia a tre capi policroma con andamento meandriforme resa in tessere bianche, verdi, gialle, rosse, marroni e azzurre. Il campo presenta una composizione ortogonale di stelle a otto losanghe", whose larger squares are characterized by plant themes framed by a braid and meanders (Bueno, 2011).

3. The Virtual archaeology strategy of the project

The current potentialities of virtual archaeology allow the general public, archaeologists and museum curators to well understand the contexts and somehow retrieve, with modern technologies and languages, the highly imaginative aspect of the reconstructive representation.

Moreover, the 3D visualizations and the virtual reconstructions based on the data collected during the architecture's surveying campaigns offers the possibility to make interactive simulations and thematic interpretations of an archaeological context and to display complex information in visual way using a communication tuned on a wide and diversified audience of users.

Although virtual archaeology founds its theory in numerous statutory documents (ICOMOS, 2008; Denard, 2009; Principles of Sevilla, 2011) the state of the art cannot yet be considered settled and various reasons (being a complex discipline that requires strong interdisciplinarity, the lack of a shared methodology, some unscientific approach in the use of a too "game designed" visual language) contribute to keeping this activity too often in the context of graphic expression only.

The great potential of virtual archaeology remains fundamental in defining the common terrain of analysis and interpretation of the archaeological heritage when it is the subject for all material aspects of study by joint groups of architects and archaeologists, as important projects show in one of the first exemplary pilot cases (see the Swedish Pompeii project).

In the case of the Guarnacci Museum, the original museum exhibition -itself an historical memory of the museum culture at the time of its establishment- has recently been added by another more didactic one (Cateni, 2011), with a chronological path conducting the visitor through the long historical event of the Etruscan Velathri.

The documentation and Virtual Archaeology work carried out on the two mosaics of Villa Segalari goes precisely to support this new path, suggesting a possible digital relocation of the mosaics in the original context which is now inaccessible.

In scientific terms, the operations carried out on the two mosaics correspond to the definitions given in the Seville Principles and expressed as Virtual restoration ("this involves using a virtual model to reorder available material remains in order to visually recreate something that existed in the past.

Thus, virtual restoration includes virtual anastylosis") for the integration of the lacunas in the mosaic of room XIV and Virtual reconstruction ("this involves using a virtual model to visually recover a building or object

made by humans at a given moment in the past from available physical evidence of these buildings or objects, scientifically-reasonable comparative inferences and in general all studies carried out by archaeologists and other experts in relation to archaeological and historical science.") for the 3D modeling work of the Villa Segalari.

4. The methodology of the study

The workflow of the data acquisition, modelling and virtualization was organized in 3 phases, carried out in about 4 months of work.

The survey campaign was carried out in twenty working days spent using a combination of technology starting by hand measurements and sketches for the acquisition of the main dimensional characteristics (Chiavoni, Filippa, Docci, 2011; Bertocci, Bini, 2012; Brusaporci, 2015;) and photogrammetric methods such as point cloud through 3D stereoscopic couple of pictures, panoramas etc. for the SfM.

The photographic campaign was aimed at creating an archive of digital images to be processed with the Structure from Motion technique: the photo shoots were processed with appropriate photo modelling software and referenced using the data obtained from direct survey; these data were finally used to product textured 3D models and high resolution orthophotos.

The SFM method has been then used to realize 3D models with photorealistic textures, the combination of which made it possible to document the geometric and material aspects of the artefacts by working on a digital basis (Remondino, Campana, 2014; Fazio, Lo Brutto, 2020).

To survey the mosaic carpet with coloured details it was necessary to define a workflow that could guarantee an appropriate degree of color control both in the acquisition and representation phases (Santopuoli and Seccia, 2008; Versaci and Cardaci, 2011).

Although we worked on objects exposed to controlled light conditions, the workflow was set to obtain the correct colour sampling and the parameterization of the acquisition characteristics that could guarantee homogeneous captures even if carried out by different cameras (therefore with a yield of the RGB values influenced by the characteristics of the different sensors).

One of the advantages offered by the digitalization of photographic acquisition processes is certainly represented by the possibility of taking images in Raw: this format represents, in fact, a method of data acquisition in which no interpretation and modification processes have been carried out by the capture sensor. In the case of digital images, it means to obtain a photographic shot that does not suffer any loss of data due to compression and allows therefore to intervene, in the post-production phase, on the aspects that more than others define the good quality of an image. Once the preliminary white colour's balance phases were carried out, the samples were then created from which to extract the colour profile characteristics to carry out the subsequent adjustments by overlapping a colour checker on the items to be photographed (in our case the Kodak Colour Control Patches) whose printing characteristics were known. The images where the checker was present have been converted into DNG (Digital Negative) format and then analysed with the Adobe DNG Profiler Editor software making it possible to check the RGB values of the individual colours present in the checker itself and make the appropriate corrections for bring them closer to the reference parameters.

Once the samples were corrected, it was therefore possible to generate the corresponding colour profiles to be used for the normalization of all the Raw images (Volker, 2010).

The different photo shoots were processed and assembled for the subsequent production of high-resolution screenshots aimed at the production of the graphs in the usual architectural detail in 1:10 scale.

The first mosaic in room XVIII measures 297x510 cm (12x25,5 Roman feets), and includes 4x7=28 black and white square patterns. The second mosaic room XIV measures 353x757 cm (10x17,5 Roman feets), and includes 9x3=27 circle and square polychrome patterns.

The graphics were produced following a traditional workflow (Ippoliti and Meschini, 2011; Pescarin, 2016; Puma, 2018), including 2D drawings descriptive of the dimensions (quoted), of the morphology (geometric) and of the photorealistic characteristics of the artefact by integrating the CAD drawings and 3D textured models by SfM; the representation of the two mosaics has been completed by the metric-proportional interpretation of the mosaic's patterns and schemes.

Fig. 1. The case study location (left side: the mosaic in room XVIII, right side: the mosaic in room XIV), the documentation of the two mosaics, the workflow.

5. Conclusions

The virtual archaeology application consisted of two phases: in the first phase by photo editing work, it was possible to carry out the digital restoration by reconstructing the lacunas in the first mosaic in the areas damaged by use and time, thus obtaining the final image of the floor as similar as possible to the original one. In the second phase we worked to visualize in a 3D model a hypothetical reconstruction of the Villa Segalari including the relocation of the two mosaics, setting the work according to the scientific and the archaeologist's guidelines.

The 3D model has been conceived by modelling the Gamurrini's map and integrating his indications with the typological scheme typical of the villa spread during the Romanisation phase of central Etruria, to suggest the

imagination of the museum finds in their origin context.

A short video was finally made for communication issues and useful for a first spreading about the study carried out and about the mosaics, on which visual studies had never been carried out on graphic documentary bases before today (Fig. 1).

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References

Bertocci, S., Arrighetti, A., (Eds.), 2015. *Survey and documentation for archaeology*, a special issue of Scires-it 5(2). http://caspur-ciberpublishing.it/index.php/scires-it , Italy.

Brusaporci, S., (ed.), 2015. *Handbook of research on emerging digital tools for architectural surveying, modeling, and representation*. Igi Global, Hershey, Pennsylvania, USA.

Bueno, M., 2011. *Mosaici e pavimenti della Toscana Il secolo a.c.-V secolo d. C.* Edizioni Quasar, Milano, Italy.

Cateni, G., 2011. *Volterra-Museo Guarnacci*, Pacini Editore, Pisa, Italy.

Chiavoni, E., Filippa, M., Docci, M., (eds.). 2011. *Metodologie integrate per il rilievo, il disegno, la modellazione dell'architettura e della città*, Gangemi, Roma, Italy.

Ciampoltrini, G., 1994. Mosaici del II secolo d.C. nell'Etruria centrale marittima, in *Prospettiva* n.75-76, pp. 2-13, Centro Di Della Edifimi SRL, Florence, Italy.

Fiumi, E, 1976. *Volterra: il museo etrusco e i monumenti antichi*. Pacini Editore, Pisa, Italy.

Denard, H., (Ed.), 2009, *London Charter for computer-based visualization of cultural heritage,* http://www.londoncharter.org/fileadmin/templates/main/docs/london_charter_2_1_en.pdf, UK.

Fazio, L., Lo Brutto, M., 2020. 3D survey for the archaeological study and virtual reconstruction of the sanctuary of Isis in the ancient *Lilybaeum* (Italy), in *Virtual Archaeology Review*, n.11(22), pp. 1-14, https://doi.org/10.4995/var.2020.11928 , UPV. Valencia, Spain.

ICOMOS, 2008. *The charter for the interpretation and presentation of cultural heritage sites*. http://www.icomos.org/charters/interpretation_e.pdf.

Ippoliti, E., Meschini, A., (Eds.), 2011. Tecnologie per la comunicazione del patrimonio culturale, in *Disegnarecon* n.4(8). https://disegnarecon.unibo.it/issue/view/276/showToc, Università degli Studi di Bologna, Bologna, Italy.

Pescarin, S., 2016, Digital Heritage into Practice, in *Scires-it*, n.6 (1). http://www.sciresit.it/issue/view/772, Italy.

Principles of Seville, International principle of Virtual Archaeology, 2011. http://smartheritage.com/wp-content/uploads/2015/03/FINAL-DRAFT.pdf, Spain.

Puma, P., 2018. Multidisciplinary experiences of virtual heritage for the documentation of architecture and archaeology within the DigitCH Group - Digital Cultural Heritage Group, in *Digital Heritage Progress in Cultural Heritage: Documentation, Preservation, and Protection.* in: Ioannides, M., et al., (Eds.). Springer International Publishing, Heidelberg, Germany.

Remondino, F., Campana, S. 2014. (Eds.). *3D Recording and Modeling in Archaeology and Cultural Heritage. Theory and best practices*. BAR International Series 2598. Archaeopress, Oxford, UK.

Santopuoli, N., Seccia, L., 2008. Il rilievo del colore nel campo dei Beni Culturali, in *Trattato di Restauro Architettonico,* Carbonara, G. (Ed.), pp. 141-153, UTET, Torino, Italy.

The Swedish Pompeii Project, 2000-2013. www.pompejiprojektet.se (access May 2020).

Versaci, A., Cardaci, A., 2011. Il rilievo "automatico" del colore: nuove tecnologie a supporto della lettura cromatica per il restauro dell'edilizia storica, in *Il colore nel costruito storico. Innovazione, Sperimentazione, Applicazione*, Falzone, P. (Ed.), Aracne Editrice, Roma, Italy.

Volker, G., 2010. *Fotografia RAW con Photoshop*, Apogeo Editore, Milano, Italy.

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From mega to tera: Data storage and its diffusion for large-scale photogrammetric surveys

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Abstract

During the last few years, the technological development of photographic equipment and the increasing demand for detail by the client, has led to the creation of increasingly detailed photogrammetric surveys which inevitably bring with them a series of problems related to the management, storage and, subsequently, to the diffusion of materials whose size, in terms of memory, makes their appreciation and their use by external actors to the relevant process increasingly difficult. At the current state of affairs, many well-executed elaborations risk remaining usable exclusively by the operators who produced them while they can be exploited by the customer/client for only 30% of their potential. In view of the many years of experience within the Photographic Architecture Laboratory, we aim to offer some possible solutions that make the amount of photographic data easier to handle both during the treatment for the creation of the model and during the subsequent diffusion of the elaborate products. Within this work three case studies will be presented, taken from our experience in the laboratory, which will allow us to see how the problems of the amount of data have been tackled both in the survey phase and, subsequently, in the promotion phase and disclosure. The case studies, selected to include a wide range of case studies in terms of the type of relief (micro-survey, macro-survey) and the difference in materials (mainly marble in the cathedral, enamels in the mosaics of the baptistery), are united by the client's need to have an unusual level of detail such as to require, in each of these cases, many large photos. The selected case studies are those of the survey of the cathedral of Santa Maria del Fiore in Florence, of the Campanile of Giotto annexed to the cathedral itself and of the mosaics of the Baptistery of San Giovanni. In all three cases the number of photos taken in a single solution exceeded 7000 units for single component. Such many images are difficult to manage both in the alignment phase and, subsequently, in the management of the final material. In this regard, we present here the procedures developed for a rapid and effective selection of the incoming data, as well as the possibilities already tested and those being developed for the processing and the use of the final documents by the client. Some of these procedures are already a reality in the production process of our laboratory such as, for example, quality verification using the Agisoft Photoscan software before the alignment process. Still others, such as the possibility of overcoming current systems in favor of a BIM system applied to cultural assets for a more complete cataloging and management of a model in all its parts, are in an embryonic stage but of great expectation for the revolution that a possibility of this kind could lead to the management and planning of maintaining a large and difficult-to-manage cultural asset.

Keywords: Photogrammetry, Survey, Cameras, New Technology, Drones

1. Introduction

The work that we present in this first edition of ArCo conference is the result of at least five years of research involving the Architecture Photographic Laboratory (LFA), part of from the DIDALabs System at the Dipartimento di Architettura, University of Florence, which involved a team where dr. arch. Paolo Formaglini, dr. arch. Filippo Giansanti, dr. arch. Stéphane Giraudeau operated in collaboration with the Area3D studio (since 2004 a scientific partner of the Department, former Faculty of Architecture) in many of the case studies analyzed here. All the activities have been coordinated by prof. Giorgio Verdiani, scientific director of the Architecture Photography Laboratory and coordinator of the DIDALabs system.

The basic problem is to effectively combine the increase in the heaviness of the raw data acquired with the speed of execution and the satisfaction of an increasingly demanding customer/client who is often well informed about the constantly evolving possibilities of digital survey systems.

It is important to emphasize here that the production of terabytes of data is not necessarily linked to the evolution of technology or, more correctly, the leavening of the data acquired and subsequently produced is due to the choice of the operator to take advantage of these technologies that guarantee greater precision, however, generating an increase in terms of heaviness in the initial and final data.

Theoretically, the "weight" of the acquired data could paradoxically be greater (or at the most equal) if realized with past technologies compared to that realized with contemporary technologies. This aspect, which may seem absurd, is instead linked to the need that underlies the acquisition process. For example, if you wanted to represent a building on a very "pushed" scale, with photographic equipment of five or ten years ago it would be necessary to perform a significantly greater number of shots to acquire the same portion of the artifact at the same resolution that we can acquire today with a relatively small number of shots. This is because the most recent digital machines manage to acquire the same portions of the surface with a much higher number of pixels than those of a few years ago. It is thus evident that this aspect leads to the realization of a smaller number of photos for the representation of equal portions of the surface to be detected. Clearly the greater number of pixels that we can obtain from a single shot determine a weight, in terms of bytes, greater but the increase in the number of photos that would serve to represent the same portion on the same scale would lead the final bytes to equal or even to exceed those resulting from shooting with newer equipment.

The example just made, although absurd since it does not consider the impossibility of processing such a large number of photographs with hardware and software technologies coeval with those of shooting, gives a good idea of how today's increase in data is more related to a change in needs that increase the technological possibilities. Often unjustified needs which, not infrequently, lead the client not to be able to take full advantage of the final result as it lacks the technical and cultural tools (more than cultural I would say of knowledge) necessary to manage it.

On the part of the operators of the sector it is necessary to check all the phases of the construction process of the required model which aims, on the one hand, to produce the lightest possible designs, on the other, to provide the most suitable tools for the use of elaborates that now exceed abundantly several gigabytes of weight.

We will therefore analyze all the stages of processing and use of a digital survey in order to illustrate the "optimal" process for the rapid selection of the acquired photographs and their correct management without neglecting the quality of the final product but, vice versa, exploiting the processes of selection and processing to improve the quality of the survey.

Herefollowing a shortlist of the main stages of the survey:

- Analysis of the artefact
- Preliminary considerations on the acquisition and coordination of Laser / Photo
- Definition of certain topographic points
- Laser data acquisition
- Acquisition of photographic data
- Selection of the photographic data acquired
- Processing of the laser data and implementation with the photogrammetric one

We will then continue with a review of the new technologies available for the acquisition / processing of the data and for its use and then conclude with the analysis of three significant case studies for the size of the artifacts detected or for the accuracy required.

2. Evolution of photographic instruments

In the last twenty years, photogrammetry has become an increasingly indispensable discipline for professionals who carry out a photogrammetric survey campaign. The possibility of building three-dimensional photogrammetric models, with the integration of color and texture, has greatly enriched the result of the photogrammetric survey of many information, thus giving the possibility to discover the details of the detected object (Rodriguez-Navarro, 2013).

The growing and continuous evolution of digital technology has certainly helped operators in this field a lot but at the same time it has created many difficulties because the in-depth knowledge of the new tools has not grown hand in hand with the technology itself.

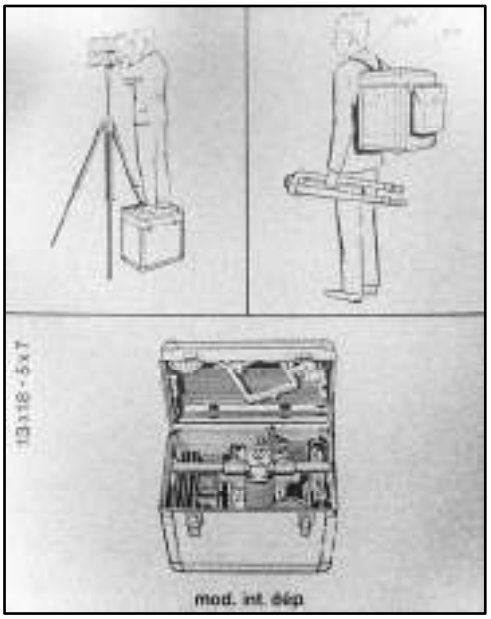

Fig. 1. View Camera usage scheme.
Fig. 2. Fuji GRX100, a 100Mp medium format mirrorless professional camera.

The replacement of the film with the digital sensor has certainly revolutionized the consumer market but at the same time has also revolutionized the approach of photogrammetric software; the image now no longer needs to be superimposed via software on a grid but by its very nature is already characterized by a divided grid that establishes the unit of measurement, the pixel precisely (Granshaw and Fraser, 2015).

As is known, the pixel is not only the unit of measurement of digital images, but it also carries with it fundamental and useful information for the correct search for homologous points between the images taken, in order to obtain an alignment on the x, y and z coordinates of the images themselves, as the definition of color is univocal because it is limited to a finite number.

Consequently, the number of total pixels with the same area is an aspect that greatly influences the workflow of the photogrammetric survey for various aspects. First of all, a greater number of pixels is the consequence of a greater number of information to be written on a digital medium, such as hard disk or Sd, and therefore the weight, better defined as the amount of information expressed in bytes, increases considerably; Furthermore, mid-range and professional cameras (nowadays even some smartphones) allow you to save images in raw format, fundamental as it not only represents image capture without internal processing of the camera processor but allows you to record in much larger number of colors, expressed by bit depth. Consumer cameras allow you to record raw files with a bit

depth of 14, while professional products record in 16 bits. All this leads to an exponential increase in space occupied on digital media.

Not only is it essential to consider the size in Mb occupied by the individual images, but it is also necessary to consider a further consequential aspect: the more information in pixels we can obtain during the image capture phase thanks to the tools used, the greater the information that the processing are able to process during the reconstruction phase of the photogrammetric survey. If we were to make a simple transfiguration, we could consider the images as a book: if we compare a book with, for example, 100 pages and another with many more pages, the second obviously contains a significantly greater amount of information and at the same however, time requires a longer reading time than the first.

In computer science, this reasoning is contained in reading and writing parameters on the digital medium: the more pixels you have at the start, the longer the time required for reading and subsequent writing in the cache, and the result produced is a considerable increase in the detail of the survey, expressed in a high number of points, defined as a point cloud. The reasoning is obviously not concluded because if we have defined a greater wealth of information at the input, also the relative saving of the project on digital support will suffer the same consequences, that is, it contains many information, translatable into a high byte weight.

In the cases dealt with within the scientific research path carried out by us at the Photographic Architecture Laboratory, we had the opportunity to test various types of photographic instruments with different technological capabilities: while the first photogrammetric scanning studies were carried out with professional cameras with full frame sensor (24X36mm) with 36 million pixels, the latest projects have been completed with 50Mpx and 60Mpx cameras. Not only has the technological capacity of the tools used increased, but the computing power of computers has also increased, which has allowed us to significantly increase the number of shots to be processed. For example, the photogrammetric survey project of the façade of Santa Maria del Fiore in Florence, carried out about two years ago, was calculated with 386 total shots while for Giotto's bell tower, at the end of 2019, 15,095 images were processed. All this has led to an exponential increase in digital data to be processed and archived, which has forced us to use 6 hard drives of 8 terabytes each, divided respectively into 32Tb for image data and 16Tb only for cache data.

3. Management and cataloging software for large quantities of photos

The correct choice of the software for managing and cataloging the photographic data is fundamental; in order to better manage significant quantity of images and to have a correct and rapid workflow, Adobe Lightroom, thanks to its characteristics, is one of the most suitable software for this task (Pierrot-Deseilligny and Clery, 2011).

Speaking of file organization, it is useful to explain the important possibility that Lightroom offers in relation to the smart previews mode.

This feature allows us to work with the previews of our "catalog" even when the original images are not linked.

If images with the "smart preview" function are imported from an external hard disk in the "catalog", we can normally work on the original images, but if the hard disk is disconnected, you can safely continue to work on the images through their previews. This mode not only allows us to work on images that do not have a real connection, but their size is less than that of the original images, occupying less physical space. Furthermore, when the connection with the external hard disk is restored, the original images are synchronized and updated with the changes that have been made. If the image had been imported without the "smart previews" option, at the moment of detachment of the external hard disk, it would result as a missing image and could not be modified or processed in any way, until the connection with the hardisk.

When we process quantities of data such as those managed by our laboratory, we should not underestimate the importance of the correct management of file folders and of the renaming of individual images. When thousands of photos are taken in single survey sessions, a series of folders is created in the memory cards, inside which the name of the photo goes from 0001 to 9999, this numbering of the photos is repeated in each subsequent folder, which will have a number sequential to be distinct from the previous ones. In this case, we must take care, during the backup of the material, not to put all the images together before having renamed them so as not to create confusion. Lightroom software helps us to manage these folders and all the material to be archived. Proper archive management is an important step to have a correct workflow (Snavely and al., 2006).

The number of bits in the image determines the "color depth" of the same, that is, the number of possible shades of gray in a pixel. The variation is exponential, so a 16-bit pixel does not contain twice as many shades as an 8-bit pixel, but many more. In fact, an 8-bit pixel can contain 256 different shades of gray, a 16-bit pixel can contain 65536; therefore in the 16-bit pixel we will have the possibility of 65536 shades of gray shades between white and black.

It is therefore clear that in a 16-bit image we will have much more color information, many more possible gradations and a greater sensitivity to color correction. A 16-bit image therefore better interprets the photographed reality, or in any case allows us greater expressive possibilities in the variation of colors. This therefore allows us to work with greater control over the result.

Precisely for this reason a correct flow of photographic work should be done in 16 bits; the problem however is the management of these files which reach considerable dimensions, and in our specific case in which we are forced to manage thousands of images it is impossible. Therefore, we are in the constant dilemma of having a very high quality 16-bit raw file, but of having to export an 8-bit jpeg file.

The images post-produced through Lightroom have the maintenance of their Exif data without the overwriting of the software. This allows us, later, in the calculation phase of the photogrammetric processing software, to exploit these exif data without which we would hardly have a correct result.

Among the final stages of the workflow process, we have the post-production of the orthophotos generated by the photogrammetric processing software. In this phase, setting the correct white balance allows us to have as the final result a real color rendering. To correctly balance the image, however, during the shooting phase, i.e. during the survey phase, you have to be careful every time you start a photographic session to take a shot by framing a colorchecker with medium gray, or white, or black. In our case we used a prism that contains these colors on its faces. We will therefore use this shot to be able to balance the final orthophoto.

Fig. 3. Partial view of the image management of a browser.

Fig. 4. Sparse cloud view from a photogrammetry processed in Reality Capture.

Speaking of useful tools for photogrammetry, which in recent years have made significant progress in terms of technology and functionality, we cannot avoid thinking about the drones and the support they give in a survey thanks to their potential and the possibility of accessing a point of view before unthinkable (Lowe, 2004).

We can divide the drones into two macro categories: the assembled ones, which could mount compact cameras (with variable zoom) or even reflex or mirrorless cameras (to which it is possible to change optics) and the standard ones, created by manufacturers, and which have standard and therefore non-replaceable cameras with a single, often wide-angle lens. If on the one hand the quality of cameras and sensors improves impressively on all types of drones, from medium to professional bands, on the other hand we must clash with the weight of the drone, which often goes hand in hand with the size of their cameras.

The Italian and European legislation on the use of SAPR (remotely piloted aircraft systems) is very stringent and limits the use of drones according to their weight and the context in which they are used. Without entering the regulations, to fly a drone of a certain weight, in addition to having a flight license and insurance, you will have to apply for special permits issued by ENAC and ENAV, air traffic control authority (ENAC. 2019).

To facilitate and bypass this problem, you can opt for the choice of lighter drones that may have fewer performing

cameras. In this case you must make a choice at the start on the real flight possibilities and the result that we want to obtain from a survey, or more simply how long we are willing to take to resolve the bureaucratic aspects for the issue of a permit. In fact, there are also waiting times of two months, which often do not coincide with the timing of the surveys, which perhaps require shorter times.

The cameras mounted on drones generally have three methods of saving files: jpeg (medium-low quality, in the order of 5/10 mb), raw and raw + jpeg; unlike a reflex or a compact camera, however, there are no possibilities to select various types of jpeg (low quality, medium quality, high quality). This implies the need, if we want to have a file full of information, to always shoot in raw and better still in raw + jpeg to always have a copy of the lightest image at hand and therefore easy to manage. So as for the photogrammetry from the ground we find ourselves with the same problem of managing large files and large quantities of images to be archived and then processed.

There is more than one software for planning and managing missions that allow to fly a drone autonomously to cover certain areas to survey, setting at the beginning the percentage of overlapping of the acquired images. These mission planning software that help and facilitate the survey, often do not support saving the raw file on the memory card installed on the drone for a too slow buffering issue and therefore save the material photographed only in jpeg. Also in this case we must make an assessment: have a quick flight time in an easy and automatic way, but have a low quality data because it is acquired only in jpeg, or perform the survey by piloting the drone manually, with longer times and a personal evaluation on the percentage of overlapping but being able to save the images in raw.

A good solution could be given by acquiring a video file given that even mid-range drones are equipped with cameras that can reproduce videos in good quality 4K. And, in this case Agisoft Metashape (former Photoscan), in its latest versions, can give some help; in fact, it is also capable of processing video data (Agisoft, 2018). Once the video is imported, the software will extrapolate the individual frames so that they can be used for the calculation process, which at that point will use the standard workflow. Surely making a single video does not have the same potential as taking hundreds of photos, however it must be considered that in some contexts the flight time must be restricted for various reasons, from adverse weather situations to the potential dangers of places with criticality; in this case a 4k video can be the optimal solution.

3.1. Optimal photo selection methods

The selection of the photographic data is a useful and necessary step to streamline the amount of material acquired during the photographic survey. Precisely because the weight of a single image is getting bigger and bigger, given the size of the sensors and the quality of the cameras, it is important not to overload the photogrammetric calculation software with a useless, redundant data that can jeopardize the process by generating mistakes. The first method of skimming, although long if you think about the quantity of images that are produced for any of the survey taken for example by our laboratory (we are talking about thousands and thousands of images) turns out to be the visual analysis of the individual images. In this case, through a software such as Lightroom that allows us to see the previews of the images and upload all the images, we can already make an assessment of the quality of the images themselves, assessing whether the photos are roughly out of focus or poorly framed or if excessively overexposed , or underexposed. For a second more accurate step a tool present in Photoscan called "estimate image quality" help us. The software manual itself informs us that poor or blurry images can adversely affect the alignment process. To help us exclude out of focus images from processing, PhotoScan suggests the "estimate image quality" feature. In this case, the software evaluates each imported photo, and the chosen parameter value is calculated based on the level of sharpness of the image surface. Used this procedure, it suggests disabling from the photogrammetric calculation process all those images that are with a value lower than 0.5 of units, however, be sure that the coverage of the survey, with the remaining photos, is still satisfactory.

4. Evolution of software for creating photogrammetric models

Photogrammetry is the art and science of extracting 3D information from photographs. The digital process therefore involves the acquisition of overlapping photographs of an object, a structure or a space and their conversion into 2D or 3D digital models. Photogrammetric survey software has been fundamental in the practical evolution of this discipline because their evolution has given the possibility to many users to develop this low-cost technology. The various milestones that lead to this progress are above all the automatic detection of points of interest, the Structure from Motion Image Matching (SfM/IM) algorithms (Guidi and Gonizzi, 2014), capable of reconstructing scenes from sets of

unordered images and the matching techniques between the images that can provide surface models of resolution equal to the size of the pixels on the ground.

The photogrammetric workflow includes the transition from images to a 3D mesh model, through the estimation of orientation parameters. In other words, it is a passage from a 2D representation of the world captured by a camera, through the inference of the position and rotation of the camera when the image is taken, towards a 3D rendering of the desired size. If the quality of the final output depends on the skillful engineering of many small processing stages, the estimation of the orientation parameters of the camera and the adaptation algorithms forms the heart of the pipeline.

To date, there are many professional software on the market, and it is essential to add that in recent years there has been a significant increase in quality thanks above all to the increase in computing speed, also taking advantage of the processors present in the video cards. The speed of calculation and processing is a non-trivial aspect as it creates the possibility for the professional to be able to quickly analyze a preview of the result, in order to identify possible problems during the processing phase. As is known, this process of aligning images is not linear, therefore it needs to be linearized. Furthermore, there is no direct algorithm capable of calculating the orientation parameters globally consistent with several images, generally with a number greater than three. To overcome this gap, bootstrap solutions have been proposed. Using direct algorithms for a single image, a pair or sequence of images, the global orientation is deduced sequentially or hierarchically starting from a base image pair. The parameters thus obtained serve as input for a system of equations composed of linearized collinearity equations, where their optimal values, with a stochastic process, are found iteratively. The results, such as the break-even points) are redundant, therefore the solution is deduced with the least squares method minimizing an objective function. The typical function is the squared

differences between the nominal observations and those foreseen by the estimated model, possibly subject to constraints. The latter stage is also known as bundle block regulation (BBA).

For photogrammetry software tools to work properly they need sufficient data within the images. The structure of the photogrammetric survey software is mainly based on the identification of textures that are used as a reference for subsequent calculations. Other programs also allow the use of coded markers. These are useful for scanning objects with features that are difficult to process, such as reflective and / or transparent surfaces. If applied correctly, coded markers can produce greater accuracy than standard software calculations.

Most photogrammetry software is rigorously designed to generate a high-quality 3D mesh or a point cloud (Hirschmuller, 2008). However, some programs also provide analysis tools within the workspace to allow the user to take measurements or perform other functions without having to use external software.

If we wanted to divide the photogrammetry software currently on the market into categories, we should first define the modalities: short-range photogrammetry and aerial photography. The photogrammetric technique is based on a camera held by a photographer or mounted on a tripod for greater image stability, known as terrestrial photogrammetry, because the images are usually taken from street level. The use of a close-range photogrammetric setting is suitable for scanning small-scale objects, but obviously even larger realities can also be scanned with short-range photogrammetry.

Often, however, there are cases, such as the roofs of a building, which are inaccessible from street level. In these cases, it is essential to integrate short-range photogrammetry with aerial photogrammetry. As in short-range photogrammetry, the camera uses hundreds, if not thousands, of images to reconstruct the object later by the computer processing. To get a high-quality 3D model, images need to overlap 80 to 90%.

In addition, the latest software developments allow a further step forward: the integration of both terrestrial and aerial laser and photogrammetric scans. This allows achievements hitherto unattainable as it combines the metric precision of the laser with the material data, a peculiarity of the photogrammetric survey.

The inevitable consequence of the integration of laser data, terrestrial and aerial photographic images is the increase in data both in the phase of calculation and subsequently of archiving.

Subsequently we will analyze case studies elaborated by us that will help better understand the workflow and management of large amounts of data.

5 Cases studies and conclusion.

After this overview of new technologies to support photogrammetry on new software and digital image management tools, let's now take a quick look at some case studies that, due to the size of the product or the great detail required, have produced a considerable amount of data to be stored both during the processing and final fruition phases.

The case studies in analysis are:

1. Fronts of the Florence Cathedral: Santa Maria del Fiore.
2. Giotto's bell tower in Florence.
3. Mosaics in the Baptistery of San Giovanni in Florence.

Santa Maria del Fiore in Florence.

The survey of the building in question was of great importance for the growth and development of the photogrammetric survey techniques of our laboratory, as well as of considerable interest for the importance of the detected object.

As far as we are concerned, the importance of this work derives from multiple aspects.

The first concerns the size of the artifact that forced us to relate to several photographs necessary to cover the entire surface to be decidedly unusual for the reliefs normally managed by our team.

The second aspect of interest was the request for extreme precision and accuracy required by the client, which led to a leavening of the data to be acquired.

The third aspect was the duration of the significant operations. This aspect proves to be very important as, a job that began in 2017 and that still needs to be completed today, has seen, given the long processing period, an increase in photographic technologies and photogrammetric processing software that has developed during the acquisition of the survey itself, allowing us to compare ourselves with a mass of incoming and outgoing data unthinkable at the beginning of the works.

Finally, as a last aspect of interest, we can certainly include the management and use by the client and the users to whom the work was aimed. The models produced are far beyond the possibility of managing the online platforms dedicated to the display of these models by non-professional users and even in the "professional" sphere, the management of even two-dimensional photographic documents was difficult given the heaviness of the orthophotos produced which they require a considerable hardware capacity and that often result beyond the possibilities of the software currently available for viewing, editing and saving photos.

Below is a review of the stages and processing data that began in 2017 and is still in progress.

Phase 1 - 07.2017/09.2018

Cameras:

1. Sony Alpha 7R: Sensor FF 35X24mm, 36,4 MP, colour depth 16-14 bit
2. Nikon D800E: Sensor FF 35,9X24mm, 36,3 MP, colour depth 14 bit
3. Nikon D800: Sensor FF 35,9X24mm, 36,3 MP, colour depth 14 bit
4. Pentax K1: Sensor FF 35,9X24mm, 36,4 MP, colour depth 14 bit

Lenses:

1. Two Nikon Nikkor 50mm F1.4 lenses
2. Pentax Takumar 55mm F1.8 lens
3. Sony Carl Zeiss 55mm F1.8 lens

Photogrammetric survey and subsequent three-dimensional restitution of the facade and the north side of the Cathedral as part of the collaboration project between the Opera del Duomo and the Department of Architecture. The photographic campaign was carried out with the aid of a mobile platform that made it possible to obtain frontal images over the entire height of the building. To be able to set up a relief so rich in details, more than 14,000 images were taken during the shooting phases. The acquired data was then meticulously processed within the Photographic Laboratory and allowed to obtain a graphic rendering of the orthophoto of the facade in 1:13 scale with an image of 40000 x 46000 pixels. It is fundamental to specify that the 3D model obtained by the photogrammetric process is almost identical to the model obtained by laser scanning (the models have an average difference of 0.00001 mm at real scale).

The orthophoto on the north side was reproduced at a scale of 1:10 generating an image consisting of 93000X53000 pixels.

Phase 2 - 01.2019/10.2019

Cameras:

1. Sony Alpha 7R: Sensor FF 35X24mm, 36,4 MP,Colour depth16 bit - 14 bit
2. Nikon D800E: Sensor FF 35,9X24mm, 36,3 MP, colour depth14 bit
3. Nikon D800: Sensor FF 35,9X24mm, 36,3 MP, colour depth14 bit

4. Pentax K1: Sensor FF 35,9X24mm, 36,4 MP, colour depth14 bit
5. Fuji GFX50S: Sensor MF 43,8X32,9mm, 51,4 MP, 14 bit

Lenses:

1. Two Nikon Nikkor 50mm F1.4 lenses
2. Pentax Takumar 55mm F1.8 lens
3. Sony Carl Zeiss 55mm F1.8 lens
4. Fuji Fujinon 32/64mm F4 zoom lens

Fig. 5. Western front of the Florence Cathedral, photogrammetry 2020.

In continuity with the collaboration project between the Opera del Duomo and Area3D/Dipartimento di Architettura, the photogrammetric and Phase-Shift 3D laser scanner (Verdiani, 2012) survey of the South side was carried out from the platform and the work continued with fine-tuning and assembling all the previous phases as well as cataloging and analyzing the produced data. Processing and consequent retopology for the purpose of use on the canonical web platforms.

Giotto's Bell Tower in Florence.

Cameras:

1. Sony Alpha 7R: sensor FF 35X24mm, 36,4 MP, colour depth 16 bit processing, 14 bit output
2. Nikon D800e: sensor FF 35,9X24mm, 36,3 MP, colour depth 14 bit
3. Nikon D800: sensor FF 35,9X24mm, 36,3 MP, colour depth 14 bit
4. Pentax K1: sensor FF 35,9X24mm, 36,4 MP, colour depth 14 bit
5. Fuji GFX50S: sensor MF 43,8X32,9mm, 51,4 MP, colour depth 14 bit

Lenses:

5. Two Nikon Nikkor 50mm F1.4 lenses
6. Pentax Takumar 55mm F1.8 lens
7. Sony Carl Zeiss 55mm F1.8 lens
8. Fuji Fujinon 32/64mm F4 zoom lens

This case study is characterized as the final part of the survey process carried out so far in the context of collaboration with the Opera del Duomo in Florence. The development of this important campaign that took place during the final months of 2019 is temporarily placed at the end of a path that has seen us as operators and, significantly, the technologies supporting the photogrammetric survey grow. In this important campaign, although the shooting equipment is almost identical to that of the final part of the cathedral, the software supporting the calculation process has undergone a significant evolution.

The increase in the computing power of the major software dedicated to the creation of photogrammetric models, thanks to the implementation of the calculation by means of a video card and to the greater computing power of the hardware systems available, although with significant differences from software to software, it allowed to process about 15,000 photographers per facade of the 15,000 made during the acquisition phase. As already mentioned in the previous paragraphs, the difference with the 386 photographs processed for the facade of the Duomo stands out, compared to the 14,000 taken during the acquisition phase. The result is an increase in the data to be managed which led us to have to use 6 hard drives of 8 terabytes each, divided respectively into 32 Tb only for image data and 16 Tb only for cache data.

Mosaics of the baptistery of San Giovanni in Florence.

Cameras:

1. Nikon D850: Sensor FF 35,9X24mm, 47,3 MP, colour depth 14 bit

Lenses:

1. Nikon Micro Nikkor 60mm F2.8 lens
2. Nikon Nikkor 16/35mm F4.0 zoom lens

This last case under analysis is of particular interest for the characteristics of the artefacts to be detected. Being the client's need to reach a scale that goes beyond 1:1 scale, it was necessary to carry out a micro-relief using lenses suitable for macro shooting. On such occasions, a Nikon 60mm Micro lens was used and, for the general connection, a Nikon Nikkor 16-35mm zoom lens. The shooting approach was identical to that made for the facades of larger artifacts and the number of total photos, given the high definition required and the high number of mosaics to be made with an average size of 100X70 cm. it is circumvented around that of larger buildings.

The number of photos acquired for each single mosaic averages around 800 photographs, of which around 500 have been processed. It is thus noted that, as the size of the artefact decreases, the request for precision of the client increases, thus bringing the number of total photos and the data to be processed to the numbers of the relevant campaigns of significantly larger objects.

The large difference between the photos taken and those processed in this case is due to the difficulty in taking reflective materials which led to a greater selection of usable photos which, from the timing point of view, nullifies the advantage of processing for more small parts.

Fig. 1. Orthographic front View of Campanile di Giotto. Fig. 7. Orthographic front view of the Baptistery's mosaic.

References

Agisoft, 2018. *Metashape User Manual: Professional Edition, Version 1.5*, Agisoft LLC, Russia.

ENAC, 2019. Regolamento mezzi aerei a pilotaggio remoto, release 3 11/11, Italy.

Granshaw, S.I., Fraser, C.S., 2015. Editorial: Computer vision and photogrammetry: Interaction or introspection? In *The Photogrammetric Record*; 30(149), pp.3–7, John Wiley & Sons, Inc., USA.

Guidi, G., Gonizzi, S., 2014. Image pre-processing for optimizing automated photogrammetry performances, in *Annual Photogrammetry and Remote Sensing Spatial Inf. Sci.*, II-5, pp.145-152, ISPRS.

Hirschmuller, H. 2008. Stereo processing by semiglobal matching and mutual information, in *IEEE Transactions on Pattern Analysis and Machine Intelligence* n.1, 30(2) pp.328–41, IEEE Computer Society.

Lowe, D.G., 2004. Distinctive image features from scale-invariant keypoints, in *International Journal of Computer Vision* 60(2) pp.91–110, Springer, Germany.

Pierrot-Deseilligny, M., Clery, I., 2011. Apero, an open-source bundle adjustment software for automatic calibration and orientation of set of images, in *Int. Arch. Photogramm. Remote Sens. Spatial Inf. Sci.*, XXXVIII-5/W16, pp.269–276, ISPRS.

Rodríguez-Navarro, P., 2013. Alcune riflessioni sul "Disegno con la fotografia digitale", in *Disegnare con*, 6, N. 12, Università degli Studi di Bologna, Italy.

Snavely, N, Seitz, S.M., Szeliski, R., 2006. Photo tourism: exploring photo collections in 3d, in *ACM Transactions on Graphics (TOG)*, vol. 25, pp. 835–846, ACM Digital Library, USA.

Verdiani, G., 2012. Rilievo digitale 3D, le metodologie e le strumentazioni per il rilievo laser scanner, Tipologie delle strumentazioni per il rilievo digitale, in *Manuale di rilievo architettonico e urbano*, S. Bertocci, M. Bini (Eds.), pp.169-197, Cittàstudi Edizioni, De Agostini, Italy.

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Remote Rapid Visual Assessment (RRVA) in the Conservation of a Dilapidated Historic Temple

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Abstract

For the conservation of a structurally dilapidated built-heritage, documentation at all stages is crucial. Recording of such structure in the initial assessment stage is often challenging as it involves the scanning of ruin which is mostly a crumbled portion of a collapsed structure with broken geometry. Also, the growth of vegetation, inaccessibility due to precarious structural conditions and poor lighting are some site constraints that a surveyor has to overcome with appropriate tools. Though a variety of sophisticated methods of documentation are available, it is pointless to record the site at a higher level of detail in such a preliminary stage. The level of information required for the stakeholders to decide on necessary temporary stabilization measures can be first derived in a pre-assessment phase and the methodology can be framed accordingly. A case study example of a recording methodology adopted at Abathsakayeswarar Temple of Kumbakonam built originally by King Rajendra Chola I *(ruled between 1014-1044 CE)* which has a rich history and architectural value is discussed, specifically on optimizing the data acquisition based on the necessary level of information having the safety of workers in concern.The study area is a precinct with the tower *(Vimanam)* crowning the main shrine *(Karuvarai)* and a few subsidiary shrines surrounded by a stone cloister *(Mandapam)* and two majestic gateways *(Gopuram)*. Valuable old paintings and inscriptions are seen over the walls in many places and sculptural detailing and lime stucco images over the vimanas and gopurams. The complexity of this conservation is seen in three different levels of interventions. A higher degree of intervention is where the heavily damaged areas would have to be documented, dismantled and reconstructed. While an intermediate degree of intervention would be in-situ repair and consolidation of the built fabric and the lower degree of intervention would imply only preventive measures for conservation of the existing fabric. This spectrum of complexity is visible at different locations of the temple campus. Documentation of such a complicated site often appears to be less safe and requires specialist skills than documenting other heritage sites. Optimization in documentation strategy is imperative in this case to perform an effective recording. This contribution introduces a pre-assessment phase in the conservation process utilizing the fullest capability of cost-effective modern commercial UAVs in capturing spherical panoramic imagery for recording architectural elements. Virtual tour supplemented with plans and elevations, high-resolution images, panoramas, ortho rectified images of facades and turn-table virtual 3d models through close-range photogrammetry is the resultant output of the pre-assessment phase. This helps architects and engineers to visualize the geometry, interpret the material components, roughly judge its structural stability, and soil capacity to diagnose the possible sources of the deterioration problem.

Keywords: Remote Rapid Visual Assessment; UAV; Dilapidated; Historic; Temple; Virtual Tour

It also aids archaeologists, art historians, and epigraphists to read the paintings and inscriptions and to understand the building material from the texture, architectural style and features from the geometry which are the evidence for history. The result of this phase serves the stakeholders in determining the areas that require further documentation with higher accuracy and other tests required for decision making, which can be carried out in the assessment phase saving time and resources. The goal is to overcome the danger in the traditional method of documentation and achieve thorough coverage of the site by introducing the multi-level documentation strategy.

1. Introduction

This paper introduces a new method for a safe, preliminary, Remote, Rapid Visual Assessment (RRVA)of a severely damaged historical structure as a first step towards development of a conservation proposal for the site and the buildings contained in it. The case scenario discussed here is a dilapidated living Hindu temple dating to the 11th c. AD, where the level of structural damage is severe, and neglect over a considerable period of time has led to deterioration. In such a condition, any physical access even for a preliminary survey for the planning and execution of temporary emergency stabilization work is fraught with dangers to the technical personnel and labor, constituting a life safety hazard. Risk preparedness policy proposed in ISCARSAH's Assisi Declaration (ICOMOS, 2000) states the importance in providing strategies for the management of emergency situations and the prevention and limitation of damage. Rapid visual assessment is indispensable in planning and execution of any temporary stabilization works or even archaeological salvage of ruins. However, can this be still carried out in a manner where safety of personnel is not compromised? Is there a possibility of using unmanned surveying to meet such a requirement? If this is the approach adopted, what are the possible technical and practical constraints, and are there ways of overcoming them? The current paper examines such a scenario in a highly dilapidated living Hindu temple in the south Indian state of Tamil Nadu.

The use of the panoramic image as a documentation and communication tool is often underestimated. With the panoramic photographs, it is possible to reconstruct the floor plans(Farin et al., 2007), reveal visual details(Jusof and Rahim, 2014), and organize the information(Napolitano et al., 2017). When development of a 3D model is not arequirementof the project, Virtual Tour and Information Modeling (VT/IM) is a suitable approach to adopt (Napolitano et al., 2018).In recent times, simple virtual tours out of spherical panoramic images are used as a representation tool in cultural heritage sites for storytelling, recording, and documentation purposes. Application of Unmanned Air Vehicles (UAV) in heritage conservation for 3D reconstruction can be extended to the purpose of safe RRVA by utilizing its capability of capturing spherical panoramas remotely. Challenges encountered in such assessment of structures remotely are demonstrated through the case study in this paper. The authors see a parallel even in post-disaster rapid visual assessment of built cultural heritage or regular infrastructure (e.g. post-earthquake reconnaissance surveys).

2. Case Study Building

Dravidian architecture is a historical style of Hindu temples seen in the southern parts of India. Monumental structures such as the rock cut Pallava temples at Mamallapuram and the living Chola Temple of Brihadeeshwara at Thanjavur, both located in Tamil Nadu, which are UNESCO World Heritage Sites are few prominent examples of Dravidian temples.

The Religious Endowments Department of the State of Tamil Nadu has as many as 8450 historical living temples under their jurisdiction, which are a 100 years or older (refer: https://tnhrce.gov.in/hrcehome/temple_list.php), including the one discussed in the paper here. These precincts of Dravidian temples have witnessed a continuing tradition of worship of the presiding deities, right from their inception, making them a living cultural heritage of India. The constant efforts at conservation and restoration of the historic temples and the construction and consecration of new temples, have resulted in the survival and transfer of the traditional knowledge on design and construction techniques of Dravidian temples through generations. This constitutes a living intangible heritage of the region of Tamil Nadu.

Sri Abathsakayeshwar Temple is a Dravidian temple situated in Thukkachi village, on the banks of Arasalar River, 16 kilometers east of Kumbakonam town. The temple was built originally by the king Rajendra Chola I (AD1014-1044).

Fig. 1. Aerial image of the 11th c. AD Sri Abathsahayeswarar Temple of Kumbakonam in South India.

Fig. 2. Enlargment from the Aerial image of the 11th c. AD Sri Abathsahayeswarar Temple of Kumbakonam in South India.

The temple seen in Fig. 1, covers a rectangular area, extending 257 ft.(78m) north-south by 330ft. (100m) east-west, with two concentric precinct walls (*Prakaram*). The temple complex houses the shrine of the presiding deity, Lord Shiva (facing the east) and that of his consort (facing the south), stone cloisters in the south and west, and another shrine dedicated to Goddess Durga at the north-east corner between the first and in the second precinct walls, facing the south. Each shrine consists of thesanctum sanctorum (*Karuvarai*), an adjoining open hypostyle or pillared small hall (*Anthralam* or *Mukhamandapam*), an open hypostyle large hall (*Mahamandapam*) and a semi-enclosed space connecting the open halls with the sanctum (*Ardhamandapam*). The site plan of the temple complex is illustrated in Fig. 2.

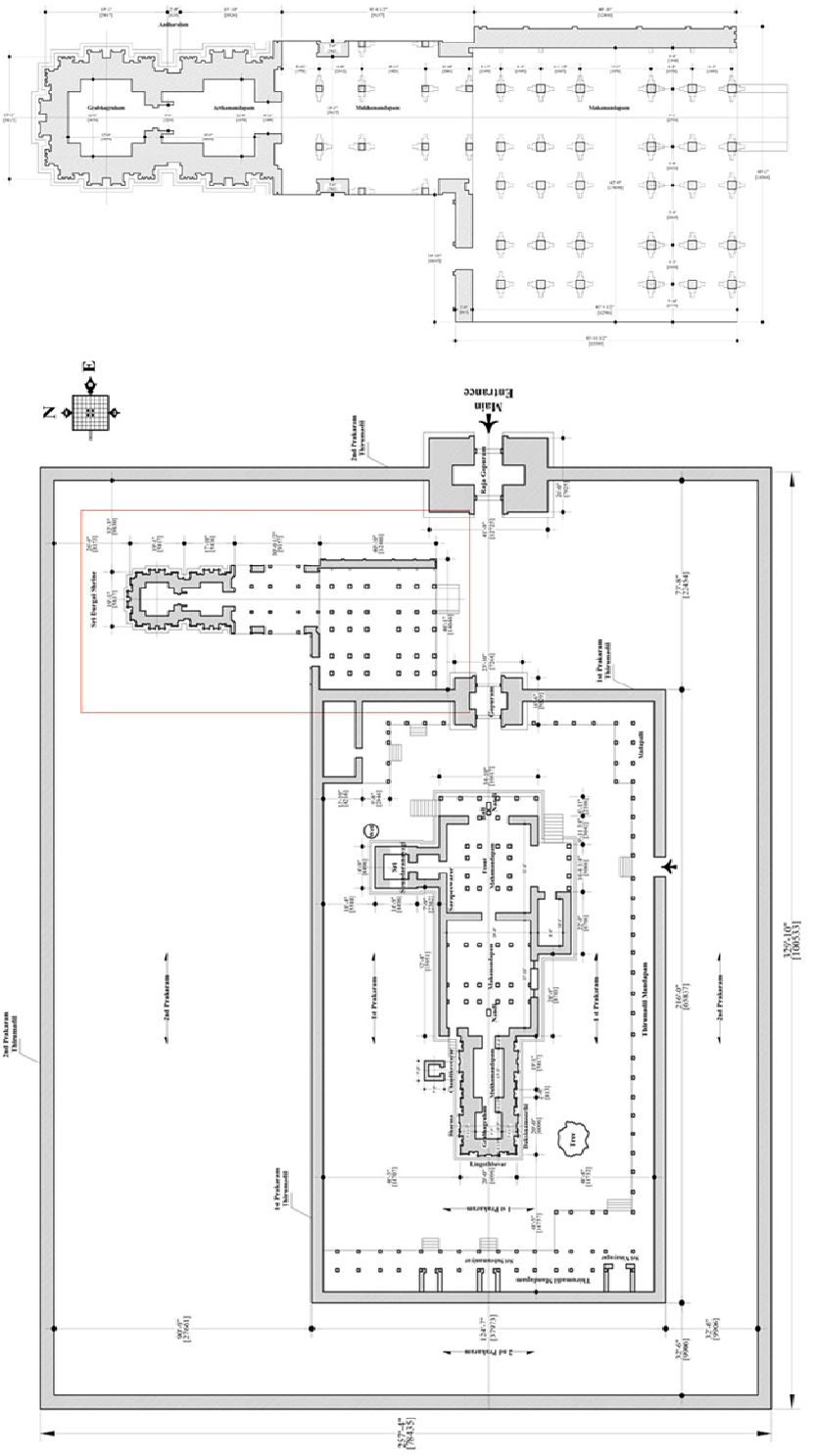

Fig. 2. Plan showing theentire temple complex with the Durga shrinehighlightedwith a red box, and enlarged plan.

The hypostyle halls of the temple are constructed in the post and lintel type with monolithic pillars and beams in granite, which are intricately sculpted.

A multi-tiered tower in brick masonry spire (*Vimanam*) surmounts each sanctum sanctorum, whose walls are in turn constructed in three-leaf stone masonry.

The three-leaf stone masonry precinct walls are adorned with a multi-storied majestic gateway (*Gopuram*) in each precinct wall, on the eastern side, with stone masonry walls in the ground story and brick masonry in the upper stories.

Sri Durga (shown in a detailed plan in Fig. 2) shrine at the north-east corner of the temple also houses a *Karuvarai*, *Ardhamandapam*, *Anthralam* and *Mahamandapam*.

The *Anthralam* and the *Mahamandapam*, the areas of focus in this paper, are the portions that are in a highly precarious condition due to structural damage. Partially collapsed roof, skewed pillars, cracked beams, and dislodged stone veneers of the three-leaf walls make the shrine unsafe to surveyors during the process of documentation. The existing state of these portions of the temple are illustrated in Fig. 3.

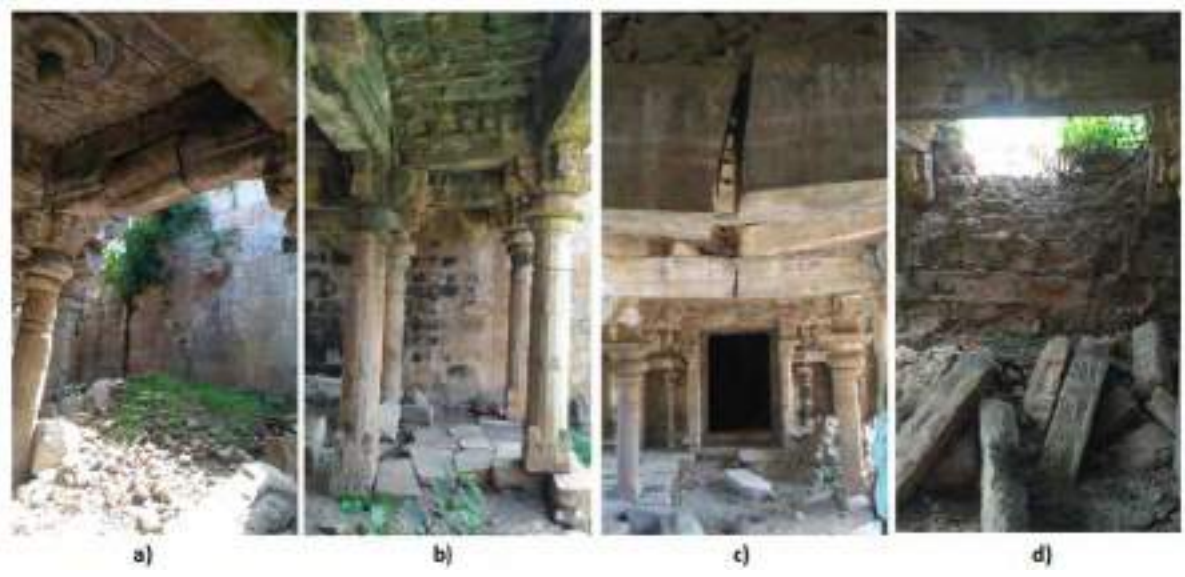

Fig. 3. Illustration of the condition of structure. (a) Fallen roof, (b) skewed pillars, (c) cracked beams, (d) collapsed stone veneer of three-leaf wall.

3. Objectives

The primary objective of the paper is to propose a remote rapid visual assessment (RRVA) procedure that can be applied to a cultural heritage site that is in a dilapidated condition making physical access to the construction for any surveying unsafe. Identification of the degree and types of hazards at different locations of the construction, the formulation of a temporary stabilization strategy and a strategy for salvage of archaeological ruinsare the primary objectives of this process.

The rapid visual assessment process will include visual recording, processing, presenting, and decision-making phases.

A virtual tour as a product of this process would facilitate experts invisualizing the structure with maximum coverage possible, without having to directly access the endangered site, and take necessary decisions on salvage of ruins and strategies for temporary stabilization.

The proposed methodology is relevant even in post-disaster rapid visual assessment of built cultural heritage or regular infrastructure (e.g. post-earthquake reconnaissance surveys).

The extraction of dimensions of the elements recorded and other measurements from the structure, though possible with the technique used, is not the scope of such an exercise.

4. Methodology Adopted

The approach adopted in RRVA includes four phases, namely recording, creating a virtual tour, presentation, and decision-making. The output of each phase forms an input to the subsequent phase. An overview of the methodology is shown in the following table and the detailed procedure for execution of the methodology for each phase is discussed in the following sections.

Table 1. Sequential phases of RRVA adopted in the project.

Phase	Process	Output
1. Recording	Acquisition of data by careful operation of UAV for maximum possible coverage	Panoramic images, videos
2. Creating Virtual Tour	Defining hotspots, defining signage for navigation, linking scenes to create transition map, adding ancillary data (e.g. audios to guide, descriptions and hints as text, links to other sources of information or uploaded videos)	Virtual Tour (VT)
3. Presentation	VT is user-friendly and mostly self-rendering. Additionally, walk-through videos can be made by screen recording.	Link for Virtual Tour, recorded walk-through videos.
4. Decision-Making	Creating two-dimensional drawings to map the existing structural condition, physical access constraints, presence of high value decorative elements and degree of complexity in stabilization or salvage operations.	Decisions on temporary stabilization and salvage operations.

4.1. Hardware and Software Deployed

DJI Mavic 2 pro (see Fig.4a-b), a Micro drone as classified by Directorate General of Civil Aviation (DGCA) in India, is used as the vehicle for capturing the spherical panoramic images and supplementary photos and videos. The dimension of the drone in unfolded state is 322×242×84mm (l×w×h). It is equipped with a Hasselblad camera that can capture images in 20 megapixels and videos in 1920x1080 pixels resolution at 120 fps. The camera lens has a field of view of ~77o, fixed focal length 35mm and aperture range f/2.8-f/11.

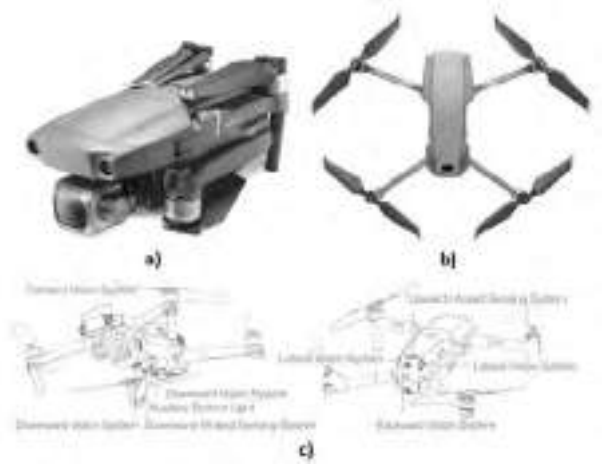

Fig. 4. (a)Front and (b)top view of DJI Mavic 2 pro (c) Illustration of vision and sensing systems (Credits: https://blog.alansoon.com/category/technology-gadget-software).

The camera is mounted on a 3-axis gimbal that can tilt -90^o to 30^o and pan -75^o to 75^o. Mavic 2 has an Omnidirectional Obstacle Sensing featurethat helps in detecting any diffused reflective surfaces (walls, trees,

people, etc.) during the left/right, up/down, and forward/backward movements in air while flying. This obstacle detection and collision avoidance feature works with vision systems (optical sensors) in forward, backward, downward, and lateral directions and infrared sensing system (infrared sensors) in upward and downward directions (see Fig.4c).

The drone comes with a controller used to control the dronefor navigation, andDJI Go 4 is the mobile application used for capturing images. Images are converted to panoramas by this mobile application and saved in the memory readily usable as input for VT creation. An online tool, makevt.com, is used for generating the Virtual Tour as it is free, simple, and user-friendly and has the required options for RVA.

4.2. Phase 1: Recording

The most challenging phase in the RRVA process is the acquisition of data, which requires thorough initial planning, and a drone operator with training and expertise in the controlled operation of UAVs. The constraints in this case can be categorisedasthose pertaining to the site and to the tool, which vary across the spatial dispositions in the object of survey, the dilapidated shrine in current case. Tabulating the site and the tool constraints helps in identifying the need for and the feasibility of RRVA, respectively, across the entire temple complex. Table 2 reports how evaluation of these constraintsresulted in selecting specific locations where the RRVA strategy to carryout remote recordingwas required and feasible, namely in the multiple bays of *Mahamandapam*, *Mukhamandapam* and *Ardhamandapam*, and the sanctum (*Karuvarai*).

Table 2. Site and tool constraints in identifying the need for and the feasibility of RRVA in the temple complex.

Space / **Constraints**		**Precinct Wall; Exterior of Vimanam and Gopuram**	**Multiple bays in hypostyle halls (Mukhamandapam Mahamandapam)**	**Ardhamandapam**	**Sanctum Sanctorum**	**Interior of Gopuram**
Site constraints						
Spatial disposition		Exterior	Open from two or more sides	Semi-enclosed Space	Enclosed Space	Semi-enclosed Space
Structural distress		Partial collapse; deterioration of decorative elements	Partial collapse with debris; heavy structural damage with imminent collapse	Nil	Nil	Partial collapse with debris
Animal infestation (e.g. bats, snakes)		Nil	Yes	Yes	Yes	Yes
Safe physical access		Completely safe	Highly unsafe	Unsafe	Unsafe	Unsafe
Availability of day light (for image visibility)		More than Sufficient	Sufficient	Just Sufficient	Insufficient	Just Sufficient
Tool constraints						
Visual access to the drone		Yes	Yes	No	No	No
Feasibility of drone operations	Via VPS	Yes	Yes	Yes	No	Yes
	Via GPS	Yes	Yes	No	No	Yes
Need of RRVA		**Not required**	**Required**	**Required**	**Required**	**Required**
RRVA feasibility		**N.A.**	**YES**	**YES**	**NO**	**YES**

As a first step, it is crucial to plan the survey, in order to understand the spatial configuration and disposition, and to locate the hotspot (i.e. viewing point of a spherical panorama) such that there is maximum coverage with no blind spots. Inter-visibility between two hotspots is essential to give an experience of walking through the space in the virtual tour. Hence, with the rough plan of the site made after a quick preliminary exterior survey or with a detailed plan if available, the selection of hotspot can be carried out. A first level drone survey of the interior gives a feel of

the site to the operator, and also helps identifying any limitations. By recording videos during the first level operation, the robustness and viability of the chosen hotspots can be verified.At this stage, it is advisable to compromise on the quality of the video to a lower resolution and set the frame rate high, say 120fps, such that during the video capture, the location of any special elements suchinscription, paintings or decorative elements can be identified without motion blur.When an execution plan with the location of hotspots and the location of special elements marked is ready, the spherical panoramic images and supplementing pictures can be captured.

4.3. hase 2: Creating the Virtual Tour

The output imageries and other data from the recording phase becomes the input for creating the virtual tour, which is illustrated in Fig. 5. A total of 19 spherical panoramas were used to cover the entire shrine except the interior of sanctum. The online tool used in the process assists the user with simple steps for execution.

Fig. 5. Interface of the onlineVT builder (a) Hotspot editor, (b) Transition map,
(c) Available icons for navigation and embedding ancillary data (d) Final output.

The captured panoramas or images when uploaded, are listed in the hotspot editor. Creating links between panoramas using the signage available can be done in this hotspot editor. Sensible linking of panoramas result in a proper virtual tour. As and when the images are linked, the transition map is updated with the arrows connecting images. This tool also has the sophistication of adding ancillary data to support the virtual tour such as, audio files, descriptions and hints as texts and links to other information such as uploaded reference videos online.

4.4. Phase 3: Presentation

The final output of the virtual tour created is in the form of a shareable web link, with which the VT can be accessed online. The interface of the VT is sufficiently user-friendly such that even a new user can easily maneuver it. When the complete information of the shrine is embedded with the VT, a user would be able to gain sufficient understanding of the precinct due to the self-explanatory nature of the tool. The link can be visited by any number of users, any number of times. For a quick viewing of the structure to understand its current state, a walk-through video is made by screen recording which can be displayed at project meetings.

4.5. Phase 4: Decision making

The structural engineering team working on the project in the subsequent phase makes use of the VT to map the structural condition of the shrine, classifying the spaces based on the severity of damage, feasibility of physical access which is impeded by debris from partial collapse, and safety of access for initiating temporary stabilization interventions.

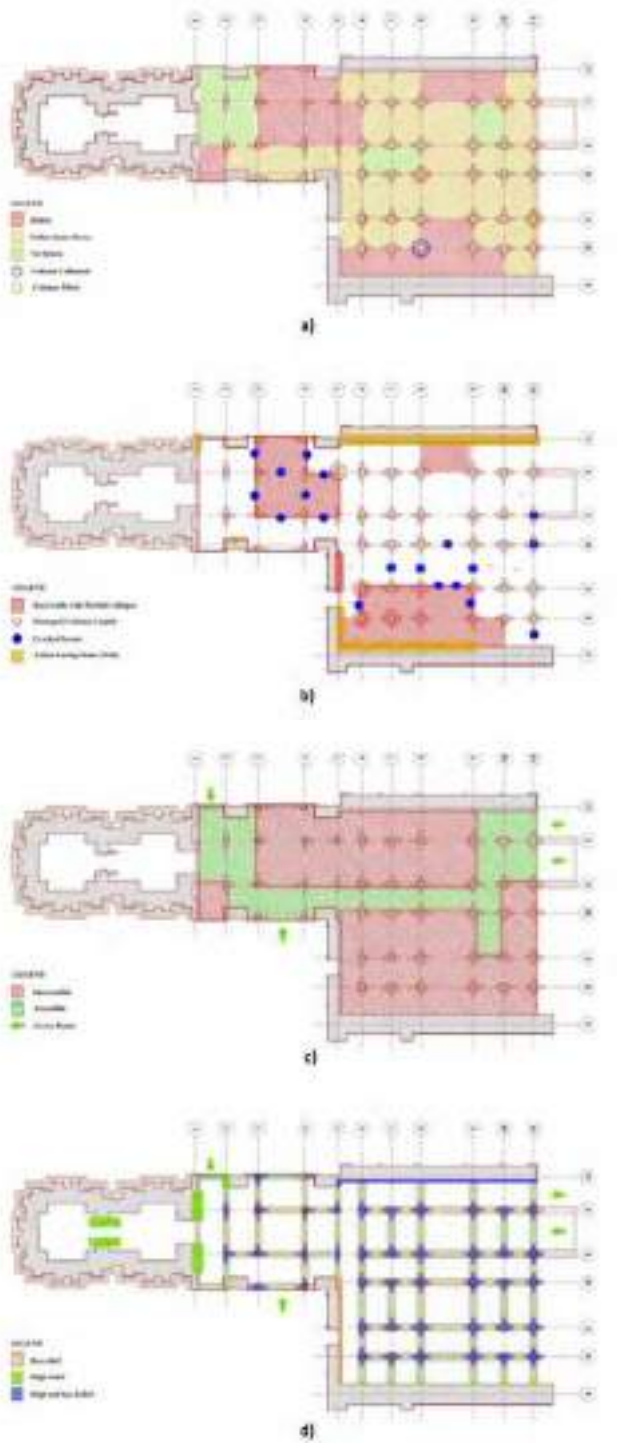

Fig. 6. (a) Reflected ceiling plan, (b) Floor plan, (c) Access and propping plan, (d) Decorative elements distribution.

Fig. 6 illustrates the output of the current phase in the form of reflected ceiling and floor plans identifying the condition, presence, and condition of decorative elements, from which the access plan and preliminary strategy for temporary supports and stabilization and salvage of ruins is arrived at.

5. Demonstrative examples:

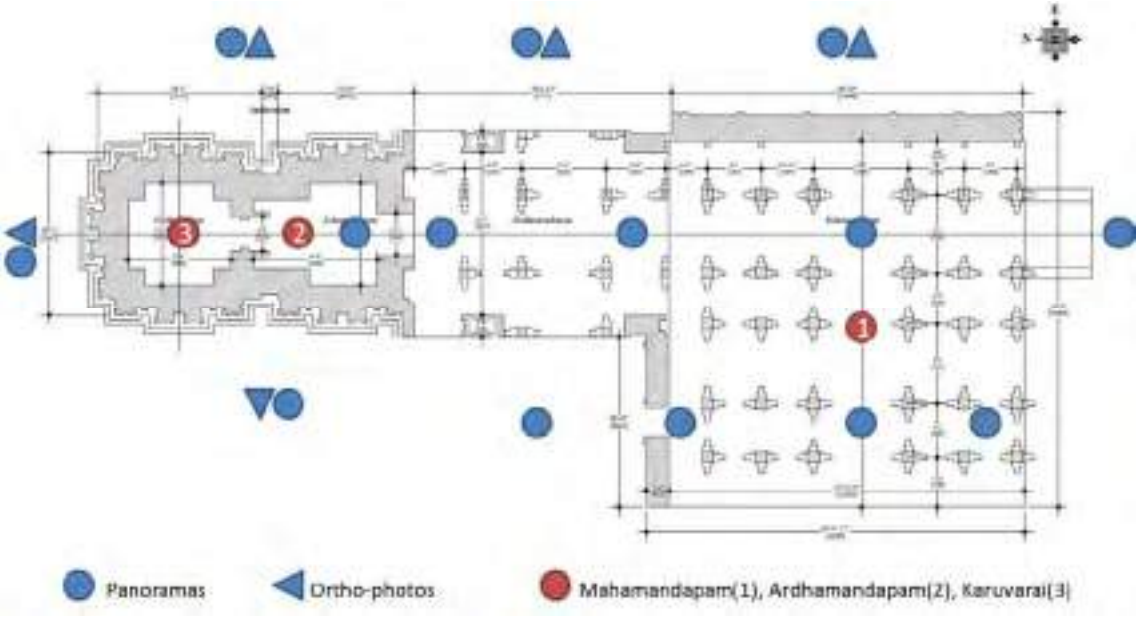

Fig. 7. Plan showing the locations of demonstrative examples and the location of hotspots.

The process of developing RRVA in three locations in the shrine are discussed as demonstrative examples in the current section, highlighting the constraints and opportunities to develop the process. The three locations are identified with encircled numbers in Fig. 7, whereas locations of hotspots where the panoramas are captured are shown as circles and the ortho-photos are shown as triangles. Readers are invited to experience the complete virtual tour at: https://makevt.com/media/tourmaker/rvdjfhgayt/ .

5.1. Location - 1: Mahamandapam.

Fig. 8. VT environment that helps user identify (a) cracked beams (b) damaged walls.

For the *Mahamandapam*, which is a partly open hypostyle hall, operation of the drone inside was not challenging. Based on the visibility of the drone to the pilot during operationsin the area of focus, the hotspot locations for capturing the panoramas are decided. With five panoramas in the *Mahamanadapam*, the required coverage is achievable. The opportunities and the challenges faced in the recording of this location is discussed in this sub-section. The user when experiencing the VT environment can identify and locate distressed elements such as cracked beams, the fallen portions of the stone veneers and the inner core of the wall, as seen in Fig. 8. By walking through the space virtually, and also by accessing the supplementary photographs attached, the user can understand the state of the structure clearly.

Fig. 9. (a) Reflected view of the ceiling in a hotspot with icons to access images (b) Embedded image of the roof.

The major drawback faced in developing the spherical panorama for the drone based RVA is the missing information pertaining to the ceilings (see Fig. 9a). This is due to a 60-degree cone of vision from the vertical that is masked by the body of the drone itself. To overcome this drawback, the photographs of the ceilingcaptured between the pillars, to supplement the missing information. Thereby, a user can click on the icon to view the condition of the ceilings from these photographs (see Fig. 9b). These images are recorded by tilting the drone camera 60 degrees upward from the horizontal and making multiple photographs videos that can provide complete coverage of the ceiling targeted.

5.2. Location - 2: Ardhamandapam

Ardhamandapam is a relatively dark, semi-enclosed space connecting the sanctum with the *Mahamandapam*. The major challenge faced in the acquisition of the interior image in this location is the careful operation of drone with no inter-visibility through the narrow entrance. The drone could not be takenbeyond the narrow entrance as the sensors in the drone have obstruction avoidance feature. Hence, in a careful manner these sensors were disabled in order to maneuver and take it within the *Ardhamandapam*, after which the sensors were enabled again. The UAV used in this case has a light at the bottom that serves as a visual positioning system (VPS) for landing operations in the absence of natural or artificial light. However, in this case, the same feature could be utilized in capturing the details of the floor (see Fig. 10a). The other minor challenge was in tackling the animal infestation (i.e. bats in this case) inside the sanctum, the darkest enclosed space in the shrine; the bats tend to exit through the only opening, which is through the *Ardhamandapam* during the drone operation. During the assessment phase in the laboratory, the VT helped the structural team even identify crack patterns on the walls of this space (see Fig. 10b-c), which then serve as critical data to decide on the feasibility of physical access and need for temporary measures.

5.3. Location 3: Sanctum Sanctorum

The sanctum is the darkest, enclosed space in the shrine with only one door opening connecting the sanctum with the *Ardhamandapam*. In order to decide on the feasibility of operations, the operator must be aware that the drone positions itself in space efficiently with a Global Positioning System (GPS) in the

presence of satellite connectivity both during daytime (with sufficient lighting) and nighttime (with no lighting). But in the absence of satellite connectivity, particularly when performing drone operations indoor, the Visual Positioning System (VPS) is resorted to for maneuverability, with the drone completely relying on the optical sensors to position itself. The two infrared sensors in the drone are utilized for landing operations and for obstruction avoidance during vertical motion while flying. As for positioning operations, the drone depends on its optical sensors (stereoscopic with a total of eight cameras, two on each side), which require sufficient lighting for effective VPS. As the sanctum is a fully enclosed space with no GPS connectivity and extremely poor lighting, the operation of drone inside the sanctum was not feasible. However, few traces for the condition of the sanctum are seen through the door opening from the *Ardhamandapam* as shown in Fig. 10d, but the information is insufficient to draw conclusions on its structural condition.

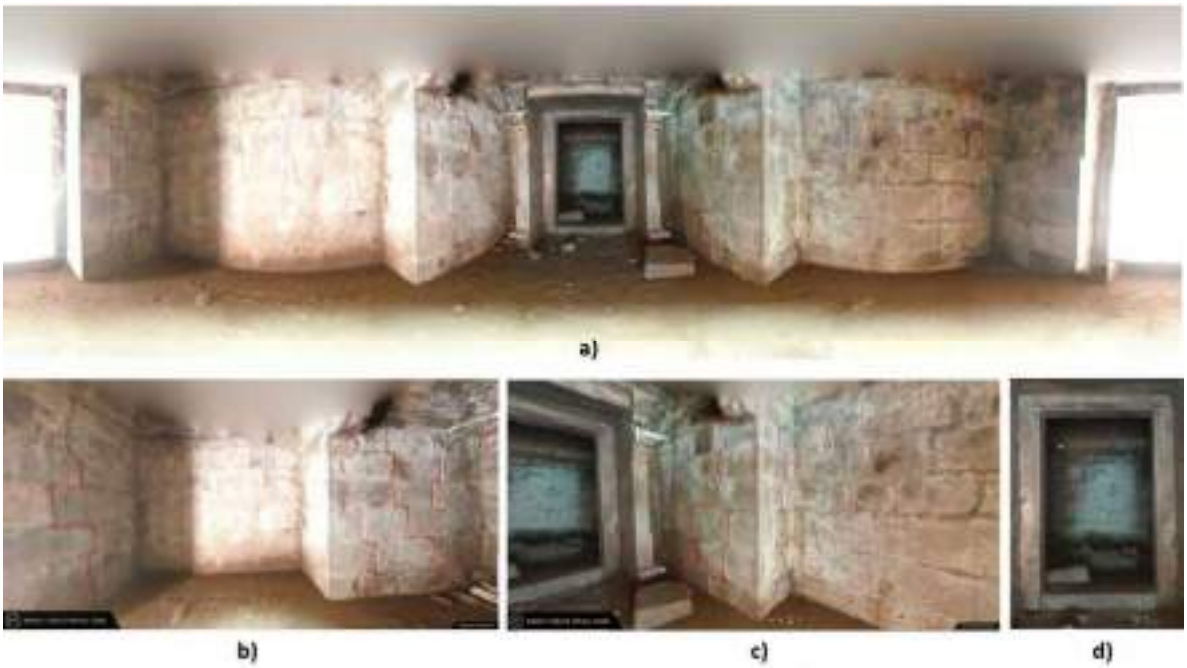

Fig. 10. (a) Un-projected spherical panorama of the Ardhamandapam interior (b-c) Identified crack pattern (d) Traces of Sanctum space visible from Ardhamandapam.

6. Recording Decorative Elements

Decorative elements include sculptural features on architectural elements, reliefs, and murals (see Fig. 11), which cannot be ignored during this process, as any temporary emergency stabilization or salvage operations can inadvertently compromise their cultural value.

These elements enable historians, archaeologists and epigraphists study the historical value of the built heritage.

Losing such elements can lead to erasing historical evidence and can even lead to erroneous choices in the conservation of the site. Hence, during salvage operations or erecting temporary supports, technicians and labor must be careful in handling such elements to prevent any damage.

In order to aid them in their operations, it is essential to provide a working plan marking all the potential risks, including that to decorative elements. High reliefs such as ornamented column capitals and projecting brackets are more vulnerable than the bas-reliefs.

Such a working plan as shown in Fig.6c-d, identifies accessible and inaccessible pathways within the shrine, and identifies decorative elements will facilitate planning for temporary stabilization, emergency measures or archaeological salvage procedures.

Fig. 11. Decorative elements located in different regions within the shrine.

7. Discussion on the Outcomes

Thorough documentation at different levels of sophistication is required in any conservation or restoration efforts in historic structuresthat are in a dilapidated condition because of natural disasters or neglect. Documentation during the initial reconnaissance surveys indispensable, to develop emergency stabilization interventions or salvage of archaeological artifacts before further conservation efforts begin. The safety of personnel working in this initial phase against potential hazards such as structural collapse or animal attack, needs to be accounted for in the strategies adopted. Necessary measure to minimize loss of historical value of the building elements must also be a constraint in this exercise. The methodology proposed in the paper for acost-effective Remote-RVA nullifies the time spent by workers in an unsafe zone, without compromising on the quality of output required for an RVA. The conventional methodology (i.e. by means of physical access) and the proposed methodology for rapid visual assessment are compared in Table 3 below.

Table 3. Table comparing aconventional method and the proposed method for rapid visual assessment.

	Conventional method (RVA)	**Proposed method (RRVA)**
Access	Physical	Remote
Acquisition time	1 day - 1 week	1 hour - 1 day
Time spent in unsafe zone	Significant	Nil
Hardware	Digital /Panorama camera or both	Drone or a mini drone
Human resource	Architect + unskilled labor (for assistance with access)	Architect + Drone pilot
Quality of output	More than sufficient for RVA	Sufficient for RVA

Fig. 12. Example showing the distortion.

8. Limitations of the Current Work

Apart from the challenges that are faced during the RRVA process which may be overcome with more sophisticated instruments, there are few other limitations in this process.

- The spherical panoramas captured with missing ceiling information, though supplemented with images, giving an incomplete feel and making it less user-friendly.
- Uneven lighting can cause over/under exposure of regions leading to missing out details.
- Because of the UAVs pitch and roll action in air during the acquisition of images at a station, there can be misalignment in capturing and poor stitching of images in certain regions as seen in the output spherical panorama (e.g. Fig. 12). This requires that the user is able to distinguish between the stitching error and the real damages in the structure.

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References

Farin, D., Effelsberg, W., De With, P. H. N., 2007. Floor-plan reconstruction from panoramic images, in *Proceedings of the ACM International Multimedia Conference and Exhibition*, *January*, pp.823–826, https://doi.org/10.1145/1291233.1291420, ACM DL, Association for Computing Machinery, New York, USA.

ICOMOS, 2000. *Declaration of Assisi*. *February*, 3–6. https://iscarsah.files.wordpress.com/2014/11/2000-02-28-declaration-of-assisi.pdf

Jusof, M. J., Rahim, H. R. A., 2014. Revealing visual details via high dynamic range gigapixels spherical panorama photography: The Tempurung Cave natural heritage site, in *Proceedings of the 2014 International Conference on Virtual Systems and Multimedia, VSMM 2014*, 193–200. https://doi.org/10.1109/VSMM.2014.7136690, IEEE, USA.

Napolitano, R., Douglas, I. P., Garlock, M. E., Glisic, B., 2017. Virtual tour environment of Cuba's national school of art, in *International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences - ISPRS Archives*, *42*(2W5), pp.547–551. https://doi.org/10.5194/isprs-archives-XLII-2-W5-547-2017, ISPRS.

Napolitano, R., Scherer, G., Glisic, B., 2018. Virtual tours and informational modeling for conservation of cultural heritage sites, in *Journal of Cultural Heritage*, *29-09*, pp.123–129. https://doi.org/10.1016/j.culher.2017.08.007 , Elsevier, Amsterdam, Netherlands.

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Between art and Documents: Exhibitions in Florence between the Nineteenth and Twentieth Centuries

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Abstract

The attempt to outline a history of exhibitions in Florence in the period from the formation of the Italian state to the advent of the Fascist regime must necessarily take into account the profound changes that have occurred on the political and social level. Under this filter, art and documentary exhibitions can be considered a privileged observatory.

First of all, the exhibitions set up for important international meetings will be investigated, as in the case of the imposing Oriental Exposition prepared for the IV International Congress of Orientalists and held at Palazzo Medici Riccardi in 1878. A case at the antipodes is that of the neglected Exhibition of America memorabilia at the newly founded National Museum of Anthropology and Ethnology, set up for just two days in conjunction with the Florentine stage of the XXII International Congress of Americanists (1926), opened in Rome in the halls of the Capitol by Benito Mussolini himself.

As for the more exquisitely artistic exhibitions, born in the wake of the success of the great exhibitions of 1911 and 1922 set up by Ugo Ojetti (Exhibition of the Italian Portrait; Exhibition of Italian painting of the Six and Eighteenth centuries), an attempt will be made to give a cross-section of the Florentine situation, and more latently Italian. But with the beginning of the Fascist period, even the most philological exhibitions became an instrument of propaganda in the hands of the regime.

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Keywords: Art Exhibition, Documentary Exhibition, Florence.

Soon after the Unification of Italy, with the election of Florence as capital of the newborn Kingdom, the city became the scene of important exhibition events. While on one hand, interest in the arts of the Middle Ages and the Renaissance reflected a norm already established in international exhibitions in London and Paris (Levi, 2008: 17ss), on the other hand, attention paid to these periods had to deal with much more binding demands for identity of civil, cultural, and moral values (Casprini, 2014).

The celebrations planned for the centenaries of the "Fathers of the Nation", represented the climax, as was admirably defined by Carlo Dionisotti, of a «secular, democratic, nationalistic and historicist religion» (Dionisotti, 1966: 544; Corsi, 1994: 13), of such importance that it left a tangible sign on the urban panorama. Imposing monuments such as the colossal statue of Dante in Piazza Santa Croce (Paolini, 2015: 38-42) (Fig. 1) - no longer centrally located (Comitato, 1970; Sisi, 2014: 73) - and the bronze reproduction of Michelangelo's David in Piazzale Michelangelo, surrounded by the temporal allegories from the New Sacristy of San Lorenzo (Faleni, 1875: 7-14, 39-40; Parrini, 1876; Paolini, 2015: 43-47) (Fig. 2), both dates to these memorable celebrations. These monuments also served a pedagogical function, which aimed at building a new national consciousness through the images of those who embodied virtue and greatness in the civil field, as well as in the arts and literature. The inscriptions that Cesare Guasti later composed for the bronze statue of David are exemplary: «contemplando questi simulacri / se ti conduca il pensiero / dal palagio dei Signori ai sepolcri medicei / vi leggerai o cittadino scolpita / l'ultima pagina della Storia di Firenze repubblicana» (Parrini, 1876: 81).

Within these events there was also space for the setting up of exhibitions of artistic objects and documentary evidence, such as the *Esposizione di Oggetti dei Tempi di mezzo e del Risorgimento* (14 May 1865-1 July 1865), where prominence was given to the 'industrial arts' of the past, and the *Esposizione Dantesca* (14-16 June 1865), of a more strictly documentary nature (Esposizione 1865); both shows were held in the new Museo Nazionale in the Palazzo del Podestà (Guida, 1865; Barocchi and Bertelà, 1985a: 251-254; Barocchi and Bertelà, 1985b). Although it lasted only three days, the *Esposizione Dantesca* saw the participation of 8000 people (Barocchi and Bertelà, 1985b: 45).

Fig. 1. Monument to Dante in the center of piazza Santa Croce, Florence.

Fig. 2. Monument to Michelangelo, Piazzale Michelangelo, Firenze.

A combination of art and document also emerged on the aforementioned celebrations of Michelangelo (1875), when, in addition to the memorable exhibition at the *Galleria dell'Accademia*, an exposition of Michelangelo's autographs and documents was prepared in the *Regio Archivio di Stato* by Cesare Guasti, who had recently been appointed *Soprintendente agli Archivi Toscani*. A short catalogue accompanied the exhibition, which remained open beyond the original time limit due to the large number of people — especially foreigners — who came to Florence to take part in the celebrations (Corsi, 1994: 18).

Other exhibitions of documentary nature were also held, such as the one in the Biblioteca Laurenziana dedicated to Vittorio Alfieri (1903), another "vate" of the new Italy (Rostagno, 1903), but now we intend to deal with a particular

type of exhibitions, one of which was substantially overlooked by the scholars, especially in its sociocultural implications. These exhibitions often accompanied important international congresses, such as the *Esposizione Orientale* of 1878 (Fig. 3), held for the *IV International Congress of Orientalists* in Florence and the neglected *Mostra dei cimeli americani*, organized for the scholars' trip in Florence who took part to the XXII International Congress of Americanists, held in Rome from 23 to 30 September 1926. These two exhibitions are chronologically located at the opposite ends of the period we are investigating: the first one located in the years following the transfer of the Italian capital to Rome (when Florence suffered a disastrous financial collapse), while the second one was prepared during the early years of the Fascist era. The proclamation of Florence as the seat of the IV International Congress of the Orientalists resulted from the well-balanced cultural policy that was strenuously pursued by the professors of Oriental studies within the *Istituto di Studi Superiori pratici e di perfezionamento*, the ancestor of the modern University of Florence (L'Istituto, 2016). The Istituto framed itself as a national model of research, establishing Oriental studies among its essential components with the hope of deprovincializing Italy and aligning it with the most advanced foreign intellectual instances; however, the choice was also linked to the surge in financial transactions following the opening of the Suez Canal (Rosi, 1984; Marrassini, 2007; Lowndes Vicente, 2012: 53ss.; Lelli, 2016; Soldani, 2016: 59). Italian Oriental studies, especially in Florence, were essentially of literary nature, an orientation already explicated since the time of the inaugural speeches at the Istituto in 1859 (Rosi, 1984; Marrassini, 2007; Lelli, 2016). This attention stemmed from the desire to promote the rich heritage of Hebrew, Chaldean, Syrian and Arabic codices, and manuscripts in Florence libraries (Discorso, 1860). The fervent activity of the professors who work at the Instituto, in particular that one of the Arabist and patriot Michele Amari (1806-1889) (Gabrieli and Romeo, 1960; Mallette, 2005; Wolf, 2019) and of the Sanskrit scholar Angelo De Gubernatis (1840-1913) (Solitario, 1996; Taddei and Sorrentino, 1995-2004; Lowndes Vicente, 2012; Benedetti, 2013), is reflected in the foundation of journals, societies and academies. These served also to highlight the reality of the Italian Oriental Studies at the III International Congress of Orientalists in St. Petersburg (1876). De Gubernatis, as delegate of the Italian government on behalf of the Ministry of Education (De Gubernatis, 1876), drafted a ponderous report *entitled Matériaux pour servir à l'histoire des études orientales en Italie*, that was offered to congress participants together with the first issues of the *Bollettino italiano di Studi orientali* (Diana, 2018: 9). De Gubernatis' activism - together with Amari's support, fame and excellent foreign relations - assured Florence the nomination as the seat for the next congress, in view of which immediate plans for a special *Esposizione orientale* were made (Stasolla, 2013; Diana, 2018).

The idea to set up this exposition came from the St. Petersburg congress, when the «objets ayant trait aux antiquités et à l'état actuel des peuples de l'Orient» were on display in an exhibition curated by the Russian orientalist Peter Ivanovich Lerch (Diana, 2018: 12). Judging from De Gubernatis, who described it as a «piccola mostra archeologica orientale», it must have been a small one (De Gubernatis, 1876: 828; De Gubernatis, 1878). In Florence the project was more complex, because Amari intended to promote an exhibition of Oriental manuscripts, to set up an exact and complete bibliography of Italian travellers to the East and to prepare several specialized works devoted to each of the other oriental languages (De Gubernatis, 1876: 834). With a clear prevalence of Islamic works, the *Esposizione orientale* placed on display the most important Oriental objects in Italy, some of which had been in Italian collections for centuries, together with materials brought by Italian ambassadors abroad and objects lent by private collectors (Quarto Congresso, 1878: 42-43; Diana, 2018: 12ss). It is important to note that the exhibition was conceived as scientific support to the lectures held during the congress. Francesco Pullè, a Sanskrit scholar and member of the conference organizing committee, effectively outlines the twofold intent of the exhibition: «to bring these objects to public attention as an available means of study and to add dispersed and often forgotten works to the repertoire of known works discussed at previous congresses» (Pullé, 1878).

The exhibition was set up in Palazzo Medici-Riccardi, in spaces made available by the Province of Florence, as we see in two engravings by Odoardo Borrani (Carocci, 1878) (Fig. 3). Each of eight sections of the exposition included different types of materials: manuscripts, codices, documents, epigraphs, nautical charts, printed books, and modern publications, and archaeological, artistic and craft materials ranging from sculptures and architectural fragments, to metals, majolica, coins, ivories, wood weapons, musical and astronomical instruments, etc. (Diana, 2018: 9-17). However, it is difficult to quantify the exact number of objects displayed but, by judging the synthetic exhibition catalogue, there were more than one thousand pieces.

The entire project was inspired by a positivist and erudite approach, for example also the exhibition of an artistic artefact such as the famous *Vaso Cavour* (Carboni, 2001), was subordinate to the eminently historical, linguistic, and philological information related to its inscriptions (Diana, 2018: 26-32). Nevertheless, this approach provided to modern historiography useful tools for a correct classification of this kind of objects, if compared with an eminently

aestheticizing perspective (Diana, 2018: 1-2). It is not irrelevant to note that no art historian took part in the exhibition, in any form whatsoever, whereas the presence of eclectic collector such as the Count Ferdinando Panciatichi Ximenes d'Aragona, the owner of the marvelous Castle of Sammezzano near Florence, is well-documented (Lowndes Vicente, 2012: 58). But it is however worth pointing out that only a few years later, the art historian Adolfo Venturi engaged in the cataloging of Islamic metalworks in the Este collections in Modena, did not hesitate to turn to an Arabic language expert for the translation of inscriptions contained on some specimens; an approach that could no longer be ignored (Venturi, 1882: 85).

Fig. 3. View of some of the rooms of the *Esposizione Orientale* in *Palazzo Medici-Riccardi*, Florence.

While the *Esposizione orientale* was prepared in close synergy with conference themes, it was also open to the public. This was not the case for the more restricted *Mostra dei cimeli americani* at the National Museum of Anthropology and Ethnology. Although the Americanists did not hold their congress in Florence, their visit to the city was planned in virtue of the well-known historical links between Florence and the 'New World'. These connections were exalted through the exhibition of anthropological, artistic, cartographic, and documentary evidence of pre- and post-Columbian era. From the point of view of the fascist regime, the Americanists' congress was the perfect instrument to illustrate the myth of the nation of "saints, poets and navigators", and Mussolini himself presided the opening of the conference on the Campidoglio (Diana, 2019: 63ss) (Fig. 4).
The small but precious exhibition housed in Palazzo Nonfinito, new headquarters of the National Museum of Anthropology and Ethnology, was curated by the man of letters and anthropologist Nello Puccioni under the supervision of Aldobrandino Mochi, full professor of Anthropology and director of the museum. The exposition and the museum (not yet officially inaugurated) were opened to the congress attendees and the city authorities for only two days, on 3-4 October 1926 (Diana, 2019). Exhibited works were scrupulously chosen from the extensive range offered by the city's vast heritage and indeed most works were on loan from other Florentine cultural institutions. Among the items were two exceptional gilded wood ceremonial throwing-sticks called 'Atlatls' (recent purchase of the museum founder Paolo Mantegazza's), the famous featherwork mitre of the Medici collection, and one of the oldest images of the Emperor Montezuma, as well as a series of small artefacts in semi-precious stones, such as idols and votive masks (Fig. 5), sent by the Uffizi Gallery and the Archaeological Museum (Diana, 2019: 68ss). Alongside these more artistic objects, there were also nautical charts, bibliographical rarities, and manuscripts, such as the very precious *Libro de la vida degli Indios*, a letter signed by Amerigo Vespucci and an extremely rare Quattrocentina containing a letter by Cristoforo Colombo (Diana, 2019: 72- 73).

Next to museum founder Paolo Mantegazza's recent purchase of two very rare, gilded wood ceremonial throwing-sticks called *atlatls*, precious relics from the ancient Medici collection were on display. Among the items was a famous featherwork mitre with the oldest image of the Emperor Montezuma, as well as a series of small artefacts in semi-precious stones, such as idols and votive masks (fig. 5), sent by the Uffizi Gallery and the Archaeological Museum (Diana, 2019:68ss). Alongside these more artistic objects, there were also nautical charts, bibliographical rarities and manuscripts, such as the very precious *Libro de la vida degli Indios*. Last but not least was a letter signed by Amerigo Vespucci and a very rare *Quattrocentina* containing a letter by Cristoforo Colombo (Diana, 2019:72-73). The paper

and parchment materials on loan from the *Biblioteca Nazionale Centrale*, the *Biblioteca Laurenziana* and the *Biblioteca Riccardiana* were returned immediately to their respective institutions when the exhibition ended. Many of the artistic artefacts on the other hand were loaned to the Museum of Anthropology, where some remained in temporary storage for more than half a century before returning to Florentine Galleries (Diana, 2019:76).

Fig. 4. Inaugural speech given by Benito Mussolini in the Capitol on the occasion of the XXII International Congress of Americanists.

Fig. 5. Some hard stone items on display at the *Mostra dei cimeli americani.*

The paper and parchment materials on loan from the Biblioteca Nazionale Centrale, the Biblioteca Laurenziana and the Biblioteca Riccardiana were returned immediately to their respective institutions when the exhibition ended, while some of the artistic artefacts, such as the idols in semi-precious stones, were loaned to the Museum of Anthropology, where remained in temporary storage for more than half a century before returning to Florentine Galleries (Diana, 2019: 76).

Despite their diversity, the *Esposizione orientale* and the *Mostra dei cimeli americani* were linked by a great deal of wide-ranging research on the vast and stratified Florentine artistic, archival and book heritage. This thematic approach to displaying objects, which saw a glowing variety of items exhibited with no clear prevalence of technique or materials, did not last long: from the early twentieth century the most significant Florentine exhibitions can only be understood as *sub specie picturae*.

The twentieth century opened with the fiftieth anniversary of Italian national unity, and Florence participated in the celebrations, alongside Rome and Turin, with two exhibitions: one dedicated to floriculture and another, organized by Ugo Ojetti, of portraits. The undertaking that the Roman critic was about to embark on was very delicate: it was necessary to devise an initiative worthy of a city like Florence that would constitute a moment of enrichment for scholarship. Ojetti proposed a review of Italian portraiture, pursuing an idea he had been dreaming of since the beginning of the century. The concept was probably inspired by events taking place outside Italy. One has only to think of *L'exposition rétrospective de portraits d'hommes et de femmes cèlébres (1830-1900)* held in Paris in 1908, which intended to illustrate French history by using painted and sculpted images of the nation's most famous figures from various fields of politics, culture and society. Why couldn't this be done in Italy? The Florentine exhibition presented itself as an ideal opportunity for revitalizing the nationalistic spirit through its display of effigies of the most prominent figures in Italian history, while at the same time exalting the excellence of the great masters who, with their work, had immortalized their likenesses.

In the preparatory notes for the Florentine exhibition Ojetti does not hesitate to reaffirm the choice of a portrait exhibition, believing that in this genre even «gli artisti più accademici e convenzionali diventano fatalmente sinceri ed espressivi. La nostra esposizione riassumerebbe tutt'una storia ignorata, rialzerebbe rinomanze abbandonate, e mostrerebbe […] la continuità della nostra pittura anche in epoche finora credute povere solo perché non sono state studiate» (Ojetti, 1908:11). The exhibition in Palazzo Vecchio was the right occasion to re-evaluate a vast page of Italian painting that until then had been ignored.

The *Exhibition of Italian Portraits from the late 16th century to 1861* opened in Palazzo Vecchio on 11th March 1911 (Mostra del ritratto, 1911; Casini 2012; Certini, Giometti, 2019). It was a titanic achievement for the Tuscan capital, which gathered 850 works from both public and private, Italian and European collections, but also drew

material from the antique market. The exhibition itinerary included thirty-four rooms of apartments in Palazzo Vecchio (Cosimo I, the Elements, Eleonora di Toledo and Priori, Leo X) and proceeded through regional schools following a chronological order. Paintings were hung on simple panels or set on easels, often set one above another, which made the layout confusing at times. At the end of the visit viewers were given access to the Salone dei Cinquecento where 18 Medici portraits from Villa Poggio a Caiano were exhibited, on loan from the King. The exhibition was very well received by the public, so the closure scheduled for 15th June was extended to 31st October. Such success did not fail to refresh the spirit of revanche in the local newspapers with regard to the initiatives underway in the other two capitals. But the real merit of this enterprise was to have initiated a critical re-evaluation of Italian painting of the seventeenth and eighteenth centuries on a national scale, bringing to the fore a series of artists who until then had been almost completely ignored. These new aspects that were highlighted by Nello Tarchiani in his long report on the exhibition published in May 1911 in the periodical *Rassegna d'Arte*. He described the group of portraits by Carlo Maratti and Giovan Battista Gaulli, two artists destined for a renewed and full discovery, as "remarkable". Baciccio, a true surprise of the Florentine event, was represented, among others, by his portrait of Clement IX (fig. 6), and is described as «il più abile nell'impastare incarnati caldi di sangue, e nel dare alle sue creature verità e quasi direi umanità di sguardo». Tarchiani continues his examination into the nineteenth century, and among many confirmations - see for example the portraits of Bezzuoli and Hayez - the rediscovery of Il Piccio, born Giovanni Carnevali, emerges strongly. The scholar defines him as the real "surprise" of the Florentine event (Tarchiani, 1911:77, 92).

Fig. 6. View of the room of the Baroque portrait at the *Mostra del Ritratto Italiano* in Palazzo Vecchio.
Fig. 7. View of the Sala delle Nicchie at the *Mostra della pittura italiana del Seicento e Settecento*, Palazzo Pitti.

On 31 October 1911, at the closing of the exhibition, there were about 170,000 visitors, many of whom had been able to purchase the short guide to the exhibition but not the complete catalogue, which was still in preparation at the time. Publication was interrupted due to the outbreak of the First World War and the catalogue was not published until 1927 (Il ritratto, 1927).

Exhibitions held in Florence during the Fascist regime began almost casually in 1922 with a large exhibition on Italian painting in the seventeenth and eighteenth centuries held at Palazzo Pitti (Fig. 7). Highly celebrative with strong patriotic values, the initiative is remembered by Francis Haskell with these words: «The exhibition was intended to celebrate the recent victory that Italy, fighting alongside its Western allies, had achieved over Austria. Its main objective, however (which was not specifically stated), was the restoration of national pride» (Haskell, 2008:176). A difficult task. Above all because the choice to present a vast series of Baroque artworks was quite out of place, since these painters needed re-evaluating, as they were still perceived as the real culprits of artistic decadence.

Once again, Ugo Ojetti was the one to plot the enterprise. He had initially thought of limiting the chronological span to the seventeenth century, only to realize that it was impossible to divide it from the following century. The entire show was set up, with an initial grant of 50,000 lire from the Municipality of Florence, in a very short period of about six months. This efficiency was due to the creation of territorial scientific committees, thirteen of which were regional and four foreign. They selected 1,054 works, mostly

from public galleries and private collections in Venice, Milan and Naples. Giovanni Poggi, who was Superintendent of the Galleries and Museums of Tuscany at that time, had the task of adapting Palazzo Pitti to the needs of the exhibition itinerary. He was assisted by Carlo Gamba, who took care of the display. The inauguration took place on April 20, 1922: in the station of Santa Maria Novella citizens and authorities waited for the arrival of the King, who was then accompanied in full procession to the exhibition venue.

In the following days, Ojetti registered an uninterrupted turnout of about one thousand visitors a day and these numbers increased thanks to pre-established reductions for entrance tickets (from 2.50 *lire* to 1.00 *lire*) and the usual railway reductions. The brief catalogue, available since the exhibition opened, highlights the advantages and disadvantages of its hasty organization: although it is accompanied by good photographic reproductions, it lacks measures of the works and numerous publication errors were not amended in the second edition, released just before the show closed (Mostra della pittura, 1922a; Mostra della pittura, 1922b). When on November 6, 1922, the curtain came down on the major sixteenth and seventeenth century kermesse held at Palazzo Pitti, the political situation had radically changed. Only nine days before, the March on Rome had taken place and on 30 October King Vittorio Emanuele III gave Benito Mussolini the task of forming the new government. Born under the anti-Austrian star, the Florentine exhibition closed with the menacing march of the Blackshirts. In the monumental extended catalogue, published in 1924, Ojetti states that Italian art of the Baroque age anticipates «tutta la più bella e sincera e profonda pittura di paesaggio degl'inglesi e dei francesi tra la fine del '700 e la metà dell'800». Patriotism triumphed and nationalist rhetoric outclassed a more careful philological reading (Ojetti, 1924:12).

Until the Ojetti exhibition in 1922, expositions in the Tuscan capital were designed to attract the public, especially in spring, and they were not necessarily intended to exalt the national spirit. From 1922 onwards, the aim was to «presentare l'arte italiana in modo da far stupire il mondo», as Mussolini would declare a few years later (Longhi, 1985:62).

Another turning point was 1933. Alessandro Pavolini, Secretary of the Provincial Fascist Federation of Florence, instigated the first edition of the Maggio Musicale Fiorentino, which was inaugurated with *Rigoletto* at the Teatro Comunale on April 22. On May 6 the Mostra del Tesoro di Firenze Sacra opened to the public in the halls of the convent of San Marco. It was a ground-breaking exhibition, whose promoting committee was chaired by the omnipresent Pavolini (Carelli, 2019). A display of ancient art with an ambitious scientific plan, it was linked to the extraordinary Jubilee called for by Pope Pius XI to celebrate one thousand nine hundred years since the Resurrection of Christ. Organized on a tight schedule thanks to the enthusiastic and active support of Superintendent Poggi and the local Curia, the event gathered 1260 works including sculptures, paintings, illuminated manuscripts, precious metalwork, furnishings and sacred vestments. Objects were scattered throughout the museum and convent rooms, including the cells, while six hundred meters of display cases were used to contain smaller items. Large wooden crosses, including one from Rosarno and another from San Giorgio a Ruballa, attributed to Taddeo Gaddi, were set up in the Chapter Room. The small refectory was transformed into a sort of chapel with an altar, where 85 reliquaries were on display. Showcased at the center of the room was the *reliquary bust of St. Zanobi* from the cathedral of Santa Maria del Fiore, which dated to 1331 and was chosen to illustrate the cover of the catalogue (fig. 8). From its inauguration on 6 May, the flow of visitors to the exhibition was substantial and the original closing date of August 31 was extended by two months. By the end of the show a total of 46,068 visitors had frequented it, which was a flattering result, especially when compared to other initiatives mentioned so far. In his review published in "Emporium", Jahn Rusconi voiced his hopes for a future Museum of Sacred Art. He also suggested some exhibited works be used as models by «industries, especially textiles and goldsmiths who work for churches and who today, more than ever before, need to reconnect with the healthiest and safest traditions of Italian art» (Rusconi, 1933:39).

The Palazzo del Parterre also hosted a highly significant exhibition in 1933, especially from a political point of view. The Germanic Art Exhibition was organized by an Italian-German executive committee chaired by Antonio Maraini (National Commissioner of Fine Arts and Secretary General of the Venice Biennale). This happened just months after Adolf Hitler was appointed Chancellor of the Reichstag. The Tuscan capital immediately decided to celebrate the communion between the two dictatorships. The exhibition counted more than three hundred works, including paintings and sculptures, with the intent of restoring German Romanticism it drew on «purely indigenous sources without Hellenistic substructures» (Settala, 1933:3; Ambrusiano, 2019). The result was a nationalist and overtly racist selection of very low quality. At the end of the exhibition, the Minister of National Education, Francesco Ercole, granted the maximum sum of 2,000 lire to purchase any

paintings and sculptures that had arrived in Florence. An operation that was evidently unwelcome to Superintendent Poggi, who managed to prevent any acquisitions on formal grounds, because the statutes of the Galleria d'Arte Moderna in Florence did not allow expenses for foreign works.

Attention to the German art scene did not end with that great political initiative. In 1935 a small but very interesting retrospective dedicated to the painter Karl Hofer (1878-1955) was organized at the Lyceum club by Elena Salvaneschi, secretary of the art section of the aforementioned association. The German master had been dismissed from teaching at the Kunsthochschule in Berlin the previous year because of his ties with expressionist currents, which were considered "degenerate". Indeed, his works were later exhibited at the notorious *Entartete Kunst* exhibition in Munich in 1937 (Hüneke, 2015).

Fig. 8. Cover of the catalogue of the *Mostra del Tesoro di Firenze Sacra* with the reliquary bust of St.Zanobi by Andrea Arditi (1331).
Fig. 9. King Vittorio Emanuele III at the Giottesca exhibition.

Finally, one cannot avoid an albeit brief commentary on the fundamental *Mostra Giottesca* hosted in the rooms of the Uffizi Library in 1937. The Giotto Exhibition intended to highlight the great novelty of the Florentine master. Among the 303 items on display, most were paintings (204), followed by far smaller numbers of illuminated manuscripts (42), manuscripts (24), sculptures (19), works in precious metals (10) and drawings (5); more than half of the objects came from Florence and its county (143). The exhibition gathered a vast and to this day unsurpassed group of primitive works, with the aim of highlighting both «la corrente artistica nella quale, attraverso Cimabue, Giotto si formò, quanto le correnti bisantineggianti, a cui Giotto reagì» (Sinibaldi, Brunetti, 1943:7; Monciatti, 2010; D'Ettorre, Mencaroni, Vespari, 2019). The 13th-century paintings were organized by city and regional schools (Lucca, Pisa, Siena, Arezzo, Umbria and Florence), to which was added the school of Giunta Pisano. The corpus of Giottesque works marked the passage into a new century, represented by a series of more or less important artists: Taddeo Gaddi, Bernardo Daddi, Maso di Banco, Pacino di Bonaguida, up to the Maestro di San Martino alla Palma. On the day of its inauguration Vittorio Emanuele III (fig. 9), accompanied by Minister Bottai, attended preliminary events presided over by Ojetti in the Salone dei Cinquecento. Then everyone moved to the exhibition spaces, which had been set up by the architect Michelucci. Ojetti's speech reinforces the centrality of Rome with respect to Byzantium and Tuscany as a direct descendant of true classicism: «Ebbene dinanzi a quel tanto dell'antica Roma che ancora era in piedi e splendeva, dinanzi alla scultura romana che nel ritratto aveva posto quasi la ragione dell'arte, il toscano o, se vogliamo adoperare un misterioso aggettivo che è anche troppo di moda, l'etrusco, dopo i tanti voli della dialettica e della pittura bisantina nei cieli dell'astrazione, sente e gode la grave certezza della realtà, la bellezza delle passioni, la varietà dei costumi, e il vigor dei caratteri» (Ojetti, 1937:139).

However, by 14 October, only two weeks before its closure, there was a huge economic deficit (over 150,000 *lire*) in the exhibition budget and the Executive Committee proposed an extension of one month to recover costs. At its

closure on 30 November, the numbers - about l50,000 official visitors including those free of charge - indicates that the show was a substantial failure compared to expectations. But the Giotto Exhibition would have fared even worse if corporate and school organizations had not been co-opted in its final month to increase the number of visitors. Public response to the Exhibition of Ancient Arms held in Palazzo Vecchio from 1st April to 31st October 1938 was significantly more enthusiastic, with over 600,000 visitors (Madella, 2019) (fig. 10).

Fig. 10. The ride in the Salone dei Cinquecento in Palazzo Vecchio.

Staged on the threshold of the Second World War, the epilogue of the Giotto Exhibition is nevertheless significant as it underlines a transversal and constant aspect that characterized Florentine exhibitions between the nineteenth and twentieth centuries: the figure of the artist, genius and innovator was an effective instrument of propaganda that could revive values of national unity and patriotism, equally valid in different political moments. Giotto, Brunelleschi, Donatello and Michelangelo were as much involuntary spokesmen for the monarchical State and constitutional Italy as they were for Mussolini's regime.

References

Ambrusiano, F., 2019. La Mostra d'Arte Germanica nel 1933: l'"Arte" della diplomazia: regimi a confronto, in *Mostre a Firenze 1911-1942*, Giometti, C., (Ed.), pp. 137-147, Edizioni ETS, Pisa, Italy.

Amico, F., 2006-2007. *La mostra della pittura italiana del Seicento e del Settecento a Palazzo Pitti nel 1922: documenti, dibattiti e rivisitazioni su due secoli resuscitati dell'arte italiana*, PhD diss., Università degli Studi di Firenze, Italy.

Barocchi, P., Gaeta Bertelà, G., 1985a. Ipotesi per un Museo nel Palazzo del Podestà tra il 1858 e il 1865. Studi e ricerche di collezionismo e museografia. Firenze 1820-1920, in *Quaderni del seminario di storia della critica d'arte 2*, pp. 211-377, Pisa, Italy.

Barocchi, P., Gaeta Bertelà, G., 1985b. IV. Mostra di Dante e Mostra del Medio Evo 1865, in *Dal ritratto di Dante alla Mostra del Medio Evo 1840-1865*, Exhibition Catalogue, Barocchi, P., Gaeta, P., Bertelà, G., (Eds.). pp. 39-46, Firenze, Italy.

Benedetti, A., 2013. L'attività fiorentina di Angelo De Gubernatis, in *Atti e memorie dell'Accademia toscana di scienze e lettere,* pp.122-150, La Colombaria 64, Italy.

Carboni, S. 2001. Cavour Vase, in *Glass of the Sultans*, exhibition catalogue, Carboni, S., Whitehouse, D., (Eds.). cat. 129, pp. 260-263, New Haven-London, UK.

Carelli, F., 2019. "Di tutte le meno note e già pregevoli opere d'arte": la Mostra del Tesoro di Firenze Sacra, in *Mostre a Firenze 1911-1942*, Giometti, C., (Ed.), pp. 127-136, Edizioni ETS, Pisa, Italy.

Carocci, G., 1878. Il Congresso degli Orientalisti a Firenze, in *L'Illustrazione Italiana*, 5, 40 (October), pp. 218-219, Fratelli Treves, Milano, Italy.

Casini, T., 2012. Firenze 1911. La mostra del ritratto italiano e le radici iconografiche dell'identità nazionale, in *Conosco un ottimo storico dell'arte…, Per Enrico Castelnuovo scritti di allievi e amici pisani*, Donato, M.M., Ferretti, M., (Eds.), pp. 407-413, Edizioni della Normale, Pisa, Italy.

Casprini, S., 2014. L'inaugurazione della statua di Dante in piazza Santa Croce nel 1865: celebrazione di Firenze capitale ed educazione ai valori nazionali, in *Le Bandiere di Dante. L'inaugurazione del monumento a Dante in Firenze capitale*, proceedings of the conference (Florence 2013), Cirri L., Casprini, S., Savorelli, A., (Eds.), pp. 21-27, Edizioni Il Campano, Pisa, Italy.

Certini, C., Giometti, C., 2019. La mostra del Ritratto italiano, in *Mostre a Firenze 1911-1942*, Giometti, C., (Ed.), pp.11-26, ETS, Pisa, Italy.

Comitato, 1970. *Comitato Internazionale per il ripristino del Monumento a Dante Alighieri, Libro bianco per il monumento a Dante*, Tipografia L'artigiano, Firenze, Italy.

Corsi, S., 1994. Cronaca di un centenario, in *Michelangelo nell'Ottocento. Il centenario del 1875*, exhib. cat. (Florence 1994), Corsi, S. (Ed.), pp. 12-30, Charta, Milano, Italy.

De Gubernatis, A., 1876. Congresso Internazionale degli Orientalisti a Pietroburgo. Relazione del delegato ufficiale italiano a Sua Eccellenza il Ministro della Pubblica Istruzione. in *Bollettino ufficiale del Ministero della Pubblica Istruzione II*, X, 827-834, Italy.

De Gubernatis, A., 1878. Firenze e la Mostra Orientale, in *La Nazione* 238, 26th August, Firenze, Italy.

Diana, A., 2018. *Islam delle Lettere/Islam delle Arti nella Firenze postunitaria*, thesis at the Scuola di specializzazione in Beni Storico-Artistici (advisor Tigler, G.), Università degli Studi di Firenze, A.A. 2017-2018, Italy.

Diana, A., 2019. La "Mostra dei cimeli americani" al Museo Nazionale di Antropologia ed Etnologia di Firenze nel 1926. Storia di un'esposizione negletta, in *Mostre a Firenze 1911-1942*, Giometti, C., (Ed.), pp.63-77, Edizioni ETS, Pisa, Italy.

Dionisotti, C., 1966. Varia fortuna di Dante, in *Rivista Storica Italiana* 78, 3, pp.544-583, Italy.

Discorso 1860. Discorso letto dal professor M. Amari nella inaugurazione dell'Istituto di Studi superiori il 29 gennaio 1860, in *L'Istituto di Studi Superiori Pratici e di Perfezionamento in Firenze*, pp.1-21, Stamperia reale, Firenze, Italy.

Esposizione 1865. *Esposizione Dantesca in Firenze, Cataloghi*, Le Monnier, Firenze, Italy.

Faleni, A., 1875. *Notizie storiche del David del Piazzale Michelangelo e cenni biografici del Cav. Prof. Clemente Papi*, Tipografia della Gazzetta dei Tribunali, Firenze, Italy.

D'Ettorre, E., Mencaroni, R., Vespari, S.A., 2019. Nuove indagini sulla Mostra Giottesca del 1937, in *Mostre a Firenze 1911-1942*,

Giometti, C., (Ed.), pp.179-194, Edizioni ETS, Pisa, Italy.

Gabrieli, F., Romeo, R., 1960. Amari, Michele Benedetto Gaetano, in *Dizionario biografico degli italiani*, vol. 2, Treccani, Roma, Italy.

Guasti, C., 1875. *Il Regio Archivio di Stato in Firenze. Ricordo del quarto Centenario dalla nascita di Michelangelo, Settembre 1875*, Firenze, Italy.

Guida 1865. *Guida officiale delle feste per il centenario di Dante Alighieri il 14, 15 e 16 maggio 1865 in Firenze*, Cellini, Firenze, Italy.

Haskell, F., 2000. *The Ephemeral Museum. Old Master Paintings and the Rise of the Art Exhibition*, Yale University Press, London, UK.

Haskell, F., 2008. Nuovi orientamenti nel gusto a Firenze e Parigi, in *La nascita delle mostre. I dipinti degli antichi maestri e l'origine delle esposizioni d'arte*, pp.173-189, Skira, Milano, Italy.

Hüneke, A., 2015. Karl Hofer und der Nationalsozialismus, in *Künstler im Nationalsozialismus*. Ruppert, W., (Ed.), pp.167-175, Böhlau Verlag, Köln-Weimar-Wien, Austria.

Il ritratto 1927. *Il ritratto italiano dal Caravaggio al Tiepolo alla mostra di Palazzo Vecchio nel 1911*, exhib. cat. (Florence 1911). Istituto Italiano d'Arti Grafiche, Bergamo, Italy.

La "primavera fiorentina" 1937. La "primavera fiorentina". Il Re inaugura la Mostra giottesca tra imponenti manifestazioni di popolo, in *Il Popolo d'Italia*, 28 April 1937, 1, Italy.

Levi, D., 2008. Il Medioevo in mostra nell'Ottocento: alcuni spunti e riflessioni, in *Medioevo/Medioevi. Un secolo di esposizioni d'arte medievale*, Castelnuovo, E., Monciatti, A., (Eds.), 1-29, Edizioni della Normale, Pisa, Italy.

Lelli, D., 2016. Gli insegnamenti di Orientalistica, in *L'istituto di Studi Superiori e la cultura umanistica a Firenze*, Dei, A., (Ed.), vol. 1, pp.241-313, Pacini Editore, Pisa, Italy.

Longhi, R. 1985. Editoriale mostre e musei (un avvertimento del 1959), in *Critica d'arte e buongoverno 1938-1969*, pp. 59-74, Sansoni, Firenze, Italy.

Lowndes Vicente, F., 2012. *Altri orientalismi. L'India a Firenze 1860-1900*, Firenze University Press, (Outros orientalismos: a Índia entre Florença e Bombaim 1860-1900, Lisboa 2009), Firenze, Italy.

Madella, M., 2019. Mostra delle armi antiche. Un successo influenzato dall'entrata in Guerra? in *Mostre a Firenze 1911-1942*, Giometti, C., (Ed.), pp.201-206, Edizioni ETS, Pisa, Italy.

Mallette, K., 2005. Orientalism and the Nineteenth-Century Nationalist: Michele Amari, Ernest Renan, and 1848. in *The Romanic Review* 96, 2, 233-252, Duke University Press, Durham, USA.

Marrassini, P., 2007. Le discipline orientalistiche all'Istituto di Studi Superiori di Firenze, in *Firenze e la lingua italiana fra nazione ed Europa*, Maraschio, N., (Ed.), pp.157-164, Firenze University Press, Firenze, Italy.

Monciatti, A., 2010. *Alle origini dell'arte nostra. La Mostra Giottesca del 1937*, Il Saggiatore, Milano, Italy.

Mostra del ritratto 1911. *Mostra del ritratto italiano dalla fine del secolo XVI all'anno 1861*, exhib. cat. (Florence 1911), Istituto italiano d'arti grafiche, Firenze, Italy.

Mostra della pittura 1922a. *Mostra della pittura italiana del Seicento e Settecento*, exhib. cat. (Florence 1922). Bestetti and Tumminelli, Rome, Italy.

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Exhibiting the Garden: An Idea and its Phenomenology in Florence from the 1930s to the 1950s

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Abstract

This contribution outlines how the idea of exhibiting the "Italian Garden" manifested in various forms. The garden "all'Italiana" assumed the specific identity of the formal garden – composed through horticultural, architectural, hydraulic and sculptural elements – and developed over the centuries in a specific geographical area. Some of the exhibition tools used during the *Mostra del giardino italiano* (Exhibition of the Italian Garden) held in 1931 at Palazzo Vecchio are examined: the so-called *teatrini*, a group of ten modern dioramas that showed the main stylistic phases of the historic Italian garden. The *teatrini* are interpreted within their historical context and then influences of the exhibition are traced into the 1950s in Florence.

Keywords: Mostra del giardino italiano, Art of Gardens, Forte Belvedere, Diorama, Museum.

1. The history of an idea

The *Mostra del giardino italiano* (Exhibition of the Italian Garden) at *Palazzo Vecchio* in 1931 has found space in the historiography of the traditional garden beginning in the last twenty years of the twentieth century when the theme was investigated several times through archival discoveries and publications from the period. Many historians have provided an account of the protagonists of the event, its organization, the large public attendance numbers, and the exhibition criteria for what was decisively relevant for the development of ideas on a theme such as that of the historic garden[1].

The critical assessments of the exhibition of 1931, beginning with the pioneering reflections of Vincenzo Cazzato, are currently enjoying a revival and emphasize its significance; the contribution that follows intends to explore the not-yet-fully-exhausted trail of material on this topic, bringing some elements to light on the history and the forms taken by an idea in Florence in the first half of the twentieth century: the idea of *exhibiting the garden*.

The Italian cultural climate at the end of the 1920s was receptive to the promotion of an event that highlighted the Italian garden.

This was a non-traditional, courageous choice because, unlike for other subjects, the garden is a very mutable art form, lacking in that enduring materiality that instead marks most of the objects destined to take their places in exhibitions (Gamba, 1931). Nonetheless, the proposal made progress, and although the plan had actually been in the works since 1912 (Tarchiani, 1931), in 1930, the idea of making an exhibition on the theme was put into action «so that the whole evolution of garden architecture is, in this historic exhibition, set before the eyes of visitors» (Lensi and Ojetti, 1931: 23-24).

The plan foresaw opening the show during the spring of 1931 in Florence, the season chosen for the previous great exhibitions such as that dedicated to the Italian portrait (spring 1911), and that on Italian painting of the seventeenth and eighteenth centuries (spring 1922) (Tamassia, 2005: 9-21, 28-39; Giometti and Certini, 2019; Policicchio, Mucciante and Stillitano, 2019) all three events revolved around the same common denominators: Ugo Ojetti (1871-1946), Nello Tarchiani (1878-1941) and Count Carlo Gamba (1870-1963).

The successes established with these earlier exhibitions were essential tools to which the organizers of the garden exhibition continually referred during its development, to support the trustworthiness of their ideas and, why not, the strength of a verifiable experience (Lensi and Ojetti, 1931: 5, 23; Archivio Storico del Comune di Firenze, (from now on A.S.C.Fi), 5089, loose papers; Cazzato, 1986; Cazzato, 1998).

Regardless of the historical and political contingencies, the spring represented a seasonal stage, which, from time immemorial, had a strong celebratory relationship with the city – ancestral and spiritual – according to which the cycle of rebirth took form in the May Day feast – *calendimaggio* – the compilation of the oldest pagan springtime celebrations.

Over the decade in question, this folklore, deeply rooted in the spirit of the city, would bring to life other lasting initiatives like the revival of the Calcio Storico Fiorentino in 1930, and the new foundation of the festival Maggio Musicale Fiorentino in 1933, and the Mostra Nazionale dell'Artigianato of 1931 (Cazzato, 1986: 80; Acidini Luchinat, 1996: 94-95; Lasansky, 2004: 57-83).

The garden exhibition was inaugurated on 24 April 1931 and closed after about three months, at the end of July. It was preceded by a half year of frenetic preparations run by an extremely efficient executive committee that supervised the logistics and creative and executive implementation.

The organization involved superintendents of art and antiquities, museum and gallery directors, state

[1] Cazzato 1986, with an exhaustive bibliography up to 1986; Cazzato 1987; Cazzato 1998; Acidini Luchinat 1996; Pozzana 1998; Lazzaro 2004; Cazzato 2007; Cantelli 2014; Cazzato 2019: 16; Bonfigli, Cencetti, Zinanni, 2019.

archives, public libraries, and public and private art collections from across the national territory; numerous experts in the field: collectors, antiquarians, and architects, both in Italy and abroad; and the major European museums.

Fig. 1. Room 1: the Salone dei Cinquecento with the installation underway of the ten *teatrini*, Florence, Gabinetto Fotografico delle Gallerie degli Uffizi. Courtesy Ministero per i Beni e le Attività Culturali.

To represent the historical development of the garden, they chose different kinds of artworks and objects: views of villas and gardens painted and printed, drawings, scenography, photographs, other kinds of paintings that have gardens portrayed in the background, architectural models of villas, toys for leisure time in villas, to which can be added the organization of a special «exhibition of faux flowers from the seventeenth century to today» (Lensi and Ojetti, 1931: 25).

The highlight of the exhibition was the installation in the *Salone dei Cinquecento*: ten *teatrini* incorporated

scale models illustrating the "types" of Italian gardens over the centuries (Fig. 1 and Fig. 2), beginning with the Roman era garden, through the Florentine garden of the sixteenth century, and up to the Neoclassical Lombard style, and the Romantic garden.

These dioramas, with their novelty and curiosity value, would ensure the success of the exhibition with the public.

Fig. 2. Room 1: the Salone dei Cinquecento with the installation underway of the ten *teatrini*, detail of a teatrino under construction, Florence, Gabinetto Fotografico delle Gallerie degli Uffizi. Courtesy Ministero per i Beni e le Attività Culturali.

2. "The world at a glance"[2]

To understand this particular choice – the *teatrini* – it is necessary to dwell on this new visual experience, the *diorama*, that "modern" machine-enchantress at the root of the many technical innovations reached following a rational and investigative progression in the course of the eighteenth century. Developed in Paris in 1822 by Louis Jacques Mandé Daguerre (1787-1851) with the painter Charles-Marie Buton (1781-1853), the diorama made for a spectacle of painted images on semi-transparent surfaces which, carefully illuminated and accompanied by acoustic effects, rendered drawn idyllic or dramatic landscapes extraordinarily realistic. The essential purpose was the imitation of nature within a closed space expressly built to aid the artifice, which, in the arc of only fifteen minutes, could show an exceptional complexity of atmospheric variations (Gernshein, 1968: 14-46; Benjamin, 1986: 8-9; Dohm, Garnier, Le Bon and Ostende, 2017: 34-39, 41-48).

But the success of Daguerre and Buton and the effectiveness of the tool were preceded by a long phase of technical experimentation aimed at the creation of artificial microcosms capable of conveying unprecedented visual experiences: the eighteenth century was marked by the creation of numerous optical mechanisms like

[2] The title derives from a chapter in the volume: Dohm, Garnier, Le Bon, Ostende, 2017: 62.

magic lanterns, candle-operated forerunners of projectors, and the *eidophusikon*, the mounting of a scene on a small stage with urban or landscape scenery, animated by moving figures and special effects, or the *diaphanorama*, the optical theaters – as large as a wardrobe – that contained transparent layers painted with watercolours depicting landscapes which lit the right way and put in motion made a tremendous impression on the viewer (Dubbini, 1994). A proliferation of inventions – these forerunners to the diorama – included a conspicuous number of imitations developed to entertain and were given names like *Cosmorama*, *Georama*, *Pleorama*, *Typorama*, *Uranorama*, and others, united by the idea of realistically reproducing reality on a small scale in an artificial space.

The idea carried such weight that it was not limited to the sphere of entertainment: the life path of the diorama follows its potential transformation into a mediating element of communication essential to the divulgation of scientific content with the "naturalistic diorama" that transfers the artificial reconstruction of habitats and their inhabitants using classification criteria and taxidermy techniques to the museum environment. The adoption of the diorama in museums for teaching purposes sees its first example in the "biological museums" created in Sweden by Gustaf Kolthoff (1845-1913), scientist and taxidermist, together with the painter Bruno Liljefors (1860-1939), creator of the first natural history diorama at the museum of the university of Uppsala in 1889 and in Stockholm in 1893 (Dohm, Garnier, Le Bon, Ostende, 2017: 64-75; Scheersoi, Tunnicliffe 2019: 69, 101-12). In the same years, the taxidermist, sculptor, photographer, and biologist Carl Akeley (1864-1926) made his first diorama creations at the Milwaukee Public Museum (1890) and later at the American Museum of Natural History of New York and the Field Columbian Museum of Chicago. By way of example, dioramas exhibitions were known to have been at the venues of the Gothenburg Natural History Museum in 1923, the Museum of Natural History of Berlin in 1918, and the Alexander Koenig Museum in Bonn, ending in 1934 (Scheersoi, Tunnicliffe 2019: 69; Dohm, Garnier, Le Bon, Ostende, 2017: 76-87).

The scientific diorama dedicated to the dissemination of natural history would then be joined by the ethnographic and anthropological one, appearing in minimal but eloquent forms for the first time at the Universal Exposition at the Crystal Palace in London in 1851. It immediately demonstrated its affinity to be an element of spectacle, thanks to the immediacy of its communication which, invoking theatricality and a sense of wonder, was suited to the vast popular participation in the fair (Dohm, Garnier, Le Bon and Ostende, 2017: 182-185). The idea of reconstructing scenes of daily life composed of a certain visual liveliness but sustained by reliable ethnographic reconstructions also permeated the Colonial Exposition of Stockholm of 1928, and the International Colonial Exposition of Paris in 1931, in which the diorama constructions, together with the cinematography, were considered the cornerstones of the expositions (Dohm, Garnier, Le Bon and Ostende, 2017: 198-201; Sabatino, 2013: 53-67). Using an approach that took into account the specific capacity for visual synthesis and the range of the viewer, Le Corbusier (1887-1965) chose to show his innovative urban visions of the "city for three million inhabitants" and the "Plan Voisin" through dioramas (one with a surface area of 80 m^2 and the other of 60 m^2), displayed in rooms specifically designed at the Pavilion of the Esprit Nouveau at the International Exposition of Decorative Arts and Modern Industry in Paris in 1925 (Boesinger and Storonov, 1948: 98-108; Alonso Pereira, 2013).

"The world at a glance" is therefore a convincing method of conveying an idea, or a world, or a civilization – past, present, and future – which through history and imagination reconstructs the content, the form, and the expressivity of that world by placing it within a small space, to which is granted a strong, special communicativity. When the organizing committee of the *Mostra del giardino italiano* of 1931 first formulated the idea of creating a garden exhibition, the idea initially was aimed at the possibility of reconstructing a series of "types" of real, historic gardens: «In the meadow of *Quercione* we can make seven gardens, from the Pompeian to the seventeenth century Italian; other romantic and modern ones can be in the meadow of the *Cornacchie*, while the meadow of the *Tinaia* can be used for a national competition of architects and horticulturists for four modern gardens» (Cazzato, 1986: 81-82). The proposal was

abandoned due to difficulties of execution, and also the lack of time: creating a garden requires a significant time frame. And yet, the idea that followed was entirely in keeping with the proposal: transforming the green areas of the Cascine Park into a museum was substituted with the idea of constructing ten dioramas – called *teatrini* – ten creations of 4.70 x 3.00 m to be installed along the walls of the *Salone dei Cinquecento*, constructed with the traditionally graceful shapes of puppet theatres. Each would house the model of a historic garden (for example the Roman garden, the Tuscan *Trecento* garden, the Florentine *Quattrocento* garden, and so on). The compositions turned out to be completely original and did not recreate a specific historical example, but rather chose a selection of characteristics that distinguished them. Thus the idea of the diorama was outlined in its entirety: with a compendium of themes to be represented, given a scientifically precise execution, philological in its stylistic solutions,[3] animated with the use of careful lighting and acoustically enhanced with the sound of water.[4] The completed installation appeared, all in all, in the context of what was happening in those same years at some of the most important museum institutions and exhibition organizations, both European and overseas. At the heart of the choice is a confidence in the idea that communication with the viewer should be mediated through the "modern" instrument of the diorama, an effective visual experience of great immediacy. With an approach that is far from low in the scientific hierarchy, the executive committee opted for the creation of this important moment of entertainment – "miniatures of earthly paradise" (Cazzato, 1986: 82), according to one of the descriptions of the *teatrini* – to which were added hundreds of artifacts – paintings, tapestries, furnishings, – of undoubted artistic value, that filled the remaining fifty-three rooms of the show. The installation revealed therefore a decisively updated approach, with widely didactic information systems deriving from the most recent communication innovations, which in the same years gave rise to an intense and lively international debate (Dalai Emiliani, 2008; Dragoni, 2016; Basso Peressut, 2005; Cecchini, 2013).

The functional and stylistic design of the *teatrini* and the selection of the types was carried out under the supervision of the architect Enrico Lusini and entrusted to the painter and scenographer Donatello Bianchini[5]; the projects were made by Lusini (Roman garden, Tuscan Trecento garden, Florentine Quattrocento and Cinquecento garden) and by Giuseppe Crosa di Vergato for the sixteenth and seventeenth century Genoese garden; Luigi Piccinato for the Roman garden from the sixteenth and seventeenth century, Tomaso Buzzi for the Venetian eighteenth century garden and the Neoclassical Lombard garden, Giovanni Chevalley for the eighteenth century Piedmontese garden, and last, Donatello Bianchini for the Romantic garden. While images of the period captured by the photographer Brogi show the models of the gardens with shots taken from an abstractly axial point of view, imitating the views of Giusto Utens, or locate the camera directly on the base of the diorama in search of a foreshortened perspective, what the visitors would have experienced was a path that allowed them to move from one model to another for the entire length of the *Sala Grande*, pausing to take in, along the way, as if from the proscenium of a theatre, the diorama

[3] On 19 January 1931 Ugo Ojetti wrote to Professor Giuseppe Lugli: «... do you think it is possible to extract a plan and perspective of the Roman garden type from that famous description in Pliny? The architect Lusini did it from the description in the Decameron and he drew out something quite interesting, which was a surprise». (… crede sia possibile ricavare dalla famosa descrizione di Plinio una pianta ed una prospettiva del giardino romano tipo? L'Arch. Lusini lo ha fatto per la descrizione che è nel Decamerone, e ne ha ricavata una cosa interessantissima, e che è stata una sorpresa.) in A.S.C.Fi, 5088, loose papers.

[4] «…These ten scenes will be installed in the Salone dei Duecento (see plan) [author's note: not present] that can take a lighting and water system for eventual fountains» (Queste dieci scenografie saranno collocate nel Salone dei Duecento (vedi pianta) [assente, nda] che è adatto alla sistemazione della luce e dei servizi d'acqua per eventuali giuochi), from the instructions for the "Commissari" sent to all the organizers on a national level, in A.S.C.FI, 5088, fasc. Scenografie Istruzioni, loose papers. In reality, the *teatrini* were displayed in the Salone dei Cinquecento.

[5] Donatello Bianchini received on loan the lunettes of Giusto Utens showing Castello, Ambrogiana and Palazzo Pitti to "copy the gardens", that he returned on 24.03.1931; each teatrino required about a month of work and "two or three" were twice as large (6.00 x 6.00 m); the cost for each *teatrino* or "model" totalled in the payment request of Bianchini was 10,000 lire; in A.S.C.Fi, 5087, fasc. Scenografie Bianchini Prof. Donatello Firenze, loose papers.

mechanisms offered to view, coloured externally with light tones and shaded frontally by a delicate arch through which they were seen. The planners obeyed a specific request, according to which:

> «before modellers and set designers can get to work, an architect needs to prepare the plan and a perspective of each garden type. A typical garden, let's say, because we don't want to reproduce this or that Florentine, Roman, Veneto, etc. garden but the Roman Garden of the Seicento, the Garden *Piemontese* of the *Settecento*, and so on. A garden that brilliantly and clearly summarizes the essential elements typical of these gardens. And this is not only because there are no gardens that have their original character preserved intact; but because for the public, not used to abstractions and synthesis, it will be easier to understand what was once the fifteenth century Florentine garden, etc. from seeing an idealized scene, instead of numerous depictions of individual gardens that actually exist or once existed. In creating the design, it is necessary to think of the various elements, using them in reference to the sculpted plane, which could also be sloped (which would be preferable); reserving a row of trees for the backdrop, or better yet a structure: balcony, cave, staircase, or gloriette» (A.S.C.Fi, 5088, *fasc. Scenografie Istruzioni*, loose papers).

The idea of producing real, easy-to-read, precious microcosms – an educational approach not without rhetorical elements – finds fertile ground in a historical period marked by a political mentality that pursues the idea of exhibition theatrics as an instrument of political strategy for the regime. The exhibition, as a planned rite that attracted thousands of visitors (Russo, 1999: 6-9; in the accounting estimates for the exhibition, the expectation of selling 18,000 tickets at 5 lire each is recorded: A.S.C.Fi 5087, loose papers.), primarily celebrated the history of the country and its achievements, as echoed in the words of Ojetti after the closing of the doors, when the materials contributed for the show were packed and shipped to the lenders accompanied by letters of thanks: «[the show] collected such a unanimous consensus on the part of all art lovers and those who feel the importance of reaffirming the Italian record for all time and in every field of art and culture» (A.S.C.Fi, 5091, letter of thanks from Ugo Ojetti, also on behalf of *podestà* Conte Giuseppe Della Gherardesca, to Sig. Trabucco, 16 Rue Daunon, Paris, lender to the exhibition, loose papers). The claim of primacy and its celebration required an essential starting element, the native invention of the idea of the "Italian" garden that sees the country as the absolute protagonist of this ideation, and as a secondary element, equally fundamental, and especially urgent: the communication of its pre-eminence to the population. In the course of the preparatory meeting on 19 November 1930, the executive committee discussed the narrow time frame available to put the show together, and while postponing to the following year was considered, the motto "lo vuole Il Duce" (Il Duce wants it) outweighed any doubt in the patriotic minds of the coordinators (Cazzato, 1986: 80-81).

«In the history of Italian architecture, there is no mention of garden architecture. For every one hundred books today that describe and address the Italian garden, ninety-nine are foreign, and most of them in English. Each year, in every part of Italy, and not only in the open countryside, but in the heart of the cities themselves, centuries-old gardens are abandoned and destroyed. In our art schools, there is no specific teaching of 'garden architecture'», were words said by Ojetti during the inauguration of the exhibition (Cazzato, 1986: 80).

The regret expressed on the occasion of the unveiling gives rise to considering how it was received in university circles: beginning with the academic year 1939-1940, in Florence, within the young architecture department of the university, the course "Art of the Gardens" would be added to the *corpus* of teachings and assigned to Professor Giovanni Michelucci (Cresti, 2001: 3-5, 78; Annuario 1940: 335).

3. "Exhibiting" the garden

Ugo Ojetti wrote to one of the many lenders to the exhibition, Duke Antonio Lante della Rovere at Bagnaia (Viterbo) on 16 July 1931 with the following words:

> «Most kind Duke,the gratifying success of our exhibition, a success due in large part to the courteous interest of those, such as yourself, who have lent paintings, drawings, prints, and photographs, has induced us to retain them in an enduring way in a work on *Ville e Giardini d'Italia* of which we are beginning the laborious compilation, and which should come out at the end of next year. It is the wish of the major Florentine authorities to preserve many materials acquired for this exhibition afterward in a Museum of the Italian Garden to be set up in one of the *Ville Reali* of the Florentine countryside. To achieve this dual purpose, and also on behalf of the Podestà of Florence, I kindly ask you to please leave with us for some time the photographs of the Villa of Bagnaia which at least in part we will need for the work on the *Ville e Giardini d'Italia*» (A.S.C.Fi, 5088, loose papers; Lensi and Ojetti, 1931: 25).

The text shows the positive consequences being disseminated with the appreciation of the exhibition: publishing a book dedicated to the theme, taking into consideration the significant collection, and cataloguing already carried out, and reorganizing the material acquired in the form of a permanent exhibition, a "Museum of the Italian Garden" to be installed where there were already historic gardens, at a Florentine villa. Thought the text would never see light of day, the proposal to build a museum had some results, albeit in an episodic way.

On 30 December 1930, the architect Armando Vené (1887-1952), superintendent of medieval and modern art for the provinces of Verona and Mantua, sent a thank you letter to Ojetti, praising him for what he described as a «brilliant and beautiful initiative» and accepted the job of serving in the «Veneto committee for the exhibition of the Italian Garden» (A.S.C.Fi, 5091, loose papers). The correspondence of Vené with Ojetti documents their familiarity and the interest and the direct participation of the superintendent at the event of 1931. After thirteen years, the architect Vené was appointed superintendent for the city of Florence (July 1943), and in the summer of 1944, he acquired a thorough understanding of the Florentine complex of the *Forte di Belvedere*, which, in the aftermath of the war, underwent a complete metric survey by the *Soprintendenza*. The occasion of the survey provided one of the preconditions thanks to which a long public debate would take shape on the most appropriate solutions for the complex of the *Belvedere*, which in a relatively short time, would be permanently decommissioned and become a civilian property (18 March 1955) (Mazzanti, 2006: 148; Acocella and Mazzanti, 2019).

In the constructive atmosphere that opened the discussion on the destiny of the Fort, which was soon to be available, the superintendent Venè sent an interlocutory request to the finance commission (*Intendenza di Finanza*) in which he delineated synthetically the terms of the transfer of property and reiterated the hope that it would be definitely decommissioned and delivered (*Soprintendenza Archeologica Belle Arti e Paesaggio per la Città Metropolitana di Firenze*, (from now on S.A.B.A.P.Fi), *Archivio Storico*, *filza* A/716, letter from the superintendent Vené to the finance commission, 22 January 1947, loose papers). The occasion gave Venè the chance to summarize the plan for the use desired by the Soprintendenza: in the *villa*, according to the definition that was correctly used to indicate the Belvedere building, «according to an old project, the garden museum would find a worthy site, the museum would be completed by actual examples of historic gardens that would be built on the ramparts of the Fort». Venè continued, hoping also that «the Caserma of San Giorgio alla Costa that was the old convent annex of the church of San Giorgio [...] would be consigned to the *Soprintendenza ai Monumenti* to be converted into a site for the museum of Roman art of the sixteenth and seventeenth centuries in addition to and as a continuation of the *Galleria Palatina*». (S.A.B.A.P.Fi, *Archivio Storico*, filza A/716, letter

from the superintendent Vené to the finance commission, 22 January 1947, loose papers). The idea of making the battlements of the *Forte Belvedere* into display areas with constructions imitating historic gardens can be traced back to the revival of the Italian garden that had characterized the first decades of the twentieth century in Tuscany, expressed in the detailed plan for restoring or creating anew the gardens in the hills around Florence, especially under the guidance of the architect Cecil Pinsent, – as at *Villa Le Balze*, *Villa I Tatti*, or at *Villa Medici* in Fiesole – and ultimately, in the consecration of the interest for the theme through the promotion of the *Mostra del giardino italiano* of 1931 (Fantoni, Flores, Pfordresher 1995).

The theme of the realistic *exempla* of historic gardens was seriously considered while at the Forte di Belvedere major reconstruction works were underway led by architect Nello Bemporad (1915-1985) (Mazzanti 2007) for the *Soprintendenza* (Mazzanti 2006: 176-197; Acocella, Mazzanti 2019) (fig. 3). The mention of reconstructing an Italian garden at the *Palazzina* appears repeatedly in newspapers from the mid-1950s, reports which include summaries of the sections foreseen for the future reorganization of the complex, «there will be lawns and meadows [...] both planted with trees and an elevated Italian garden, organized with particular care, adjacent to the massive central building». (La Nazione Italiana, Cronaca di Firenze, 16 March 1955; Il Giornale del Mattino, Cronaca di Firenze, 16 March 1955; 17 March 1955; 19 March 1955). In April 1957, at the conclusion of the renovation works on the ramparts and terraces alongside the *Palazzina* (fig. 4), no Italian garden had been created, and yet the idea must have had a certain following even during the planning of the restoration. Among the technical papers making up the *corpus* of drawings on the Forte di Belvedere at the Florentine *Soprintendenza*, there are two line drawings on that seem to be associated with the search for a solution that adopts examples of actual "Italian gardens" to be shown evidently in association with the Museo del Giardino (S.A.B.A.P.Fi, Archivio Disegni, pos. 155/7). The two drawings show solutions in plan and elevation for the creation of a geometric garden of modest dimensions on the projecting rampart at the extreme right of the upper fortress, facing North.

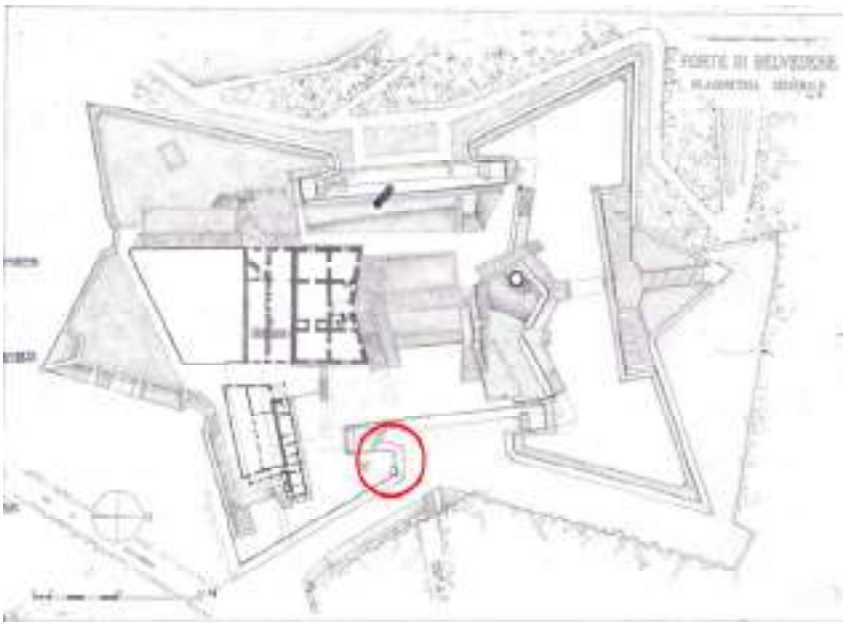


Fig. 3. General plan of the restoration project of the complex of the Forte di Belvedere, architect Nello Bemporad, circa 1955. Florence, Soprintendenza per i Beni Architettonici. Courtesy Ministero per i Beni e le Attività Culturali.

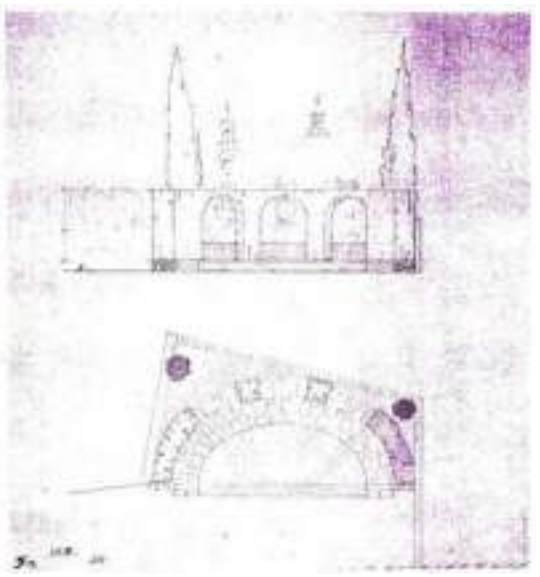
The two technical drawings in question, noted on the paper supports as "Tav. 5" and "Tav. 6" are in the scale 1:50. (figs. 5 and 6) They show compositional solutions aimed at the same portion of the rampart;

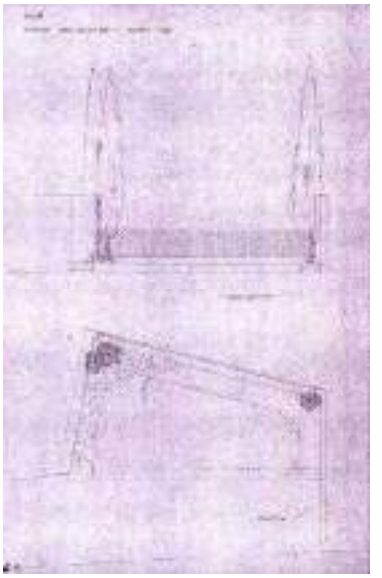
both show their strict dependence on the opportunity to create a privileged point of view toward the city, since in drawing 5, along with the garden plan, the background is indicated, with the cupola of Santa Maria del Fiore framed in the view. In both, the chosen solutions raise the level of the rampart wall to a limited extent, by a few steps (m. 0.50), and add dividing walls on the lateral east and west borders with the aim of containing and directing the view. Raising and orienting the viewpoint appears essential in both sketches.

Fig. 4. View of Florence from Forte di Belvedere, after the opening to the public on 28 April 1957.

In drawing 5, the space is designed with a semi-elliptical pavement area, predictably in stone, arranged as *opus incertum*, beyond which a wall of greenery rises as high as the lateral dividing walls and is cut by three round arches framing the landscape, bounded by cypresses. In drawing 6, a simplified solution keeps the pavement, varying its course, which now follows the irregular boundary of the ramparts allowing the complete use of the perimeter and encompassing, along the way, the same pointed cypresses. Both enclose spaces with grass lawns, bounded on the north by metal railings for protection from the dangerous drop. Neither of the solutions was carried out, as noted above, and the date of the drawings can be traced back to the years 1955-56. The possibility of installing a sampler of typical gardens of the Florentine Renaissance villa on the projecting ramparts of the Forte Belvedere is attributable to its new identity as a place of *tourist entertainment;* the drafting of the hypotheses drawn by Bemporad temporarily closes[6] the long gestation of an idea that arose forty years earlier, that of "exhibiting the garden".

[6] Cazzato 1986: 84 and note 36; with the paragraph "Verso il Museo del giardino storico" the author records that in 1986 the idea of a museum was recently brought up again but not carried out, in the section *Il Museo del giardino storico,* in Zangheri, Rinaldi, Cazzato 1982: 185–208.





Figs. 5 and 6. “Tav. 5” and “Tav. 6”: heliographic reproductions of drawings for the installation of examples of gardens on the ramparts of the Forte di Belvedere, architect Nello Bemporad, circa 1955, Florence, Soprintendenza per i Beni Architettonici. Courtesy Ministero per i Beni e le Attività Culturali.

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References

A.S.C.Fi - Archivio Storico del Comune di Firenze.

S.A.B.A.P.Fi - Soprintendenza Archeologica Belle Arti e Paesaggio per la città metropolitana di Firenze.

Acidini Luchinat, C., 1996. Il modello del giardino fiorentino del Quattrocento nella mostra del 1931, in *Giardini Medicei: Giardini di palazzo e di villa nella Firenze del Quattrocento*, Acidini Luchinat, C., (Ed.), Motta, pp. 138-145, Milano, Italy.

Acocella, A., Mazzanti, B., 2019. Un’architettura medicea per la città contemporanea. Il recupero del Forte Belvedere e l’antologica di Henry Moore, 1955-1972, in *Critica d’Arte*, LXXVII, 3-4, pp. 72-92, Fondazione Ragghianti, Lucca, Italy.

Alonso Pereira, J. R., 2013. Los dioramas de Le Corbusier, in *Cuadernos de proyectos arquitectónicos*, 4, pp. 80-87, Universidad Politécnica

de Madrid, DPA Prints, Madrid, Spain.

Annuario, 1940. *Annuario per l’Anno Accademico 1939-1940*, Regia Università degli Studi di Firenze, Firenze, Italy.

Basso Peressut, L., 2005. *Il museo moderno. Architettura e museografia da Perret a Kahn*, Lybra Immagine, Milano, Italy.

Benjamin, W., 1986. *Parigi capitale del XIX secolo*, Einaudi, Torino, Italy.

Boesinger, W., Storonov, O., (Eds.), 1948. *Le Corbusier et Pierre Jeanneret, Œuvre Complète de 1910-1929*, Les Éditions D’Architecture Erlenbach, Zurich, Switzerland.

Cantelli, M., 2014. La mostra del giardino italiano a Palazzo Vecchio (1931), in *Da Torino a Parigi: Laura Malvano storica e critica d’arte: omaggio alla vita e all’opera*, Bechelloni, A., Neppi E., (Eds.), pp.233-246, GERCI, Université Stendhal Grenoble, Grenoble, France.

Bonfigli, B., Cencetti, E., Zinanni, E., 2019. Il Giardino Italiano. Non vogliamo fare una mostra morta (…) ma una mostra viva e divertente, in *Mostre a Firenze 1911-1942,* Giometti, C., (Ed.), pp.89-110, Edizioni ETS, Pisa, Italy.

Cazzato, V., 1986. I giardini del desiderio: La mostra del giardino italiano Firenze 1931, in *Il giardino romantico*, Vezzosi, A. (Ed.), pp. 80-87, Alinea, Firenze, Italy.

Cazzato, V., 1987. Firenze 1931: la consacrazione del “primato” italiano nell’arte dei giardini, in *Il giardino: idea, natura, realtà*, Tagliolini, A., Venturi Ferriolo, M., (Eds.) pp. 77-108, Milano, Guerini.

Cazzato, V., 1998. Giardini "regali" fra realtà e immaginazione nella mostra fiorentina del 1931, in *Giardini regali: fascino e immagini del verde nelle grandi dinastie: dai Medici agli Asburgo*, exhibition catalogue, Amari, M., (Ed.), pp. 19-28, Villa Manin di Passariano, Electa, Milano, Italy.

Cazzato, V., 2007. Un architetto e una mostra: Tomaso Buzzi e la mostra del giardino italiano del 1931, Cantone, G., *Architetture nella storia: Scritti in onore di Alfonso Gambardella*, Marcucci, L., Manzo, E., (Eds.), vol. II, pp. 701-710, Milano, Skira, Italy.

Cazzato, V., 2019. Il giardino fiorentino del Cinquecento, catalogue entry, in *Viaggio nei Giardini d'Europa*, exhibition catalogue, Cazzato, V., Cornaglia, P., Reggi, M., Pejrone P. (Eds.), Reggia di Venaria 5 July-20 October 2019, p. 16, Edizioni La Venaria Reale, Torino, Italy.

Cecchini, S., 2013. Musei e mostre d'arte negli anni Trenta: l'Italia e la cooperazione intellettuale, in *Snodi di critica. Musei, mostre, restauro e diagnostica artistica in Italia (1930-1940)*, Catalano, M.I., (Ed.), pp. 57-105, Gangemi, Roma, Italy.

Cresti, C., 2001. *Storia della Scuola e Istituto Superiore di Architettura di Firenze 1926-1936*, Pontecorboli, Firenze, Italy.

Cresti, C., 2016. *Il giardino italiano: Mostra di Firenze 1931*, Pontecorboli, Firenze, Italy.

Dalai Emiliani, M., 2008. "Faut-il Brûler le Louvre?". Temi del dibattito internazionale sui musei nei primi anni '30 del Novecento e le esperienze italiane, in *Per una critica della museografia del Novecento in Italia. Il "saper mostrare" di Carlo Scarpa*, Dalai Emiliani, M., (Ed.), pp. 13-51, Regione del Veneto, Venezia, Italy.

Dohm, K., Garnier, C., Le Bon, L., Ostende, F., (Eds.) 2017. *Dioramas, exhibition catalogue*, Paris 14 June-10 September 2017, Flammarion, Paris, France.

Dragoni, P., 2016. "La concezione moderna del museo" (1930). All'origine di un sistema di regole comuni per i musei, in *Musei e mostre tra le due guerre, Il Capitale Culturale. Studies on the Value of Cultural Heritage*, Cecchini, S., Dragoni, P., (Eds.), vol. 14, pp. 25-51, Università degli Studi di Macerata, Italy.

Dubbini, R., 1994. *Geografie dello sguardo: Visione e paesaggio in età moderna*, Einaudi, Torino, Italy.

Fantoni, M., Flores, H., Pfordresher, J., (Eds.), 1996. *Cecil Pinsent and his Gardens in Tuscany, Papers from the Symposium* (Fiesole, 22 June 1995), Edifir, Firenze, Italy.

Gamba, C., 1931. La mostra del giardino italiano in Palazzo Vecchio, in *L'Illustrazione Italiana* 58, 18, pp. 665-669, Italy.

Gernsheim, A., Gernsheim, H., 1968. *L. J. M. Daguerre: The History of the Diorama and the Daguerreotype*, Dover Publications, New York, USA.

Giometti, C., Certini, C., 2019. La mostra del Ritratto italiano, in *Mostre a Firenze 1911-1942*, Giometti, C., (Ed.), pp.11-26, Edizioni ETS, Pisa, Italy.

Lasansky, D. M., 2004. *The Renaissance Perfected: Architecture, Spectacle, and Tourism in Fascist Italy*, University Park, Pennsylvania State University Press, USA.

Lazzaro, C., 2004. La partecipazione americana alla mostra fiorentina del 1931, in *Ville e giardini italiani: I disegni di architetti e paesaggisti dell'American Academy in Rome*, Cazzato, V. (Ed.), pp. 101-112, Istituto Poligrafico e Zecca dello Stato, Roma, Italy.

Lensi, A., Ojetti, U., (Eds.), 1931. *Mostra del Giardino Italiano*, catalogue, Tip. Ariani, Firenze, Italy.

Mazzanti, B. 2006. *La Palazzina del Belvedere nell'"Orto de' Pitti" a Firenze*, [PhD diss.], advisors: Rinaldi, A., Butters, S. B., Università degli Studi di Firenze, Facoltà di Architettura di Firenze, Italy.

Mazzanti, B., 2007. Bemporad, Nello (1915-1985), in *Guida agli archivi di architetti e ingegneri del Novecento in Toscana*, Insabato, E., Ghelli, C. (Eds.), pp. 54-59, Edifir, Firenze, Italy.

Policicchio, G., Mucciante, F., Stillitano, L., 2019. La mostra della pittura italiana del Seicento e del Settecento. Rilettura e riscoperta di uno stile: il Barocco, in *Mostre a Firenze 1911-1942*, Giometti, C., (Ed.), pp.41-56, Edizioni ETS, Pisa, Italy.

Pozzana, M., 1998. La Mostra del 1931, in *Giardini, parchi, paesaggi: L'avventura delle idee in Toscana dall'Ottocento a oggi*, Pettena, G., Pietrogrande, P., Pozzana, M., (Eds.), pp. 40-43, Le Lettere, Firenze, Italy.

Scheersoi, A., Tunnicliffe, S.D., (Eds.), 2019. *Natural History Dioramas - Traditional Exhibits for Current Educational Themes*, Springer Nature, Switzerland.

Sabatino, M., 2013. *Orgoglio della modestia*, Angeli, Milano, Italy.

Tamassia, M. (Ed.), 2005. Dietro le mostre: Allestimenti fiorentini dei primi del Novecento, Livorno, Sillabe.

Tarchiani, N., 1931. La mostra del giardino italiano in Palazzo Vecchio a Firenze, in *Domus* 4, 41, pp. 57-58, Editoriale Domus Spa, Milano, Italy.

Russo, A., 1999. *Il fascismo in mostra*, Editori Riuniti, Roma, Italy.

Zangheri, L., Rinaldi, A., Cazzato,V., (Eds.), 1982. *La città degli Uffizi. I Musei del futuro*, exhibition catalogue, Florence 9 October 1982-6 January 1983, Sansoni, Firenze, Italy.

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Trait d'union with History. Leonardo Savioli's Staging of the Exhibitions *Firenze ai tempi di Dante* and *La casa abitata* (1965)

Emanuela Ferretti, Lorenzo Mingardi

Abstract

Architect Leonardo Savioli's designs for temporary exhibitions (largely produced in the Sixties) are, within the architect's extensive range of work, a crucial topic of study for understanding his multifaceted body of work as an architect, a painter, and a graphic designer. Thanks to his remarkable ability to create relationships with the leading Florentine cultural institutions of the time, Savioli became one of the leading figures in that season of exhibitions.

Through a detailed study of two representative exhibitions from 1965, *Firenze ai tempi di Dante* in the Certosa of Galluzzo, and *La casa abitata* in Palazzo Strozzi, this paper brings in to focus the distinctive traits that characterize all of Savioli's productions, regardless of their subject matter. One of the main characteristics of Savioli's work as an exhibition designer is the importance of the relationship created between the objects displayed and the historical installation setting. All of the shows designed by the Florentine architect are, in fact, situated inside buildings of great historical importance, such as Palazzo Strozzi and the Certosa of Galluzzo. By placing his shows within specific historical contexts, Savioli allows new connections to be formed between the displayed objects and the spaces they inhabit. The architect pushes these exchanges to their limits: for the show in Galluzzo, the steel beams cross the entire space of the Palazzo Acciaiuoli, suspended off the ground by tie-rods, revealing new dimensional relationships. In *La casa abitata*, Savioli constructs a duplex living unit within Palazzo Strozzi, creating a show in which the interior architecture of the palazzo itself functions as the exhibition space for the duplex unit, and in which the duplex unit allows the visitor to experience the palazzo at a different vantage point from normal: from the living unit's sleeping area it is possible to touch the palazzo's corbels and see its ceiling vaults up close.

Keywords: Leonardo Savioli, Dante, Certosa of Galluzzo, Palazzo Strozzi, Casa Abitata

1. Firenze ai tempi di Dante [Florence at the time of Dante] (1965)[1] (Emanuela Ferretti)

Museum installations, both permanent and temporary, were an important part of the work of Italian architects in the second half of the twentieth century: the BBPR, Ignazio Gardella, Franco Albini and Carlo Scarpa were just some of the most important leading figures in a season that provided plenty of work opportunities (Crispolti, 1982; Tafuri, 1982; Mulazzani, 1997; Morello, 1997 Polano, 2000; Basso Peressut, 2005; Lanzarini, 2016; Tofanello, 2017). The architectural installations of post-war Italy on the one hand attempted solutions that reflected the spatial qualities of the place – usually historical buildings – and on the other clarified the diversified ideas of some art historians on methods of display (Dalai Emiliani, 1982; Massa-Pontelli, 2019) and the beneficial intersections with the languages of contemporary art. In a galaxy of creations, the three decades immediately after the Second World War stand out for their complex interweaving of the scope of exhibitions and the permanent rearrangements of major Italian museums, with the former offering themselves as workshops to test new forms of representation to be applied in the latter (Mulazzani, 1997: 63).

The construction of temporary exhibition space was independent from the museum as it was directly connected to the polymorphic world that revolved around the concepts of "staging", furnishing, and the exhibition/extension of objects (Polano, 1997: 430). In this context, therefore, the definition of the compositional palimpsest may seem to be a freer manifestation of the architect's poetics, not devoid of the characteristics of experimentation.

Leonardo Savioli's work fits into this set of experiences (1917-1982) (Fanelli, 1966; Savioli, 1982). The installation of temporary exhibitions is one of the most interesting aspects in order to fully understand his multifaceted work in which a reciprocal influence between distinct disciplinary areas can be detected: from painting to architecture, architecture to exhibition design, furnishings to the city and vice versa.

Through his relations with the most important Florentine cultural institutions of the time and his role as a university professor at the Faculty of Architecture of Florence, Savioli became an undisputed protagonist of that season of Florentine exhibitions. The *Mostra della musica* (1950) and the *Mostra delle armi da caccia* (1970) represent the start and end of this activity, which culminated in the Sixties with the exhibitions *L'oggetto moderno in Italia* (1962), *L'opera di Le Corbusier* (1963), *Casa abitata* (1965) and *Firenze ai tempi di Dante* (1965) at the Certosa (Charterhouse) in Galluzzo (Florence). Each exhibition was marked by high level collaborations (Giulio Carlo Argan, Carlo Ludovico Ragghianti, Giovanni Michelucci, among others) (Rossari, 2010: 114-115; Carotti, 2015: 75-87) and had distinct characteristics, nevertheless within a cohesive logic that also became a tool for verifying and developing a methodology that followed Savioli's way of thinking (Vinca Masini, 1966: XIII). The chronological centrality – also in the context of the most general events that marked contemporary architectural culture – and the diversified contents of the project proposal (from the whole to the details, from the choice of materials to exploration of the spatial qualities of the container represented by an important historical building), certainly made the exhibitions *Firenze ai tempi di Dante* and *La Casa Abitata* episodes of great interest. The exhibition set up in Galluzzo, which borrowed its title from the famous volume by Robert Davidsohn of 1929, differs from the others Savioli curated due to the large number of pieces that were not original. This circumstance was seen as a weakness of the exhibition (Fanelli, 1966: 240), but in fact it helped to enhance the role of the staging in the overall palimpsest. It highlighted the architect's compositional thought process, which in this "temporary" dimension found an effective explanation: it created the conditions for complete contamination between graphics, art and architecture – we need only think of the assembly and then decomposition and reassembling of fourteenth-century images – in addition to the materialization of design themes such as neoplastic decomposition (such as white panels from which square red spotlights emerged) explored by the architect in his architecture with results that came to full fruition in the apartment building in Via Piagentina in Florence (1964).

The Dante centenaries of the 19th and 20th century left significant traces in Florence. The first, coinciding with the movement of the capital of the new unitary state to Florence (1865), saw the mobilisation of the city and numerous institutions. When the second centenary came around Italy, and

[1] The sentences by Italians writers and architects have been translated by Rebecca Milner.

Florence in particular, was engaged in extensive celebrations. On the basis of Law no. 162 of 20 March 1964, *Extraordinary state contribution to the expenses for the national celebrations of the 7th centenary of the birth of Dante; establishment of a Committee for the celebrations* (La Gazzetta Ufficiale, 89 of 10-4-1964) the Ministry for Public Education and representatives of the cities of Florence and Ravenna, designated by the respective municipal councils, were rightful members of the National Committee. The National Law of 1964 also sought to finance «initiatives aimed at guaranteeing and promoting the conservation of historical and artistic items linked to the Dante tradition». To this end, the Ministry allocated the considerable sum of three hundred million lire for the important events planned in various parts of Italy (Pica, 1966: 55). The city council of Florence had already prepared for the celebrations by the autumn of 1963 with a program focused on three main events: an international congress and two exhibitions dedicated to the poet (at the National Central Library and at the Charterhouse of Galluzzo)[2]. A Florentine committee was formed, chaired by Professor Raffaello Ramat of the University of Florence, former Councillor for Culture in the last La Pira council, which also included the Superintendent of the Florentine Galleries Ugo Procacci, and the Superintendent of Monuments Guido Morozzi, as well as the important art historian Roberto Longhi and the Rector of the Florentine university, Giovangualberto Archi (Mostra di Firenze ai tempi di Dante 1966). Restoration work on the Palazzo degli Studi, or Palazzo Acciaioli, at the Charterhouse of Galluzzo (Ruschi, 1989) started in 1955 and was led by Morozzi. The structure of the Charterhouse, in addition to the church and rooms used to accommodate the religious community, also included a large L-shaped complex (the Palatium) commissioned by Niccolò Acciaiuoli (1310-1365), founder of the structure, which remained incomplete upon the patron's death. Over the centuries, the building underwent several transformations, right up to the 20th century restorations by the Superintendence which were completed at the end of 1964 (Ruschi 1989: 31-33; Procacci, Morozzi, 1966: 3-12; Morozzi, 1979).

The decision by the Superintendence and the Committee to entrust the exhibition design to a figure incapable of falling into the trap of mimicry, a real risk in an exhibition on this subject and in a place so full of history, is very interesting. For some time the Florentine institutional environment had been sensitive to partnerships of this kind, as exemplified by Michelucci's collaboration with the Uffizi before and after the Second World War (Dulio, 2006: 165, 225; Monciatti, 2010: 38-86): the exhibition by Giotto and the arrangement implemented two decades later by Michelucci himself with Ignazio Gardella and Carlo Scarpa of some rooms in the Museum are experiences expressly mentioned by Savioli himself, a pupil of the architect from Pistoia, in his writings and in his own architecture. The Florentine institution responsible for conservation and protection was known for its sensitivity – certainly not unrelated to contemporary Italian culture – to dialogue between the ancient and the modern, which would also mark the interventions of Archizoom in Orsanmichele (1967) and in the Florentine Cathedral (reorganisation of the archaeological excavations of Santa Reparata, 1968) (Gargiani, 2007: 101).

The Charterhouse of Galluzzo allowed Savioli to explore – through the temporary installation project – the characteristics of the place and its vocation as a permanent museum space, according to a conceptual dimension of other places and other protagonists of his time, first and foremost Scarpa at Castelvecchio. The site, in itself significant in terms of its historical stratification and relationship with the surrounding landscape, became an essential element in the design equation and the design thinking was declared to be site-specific. The unprecedented relationships between content and container created by the exhibition design project highlight the complexities of the Charterhouse space. Savioli chose to explore these relationships to the full, bringing dialogue to an extreme conclusion: metal girders – suspended above the ground by tie rods – and raised platforms covered in red velvet were placed throughout the entire ground floor of Palazzo Acciaiuoli, highlighting unusual dimensional relationships and setting up novel views. The architect's aim was to have the observer participate in both continuous dialogue between the old and new and the works on display. A decisive factor in Savioli's installations was his well-known sensitivity as a painter and graphic designer, which allowed him to develop particular openness to the most advanced acquisitions of international contemporary art. The reference is to pop

[2] Archivio Storico del Comune di Firenze, sezione Belle Arti, 1965. The Florentine exhibition had a relatively large budget, above all in relation to the ambitious educational and illustrative project that shaped the exhibition: five billion lire, a substantial part of which went to pay the architect.

art, optical art, kinetic art, and the new American and French realisms: these contaminations were found specifically in the early work of Archizoom, a group of architects that also included students of Savioli (Gargiani 2007: 101). It was the architect himself who mentioned, as conceptual references in this sector of his art-making, the names of Eduardo Paolozzi (1924-2005), Nicholas Schöffer (1912-1992), Jean Tinguely (1925-1991) and Victor Vasarely (1906-1997) (Vinca Masina, 1965a: 40-48; Burkhardt, 2001: 139-142): important exponents of a season that unequivocally tended to investigate new relations between the "object" and the spectator, informed by a relationship that sought to foster integrative and active behavior towards one other.

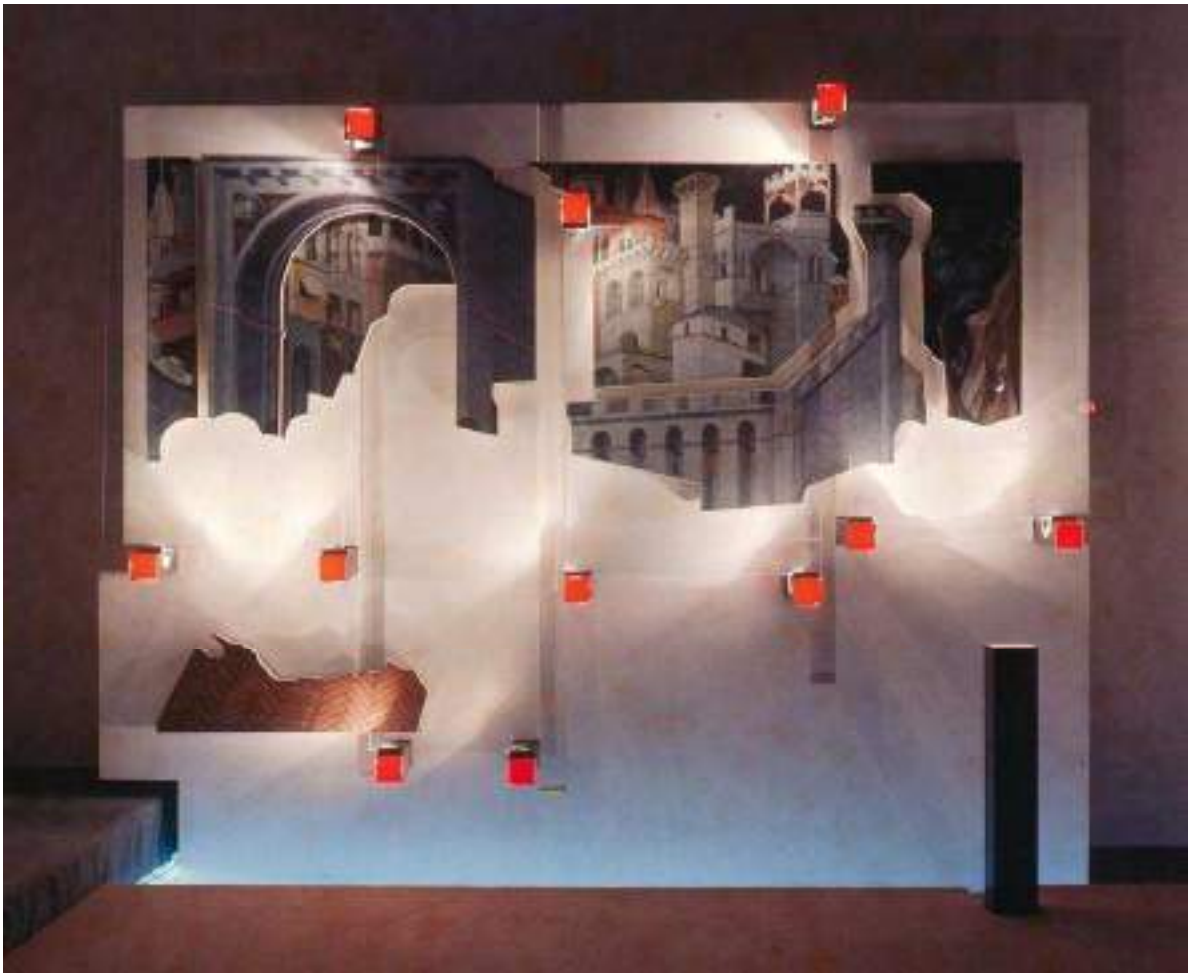

Fig. 1. Leonardo Savioli, *Firenze ai tempi di Dante [Florence at the time of Dante]*, 1965 (Archivio di Stato di Firenze, Fondo Leonardo Savioli).

Methods of creating a connection between the observer and the work of art in terms of emotional and intellectual participation, and the dynamic dialectic between past and present, were the main fields of investigation and experimentation of the work of Savioli, architect of ephemeral spaces. As already noted, this distinctive trait of the author was intertwined with the scope of reflections made by Umberto Eco in his book *Opera aperta* (1962), which presents articulated and polysemic research on the idea of the "opening" of art, proposed by contemporary poetics.

Eco taught at the Faculty of Architecture in Florence from 1966, and the publication of his book, together with the exhibition of American pop art artists at the Venice Biennale in 1964 and the educational and didactic experiences of courses by Leonardo Ricci and Leonardo Savioli, were undoubtedly significant elements in the

renewal of Italian architecture in the Sixties (Corsani, 2007: XIX; Tedeschi, 2010: 137-178; Tolu, 2010: 60-61). While dichotomous themes – often defined by the architect as a "short circuit" – were a distinct feature of Savioli's modus operandi, we must also note the attention and care underlying the development of technological detail, broken down into the accurate design and executive definition of the display supports, lighting fixtures, system of paths and didactic-illustrative tools.

Fig. 2. Leonardo Savioli, *Firenze ai tempi di Dante [Florence at the time of Dante]*, 1965 (Archivio di Stato di Firenze, Fondo Leonardo Savioli).

The architecture of the exhibition design, through this precise analysis – entirely consistent with the compositional thinking underlying the buildings that Savioli was planning at the time – became a «system of pertinent details» (Cetica**,** 1988: 12), that is, a congruent whole that helped to clarify the nature of the architecture with respect to the era and cultural horizon to which it belonged. «An aspect still to be usefully investigated – wrote Marco Dezzi Bardeschi in 1966 – and which I shall simply mention, is the indisputable technological perspective of Savioli's research understood as an instinctive fascination for the level of formativeness typical of the workshop product, whatever level it belongs to»

(Dezzi Bardeschi**,** 1966: 71). Savioli's was a personal interpretation of a primary component of making architecture of the "Florentine School" (Rossi Prodi**,** 2003: 56-57), which in his case intertwined with autobiographical archetypes.

Fig. 3. Leonardo Savioli, *Firenze ai tempi di Dante [Florence at the time of Dante]*, 1965 (Archivio di Stato di Firenze, Fondo Savioli).

At the Charterhouse of Galluzzo, a site to be given new meaning and its identity redefined in terms of its spatial, compositional, distributive and material elements, the exhibition project became a real performative artistic act: the performance was revealed where the two components – the display methods and the impressions re-established by the place and the spectators in a complex game of mirrors – emerge from its completion.

2. *La casa abitata [The inhabited House]* (1965)[3] (Lorenzo Mingardi)

Just as significant within the context of exhibitions designed by Savioli, but with an entirely different subject matter and intention from *Firenze ai tempi di Dante*, was *La Casa abitata*: in this case the interior architecture itself became the exhibition space (La casa abitata: biennale degli interni di oggi 1965; Savioli 1972; Vinca Masini, 1965b: 35). The exhibition, funded by an independent tourism agency, was set up in Palazzo Strozzi in April 1965 with the intention of becoming a sort of "pilot episode" of what at the time was thought could in future become the Florence biennale (Gastaldon, 2020), or an event at which to periodically take stock of the cultural situation of furnishing in Italy. The President of the exhibition was Giovanni Michelucci, supported on the authorizing committee by Tommaso Ferraris (secretary of the Milan Triennale), Pier Luigi Spadolini and Domenico Benini (chairman of the independent tourism agency). The exhibition sought to give an insight into the world of furniture in Italy, with the ambition of proposing an in-depth look at modern living: «We build many houses», declared Luigi Moretti, one of the participating architects, during the introductory press conference, «but we only test the floors, the pillars and the machine tools. We never test the human habitability of the houses built»[4]. Michelucci and Spadolini invited around twenty architects from different regions of Italy. Of those invited, the Castiglioni brothers, Carlo De Carli, Vittorio Gregotti, Vico Magistretti, Angelo Mangiarotti, Ettore Sottsass and Mario Zanuso from Milan; Edoardo Gellner from Venice; Luigi Moretti and Eduardo Vittoria from Rome; Michelucci's students, Giovanni Bassi, Emilio Isotta, Leonardo Ricci and Leonardo Savioli from Florence responded to the call[5]. Nothing that the market was influencing modern living and making Italian houses excessively anonymous (Vinca Masini 1965b: 31) the Florentine event stood in antithesis to the furniture exhibitions organized at the Triennale, which have always aimed to promote the economic aspect of the relationship between design and production (Pica, 1957; Santini, 1960). Based on input from Michelucci, *La Casa abitata* was to present solutions that considered domestic space as a starting point for in-depth reflections on the condition of human living in the Sixties in Italy. The organizing committee did not ask for the help of architects as furnishing professionals, but as the most suitable figures to «provide an example of an inhabited house», said Spadolini. «It is not a given that to "make" a house you need an architect. So much so that for the next biennial Professor Michelucci considered also calling on anyone – workers, employees, professionals – to set up a pre-established environment in their own way. It would be interesting to interpret these answers. The exhibition should be considered as a sort of "test." In this respect, the biennial nature of the initiative is important as it allows us to verify the problem of the inhabited house every two years» (La Nazione, 7 March 1965: 4).

Despite Michelucci and Spadolini's assumption, the proposals of the Milanese designers were in line with the most recent exhibitions at the Triennale and therefore imbued, in the wake of the economic boom of the early years of the decade, with great market optimism: not fully addressing the relationship between user and home (Borsi, 1965: 28). The Castiglioni brothers, Magistretti, Zanuso, De Carli and Mangiarotti, respecting but not dialoguing with the spaces of Palazzo Strozzi, proposed solving the problem of living through the use of mass-produced products or with prototypes that would soon be released to market. Each architect invited to the exhibition interpreted the theme given to them and the relationship with the historic building in a very different way. Luigi Moretti, for example, was not interested in market problems and set up a faithful replica of his office in Rome which – with its artisan-made wooden furniture and Baroque and contemporary works of art – fitted perfectly into the austere space of the Florentine building (Muntoni, 2009: 43-60: 53; Lanzarini 2010: 249; Rostagni, 2007: 288-289). Compared to the proposals of the Milanese and others, substantially based on indulging the narcissistic satisfaction of having brought the best of their coeval production to Florence, the

[3] The sentences by Italians writers and architects have been translated by Rebecca Milner.

[4] The reasons for the exhibition were reiterated at the Palazzo Strozzi conference on 23 April, *La funzione della casa oggi*, chaired by Alessandro Bonsanti. ASFI, *Fondo Leonardo Savioli*, Lettere a Savioli, "La Casa abitata", item 5.

[5] «A limited number of the most important Italian architects will be invited to the exhibition, and I would be delighted if you would kindly attend. Should you wish to participate, I would be grateful if you would swiftly return the attached form by post, also indicating the type of setting you wish to create so that the relevant space can immediately be assigned to you», Letter from Giovanni Michelucci to those invited, Florence 14 December 1964. ASFI, *Fondo Leonardo Savioli*, Lettere a Savioli, "La Casa abitata", item 5.

contribution to the event made by Leonardo Ricci and Leonardo Savioli was entirely different. The two Florentine men presented very different projects from a formal point of view, but they both fully grasped the spirit of the exhibition: in their installations it is clear that modern architects can no longer afford to think as a simple designer/interior designer, but instead, with proposals that embrace broader problems, they must experience what it means to live in community and therefore live in a home. Michelucci's two students present prefabricated systems with no furnishings: the functions of living (kitchen, bathroom, etc.) were integrated into the architecture (Borsi 1965: 28). Ricci presented *Spazio vivibile per due persone* (Living space for two people), in which a series of industrially produced cells offer primordial shelters for people escaping the unsustainable pressure of modern technology: the architect's installation almost seems to foreshadow the primordial and apocalyptic settings of the introduction to the film *2001 A Space Odyssey*, released in cinemas three years after the exhibition had been set up. Savioli presented *Una cellula per una casa minima* (A cell for a minimal house), which was awarded the "Golden Seal" for the best exhibit in the exhibition[6]. «This hypothesis of inhabited space – wrote Savioli – elicited in this way, in which the user plays a part in the "project", requires a different structure of the space itself, a different idea of size, dimension, function and form; and therefore requires a different attitude and openness to the project. Which mainly consists of identifying first and foremost a series of appropriate operations which, delivered to the user»[7]. The architect in fact produced some illustrations for the installation report explaining to users how to fully experience the multiple uses of the cell-home. «What I produced – Savioli told the architectural historian Franco Borsi – was a proposal rather than an actual installation. In the sense that I did not intend to produce real furnishings, a setting, a living room, dining room, bedroom, but rather to propose a housing cell as a whole. So here there are suggestions for a living room as a whole, a dining room and the upper rooms: the sleeping area. But the idea essentially started with this: there could be a cell that could be inserted into any floor of a building» (Borsi 1965: 28). The cell has fixed dimensions and certain parts of it are «made of prefabricated elements: (bathroom block, stackable tower kitchen block, stair block etc.). The internal structures are made of ordinary masonry or additional prefabricated elements in order to allow the greatest possible freedom inside. The inside of each cell can be modified according to the different needs of the user who, respecting only the fixed prefabricated elements, is otherwise free to move them as deemed most appropriate for their needs [...] The internal structure of the cell is designed to form a sort of envelope where the furniture and furnishings are integrated into a single space: only a few objects of daily necessity are placed in this space which should therefore be essential and free of any kind of waste»[8].

The exhibition was organized at a particular moment for Italian urban planning, in which operators (political and cultural) were constantly formulating new legislative proposals that could provide organic tools to the architects planning our cities (Sullo, 1964; Campos Venuti, 1967). In the first half of the Sixties, above all in Florence, where a new master plan was approved by Edoardo Detti a few years prior to the exhibition (1962) all events, whether they concerned design objects, interiors etc., had to relate to the city in some way, at least in their original intentions (Savioli, 1953: 81-96; Zoppi, 1982: 29-37; Paolini, 2014). In fact, according to Michelucci, the exhibition should have encouraged architects to think very broadly about where to place the proposed interiors: «Which city is right for this house? If we do not find the city to be an element that is homogeneous with the home and not an element independent from the home, we have not achieved anything yet» (Borsi, 1965: 28). At the exhibition opening Michelucci stated: «The preparation work for the exhibition has revealed high cultural interest which gives rise to considerations that go beyond the limits of taste to invest in building, social, human and family life issues, even addressing the underlying problem of house-city inseparability. From this we can understand how today even the smallest expression of architecture touches on problems that affect the life of the city and its population in addition to those concerning the industrialization of the life or death of craftsmanship» (La Nazione, 7 March 1965: 4). Savioli followed the thinking of his master

[6] Other prizes were awarded to Edoardo Vittoria for the furnishings of the "playroom" and Marco Zanuso for the "Lambda chair". The selection board was made up of Giorgio Batini, the architect Paolo Chessa, Gillo Dorfles, the sculptor Agenore Fabbri, and Prof. Michelangelo Masciotta. ASFI, *Fondo Savioli*, La Casa abitata, Materials for projects, item 5. The results were published in La Nazione of 25 April, p. 4.

[7] Leonardo Savioli, *La città di domani*, typed text. ASFI, *Fondo Savioli*, La Casa abitata, Materials for projects, item 5.

[8] Leonardo Savioli, *Cellula per una casa minima*, project report, typed text. ASFI, Fondo Leonardo Savioli, Materials for projects, box 5, item 220.

Michelucci: furnishings encompass a field of knowledge and actions that certainly cannot be limited to the domestic space; the cell is only a micro-part of a much more complex system that forces the architect to study the model also from an urban point of view. The house is an element of a larger integrated macrostructural system that becomes a city itself. In this respect, Savioli is perfectly in line with the traditional urban value of the historic Florentine Palace (and with the case of Palazzo Strozzi in particular) (Elam, 1985: 105-135) which is never an accurate intervention, but rather a work that seeks to change the dynamics of an entire part of the city fabric (Opus incertum, 2007; Morolli, 2013).

Savioli arrived at Palazzo Strozzi with a job that also stemmed from the need to verify the urban planning hypotheses that he was testing in the same months with the students of his courses at the Faculty of Architecture in Florence, namely proposals for macrostructural systems which, hooked up to vast frameworks, accommodate all the functions of a city or a part of it (Maki, 1964). In the cell project of *La Casa abitata* some themes were therefore read between the lines and then developed in a much more disruptive way by a group of students on his courses – Adolfo Natalini above all – who then made their mark on the Florentine and Italian scene in the second half of the Sixties and the first half of the Seventies (Mastrigli, 2016).

As mentioned, for Savioli the installation project always followed a path in which the observer is never a passive subject but rather interacts and participates in the story. One of the main purposes of the exhibitions curated by the architect was in fact not only to excite viewers, but also to make them aware that they themselves are the main protagonists of the story. In fact, in the duplex cell Savioli allowed users to station themselves at an unprecedented height compared to those who visited Palazzo Strozzi under normal conditions: from the sleeping area of the cell-accommodation the corbels were within reaching distance, and it also provided a privileged view of the vaults of the ceiling of one of the rooms in the building. Even when faced with experiments such as the cell of *La Casa abitata* that looked to the contemporary world of English and Japanese design, for Savioli the architectural history of Florence was an essential element in his journey as an architect: his installations could not do without continuous dialogue with the space designed by the architects of the city's glorious past.

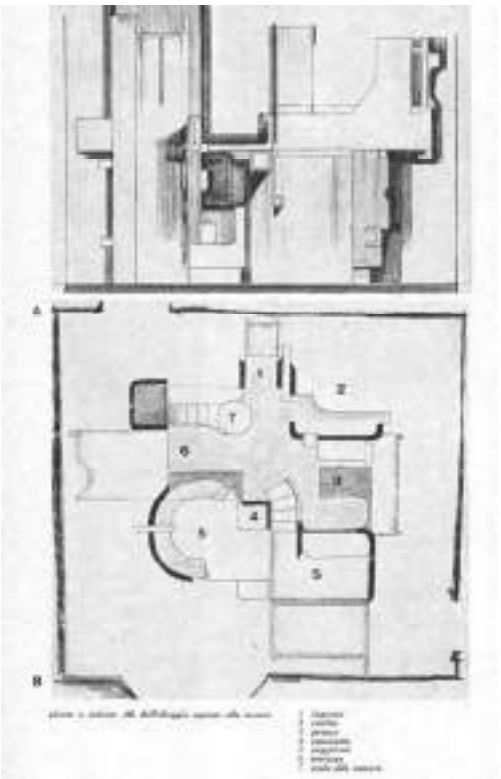

Fig. 4. Leonardo Savioli, *La casa abitata [The inhabited House]*, 1965. (Domus, 426, 1965, 44)

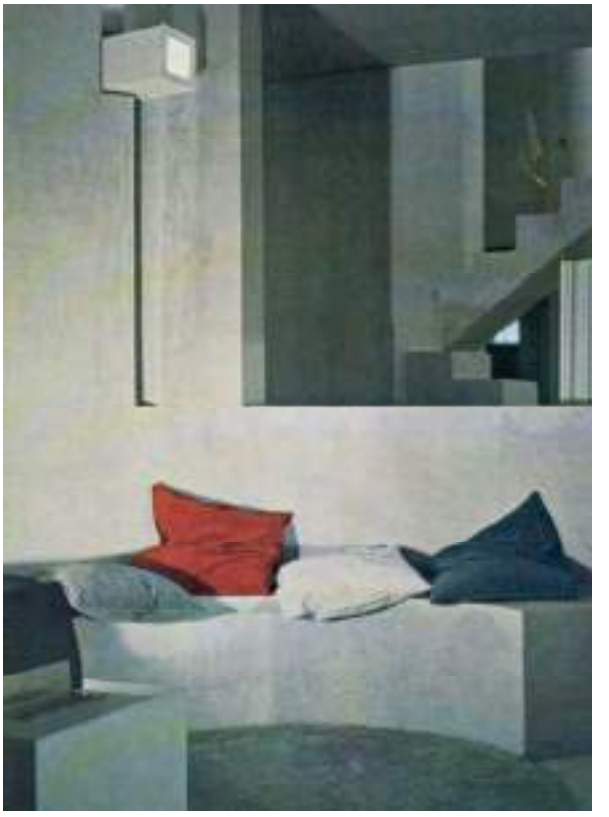

Fig. 5. Leonardo Savioli, *La casa abitata [The inhabited House]*, 1965. (Domus, 426, 1965, 45)

Fig. 6. Leonardo Savioli, *La casa abitata [The inhabited House]*, 1965. (Domus, 426, 1965, 45)

References

Basso Peressut, L., 2005. Il Museo Moderno. Architettura e museografia da Perret a Kahn. Lybra Immagine, Milan.

Borsi, F., 1965. La Casa abitata. La Tribuna, 26 March.

Burkhardt, F., 2001. Le avanguardie fiorentine dell'anni sessanta e settanta, in *Architetture del Novecento. La Toscana*, Godoli, E., (Ed.), pp.139-142, Edizioni Polistampa, Florence, Italy.

Campos Venuti, G., 1967. *Amministrare l'urbanistica*, Einaudi, Torino, Italy.

Carotti, L., 2015. La mostra di Le Corbusier a Palazzo Strozzi. Il progetto di allestimento, in *Ragghianti e Le Corbusier*, in: Caccia Gherardini, S., Eccheli, M.G., Mecca, S., Pellegrini, E., (Eds.), pp.75-88, DIDApress, Florence, Italy.

Cetica, P.A., 1988. Introduzione, in *L'architettura nei dettagli*, Legnante, E., Laurìa, A. (Eds.), pp.9-12, Alinea, Florence, Italy.

Corsani G., 2007. Premessa, in *La Facoltà di architettura di Firenze. Fra tradizione e cambiamento*, conference Proceedings (Florence 2004), Bini, M., Corsani, G., (Eds.), XV-XXVI, Firenze University Press, Firenze, Italy.

Crispolti, E., 1982. Il Futurismo negli anni Trenta, in *Gli anni trenta: arte e cultura in Italia*, exhib. cat. (Milan 1982), Bortolotti, N., (Ed.), pp.178-180, Comune di Milano, Milano, Italy.

Dalai Emiliani, M., 1982. Musei della ricostruzione in Italia, tra disfatta e rivincita della storia, in *Carlo Scarpa a Castelvecchio,* Magagnato, L., (Ed.), pp.149-170, Edizioni Comunità, Milano, Italy.

Dezzi Bardeschi, M., 1966. Leonardo Savioli, una metodologia di progettazione, in *Marcatrè* 26/29, pp.37-71, ed. Lerici, Milano, Italy.

Dulio, R., 2006. Allestimento della mostra di Giotto agli Uffizi, 1937; Allestimento di alcune sale degli Uffizi 1953-60, in *Giovanni Michelucci (1881-1990),* Conforti, C., Dulio, R., Marandola, M. (Eds.), pp.165, 225, Electa, Milano, Italy.

Elam, C., 1985. Piazza Strozzi: Two drawings by Baccio d'Agnolo and the problems of a private Renaissance square, in *I Tatti Studies* 1, 105-135, The Harvard University Center for Italian Renaissance Studies, Florence, Italy.

Fanelli, G., (Ed.), 1966. *Leonardo Savioli*, entries 82-84, pp.100-101, Edizioni Centro Proposte, Florence, Italy.

La Gazzetta Ufficiale, 1964. *La Gazzetta Ufficiale* 89, 10 April 1964, Italy.

Gargiani, R., 2007. *Archizoom Associati 1966-1974. Dall'onda pop alla superficie neutra*, Electa, Milano, Italy.

Gastaldon, G., 2020. *Carlo Ludovico Ragghianti e il Museo Internazionale d'Arte Contemporanea di Firenze: storia di una visione per una città*, Fondazione Ragghianti, Lucca, Italy.

La casa abitata, 1965. *La casa abitata: biennale degli interni di oggi*, exhib. cat. (Florence 1965). Arti grafiche Merioni, Lissone, Italy.

Lanzarini, O., 2010. «Mi attrae usa sconvolgermi insegnandomi»: gli allestimenti di Luigi Moretti, in *Razionalismo e trasgressività tra barocco e informale*, exhib. cat. (Rome 2010), Reichlin, B., Tedeschi, L. (Eds.), pp. 238-251, Electa, Milano, Italy.

Lanzarini O., 2016. «Arte al servizio di un'idea». Il ruolo dell'"Esposizione dell'Aeronautica italiana" (1934) nel dialogo tra arte, architettura, politica e pubblico, in *Musei e mostre tra le due guerre*, Cecchini, S., Dragon, P., (Eds.), Studies on the Value of Cultural Heritage 14, pp.739-786, EUM - Edizioni Università di Macerata, Italy.

Maki F., 1964. *Investigations in collective forms*, Washington University, St. Louis, USA.

Massa, S., Pontelli, E., 2019. *Mostre permanenti. Carlo Ludovico Ragghianti in un secolo di esposizioni*. Fondazione Ragghianti, Lucca, Italy.

Mastrigli, G., (Ed.), 2016. *Superstudio. Opere (1966-1978)*, Quodlibet, Macerata, Italy.

Monciatti, A., 2010. *Alle origini dell'arte nostra. La mostra giottesca del 1937 a Firenze*, Il Saggiatore, Milano, Italy.

Morello, P., 1997. Opere e modelli storiografici, in *Storia dell'architettura italiana. Il secondo Novecento,* Dal Co, F., (Ed.), Pp.392-417, Electa, Milano, Italy.

Morolli, G., 2013. *Gondi: una dinastia fiorentina e il suo palazzo*, Polistampa, Firenze, Italy.

Morozzi, G., 1979. *Interventi di Restauro*, Bonechi, Firenze, Italy.

Mostra di Firenze, 1966. *Mostra di Firenze ai tempi di Dante 1966*, exhib. cat. (Florence 1965), Giunti Barbera, Firenze, Italy.

Mulazzani M., 1997. Lo spazio interno come spazio architettato, in *Il museo italiano. La trasformazione degli spazi storici in spazi espositivi. Attualità dell'esperienza museografica degli anni Cinquanta*, Hiber, A., (Ed.), pp.59-65, Lybra Immagine, Milan, Italy.

Muntoni, A., 2009. Luigi Moretti nella storia e nella critica, in *Luigi Moretti architetto del Novecento*, conference proceedings (Rome 2009), Bozzoni, C., Fonti, D., Muntoni, A., (Eds.), pp.43-60, Gangemi, Rome, Italy.

Opus incertum, 2007. *Palazzi fiorentini del Rinascimento*, 4, Firenze University Press, Firenze, Italy.

Paolini, F., 2014. *Firenze 1946-2005. Una storia urbana e ambientale*, Franco Angeli, Milano, Italy.

Pica, A., 1957. *Storia della Triennale. 1918-1957*, Edizioni del Milione, Milano, Italy.

Pica, A, 1966. Settecent'anni dalla nascita di Dante: due mostre, in *Domus*,435, pp.101-105, Editoriale Domus, Milano, Italy.

Polano, S., L'arte dell'allestimento temporaneo. Mostrario italiano, in *Storia dell'architettura italiana. Il secondo Novecento*, Dal Co, F., (Ed.), pp.418-429, Electa, Milan, Italy.

Polano, S. (Ed.), 2000. Mostrare. *L'allestimento in Italia degli anni Venti agli anni Ottanta*, (first ed. Milan 1988), Lybra Immagine, Milano, Italy.

Procacci, U., Morozzi, G., Il Palazzo degli Studi nella Certosa del Galluzzo, in *Bollettino degli Ingegneri* 273, pp.3-12, Italy.

Rossari, A., 2010. Ragghianti e gli architetti, in *Luk*, 16, pp.113-126, Fondazione Centro Studi sull'Arte Licia e Carlo Ludovico Ragghianti, Lucca, Italy.

Rossi Prodi, F., 2003. *Carattere dell'architettura toscana*, Officina, Roma, Italy.

Rostagni, C., 2007. *Luigi Moretti 1907-1973*, Electa, Milano, Italy.

Ruschi, P., 1989. *Entry: La Certosa presso Firenze. In: Archivi dell'aristocrazia fiorentina*, exhib. cat. (Florence 1989), pp.31-33, Acta, Firenze, Italy.

Santini, P.C., (Ed.), 1960. *Catalogo XII Triennale di Milano*, Milano, Italy.

Savioli, L., 1953. Il nuovo piano regolatore, in *Urbanistica*, 12, pp.81-96, INU, Torino, Italy.

Savioli, L., 1972. *Problemi di architettura contemporanea*, G&G editrice, Firenze, Italy.

Sullo, F., 1964. *Lo scandalo urbanistico*, Vallecchi, Firenze, Italy.

Tafuri, M., 1982. *Storia dell'architettura italiana. 1944-1985*, Einaudi, Torino, Italy.

Tedeschi, L., 2010. Algoritmie spaziali. Gli artisti, la rivista "Spazio" e Luigi Moretti, 1950-1953, in *Razionalismo e trasgressività tra barocco e informale*, exhib. cat. (Rome 2010), Reichlin, B., Tedeschi, L., (Eds.), pp.137-177, Electa, Milan, Italy.

Toffanello, M., 2017. Un itinerario fra le mostre degli anni Trenta, in *All'origine delle grandi mostre in Italia (1933-1940)*, Tofanello, M., (Ed.), pp. 5-28, Il Rio dell'Arte, Mantova, Italy.

Tolu E., 2010. Ripercorrendo la vicenda umana e artistica di Leonardo Savioli, in *La pittura e il disegno di Leonardo Savioli*, exhib. cat. (Monsummano 2010), Paolini, C., Tolu, E., (Ed.). pp.60-61, edizioni Polistampa, Firenze, Italy.

Vinca Masina, L., 1965a. Arte programmata, in *Domus,* 422, 40-48, Editoriale Domus, Milano, Italy.

Vinca Masini, L., 1965b. La casa abitata, in *Domus,* 426, 29-56, Editoriale Domus, Milano, Italy.

Vinca Masini, L., 1966. Leonardo Savioli, in *Leonardo Savioli*, Fanelli, G. (Ed.), XIII-XVI, Edizioni Centro Proposte, Firenze, Italy.

Savioli 1982. *Leonardo Savioli: grafico e architetto*, exhib. cat. (Faenza 1982), Centro Di, Firenze, Italy.

Zoppi, M., 1982. *Firenze e l'urbanistica: la ricerca del piano*, Edizioni delle Autonomie, Roma, Italy.

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Tracing a History of Etruscan Art Exhibitions

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Abstract

This research aims to identify and retrace the main stages of the dissemination of Etruscan civilization in the museographical field, from the formation of the first collections in archaeological museums, focusing on the considerable organization of temporary exhibitions in Italy and Europe.
The knowledge of the Etruscan civilization and its myth develops from the second half of the twentieth century, following a clear museological and museographical project that determined a conspicuous part of its flowering. In the Eighteenth century the foundations were laid for a popular development of Etruscology.
It was in the Nineteenth century that the research found its full affirmation not only in Italy but in Europe. While public museums have expanded and modified their collections, a significant intervention in the dissemination of the Etruscan myth will be carried out, from the 1950s onwards, by the copious temporary exhibitions that follow persistently until the present day.
This essay focuses in particular on temporary exhibitions that developed the diffusion of the main features of this ancient civilization since the end of the Second World War.
Etruscan art appears in collective exhibitions related only to specific themes until the Thirties, while from the Fifties it acquires its own autonomy and complexity in the wide exhibition field.
If the museums are more rooted in the territory and in the excavation sites, the temporary exhibitions allow the dissemination of the Etruscan civilization through stories that are always new and widespread in different cities. Starting from the analysis of the first expositions and installations, the essay traces some of the main stages of the most meaningful exhibitions that led to the widely acclaimed response of this civilization nowadays.

Keywords: Temporary Exhibition, Etruscan Art, Cultural Heritage

The aim of the essay is to identify the main stages of the diffusion of Etruscan civilization in the museographical field, starting from the creation of the first collections in archaeological museums to concentrating on the considerable organization of temporary exhibitions. The knowledge of the myth of the Etruscan civilization developed from the first half of the Twentieth Century, following a clear museological and museographical project which determined a large part of its dissemination. This paper will draw special attention to temporary exhibitions as an essential category to understand changes, choices, and evolution on this topic. The aim of the research is to analyse a series of case studies which are particularly effective in extrapolating, describing and interpreting techniques and languages of expositions.

Although interest in the Etruscan civilization flourished during the Renaissance period, the trend of Etruscan art collectors witnessed considerable development in the Eighteenth Century accompanied by intense excavations and recovery of archaeological materials. Against this background, the first great popular works were written in the form of treatises accompanied by rich graphic reproductions: *De Etruria regali* by Thomas Dempster (Florence 1723), *Museum Etruscum* by Anton Francesco Gori (Florence 1737) and *Della nazione etrusca e degli Itali primitivi* by Scipione Maffei (Verona 1739). These are the first works that contain not only texts but also feature many illustrations of the finds. The first "museums", in the literal sense of the term, seem to be those presented by Francesco Gori, the *Museum Etruscum*, the *Musei Guarnacci Antiqua Monumenta* (1744) and the *Museum Cortonense* (1750). These were real catalogues that described the archaeological treasure of the collections and excavations. Gori was also the first to visit and report on one of the first public museums that exhibited materials from local excavations during a trip to Volterra (Camporeale, 2004: 26)[1]. In the same years two of the most important Academies of Tuscany were born: the Accademia Etrusca of Cortona (1727) and the *Società Colombaria* of Florence (1735) with the aim to disseminate the studies and writings on the Etruscan world. The figure of the noble abbot Mario Guarnacci emerged among the scholars. In 1738 he began some excavations near the "Portone" necropolis with his brothers Pietro and Giovanni leading to the constitution of the museum of Casa Guarnacci, organized in the two rooms on the ground floor of their palace in Piazza San Michele (the collection with the library was later moved to the Maffei Palace). The continuous discoveries and private collections created the need to gather materials and make them public in a suitably designed setting such as a museum. In 1761 Guarnacci added his own collection to canon Franceschini's, which he had visited during his trip to Volterra, defining one of the oldest public museums in Europe: the *Museo Etrusco Guarnacci*[2]. In the Eighteenth Century the foundations were laid for a popular development of Etruscology, but it was in the Nineteenth Century that the research became established not only in Italy but also in Europe. Many discoveries and new excavations formed the basis of the most important units of the Etruscan collections of European museums: British Museum in London[3], Louvre in Paris, Hermitage Museum in Saint Petersburg, Staatliche Museen in Berlin. The *Etruscan Tombs* exhibition, particularly, played a remarkable role in the diffusion of Etruscan history in the European context. The exhibition, organized by the Campanari family in January 1837 at 121, Pall Mall in London, had a considerable success, not only because it was the first exhibition of this kind, but mainly for the curatorial choices that presented, next to the classic subdivision by types of objects, the reconstructions of the tombs with reproduced wall paintings, doors, objects hanging on the walls, and sarcophagi with lids left slightly open. An attempt was made to reconstruct the experience of the archaeologist, arousing astonishment and enthusiasm with reports of fabulous discoveries that inevitably foresaw the disappearance of dead bodies, a few minutes after the opening of the tomb, once they came into contact with the air. Although the reconstruction of environments was a fake, it is important to highlight the need to show real contexts (Swaddling, 2018). The exhibition also had repercussions in Italy where, in the same period, the Museo Granducale of Florence –

[1] The origin of the archaeological museum of Volterra dates back to 1731 following the donation by canon Franceschini of numerous Etruscan finds from the Portone necropolis. An important addition to this collection was made in 1761 by the gift of the noble prelate Mario Guarnacci. The first seat of the museum was in the current Palazzo dei Priori where it remained until 1877 when it was transferred to the present-day headquarters inside the Palazzo Desideri Targassi.

[2] The museum preserves important Etruscan works from Volterra and its territory that testify the evolution of the city from the Villanovan Age (IX Century BC) up to the annexation in Rome (I Century BC) and its development in the subsequent Roman imperial period. The museum is famous for its important collection of Etruscan cinerary urns.

[3] We remember the role played by the Campanari family.

which later became the current Archaeological Museum of Florence –, the Gregorian Etruscan Museum[4] and the Etruscan-Roman Museum of Perugia opened their doors. In the second half of the Nineteenth Century the excavation activities in the Etruscan necropolis became very intense (Roselle, Chiusi, Sovana, Arezzo, Orvieto, Tarquinia) and led to the birth of the first great Italian museum complexes: the Central Etruscan Museum of Florence (1870) showing Etruscan finds or exhibits from the grand-ducal collections according to a typological criterion and those coming from new discoveries according to a topographic criterion: Museo Nazionale di Villa Giulia in Rome (1889); the museum of Tarquinia, Chiusi, Perugia, Bologna and Ferrara. At the beginning of the 20th Century scientific research was completed with the birth of the first Standing Committee for Etruria (1925) that organized the first national conference on the theme and later evolved into the Institute of Etruscan and Italian Studies (1932).

Fig. 1. *Arte e Civiltà degli Etruschi* Exhibition, 1955. (Mosca Baldessari Private Archive, Milan; in process of pending in Luciano Baldessari Found, Mart, Rovereto; signature MART_AAE_scan252).

The Italian catalogue was edited by Massimo Pallottino, who declared how the results of recent discoveries and the progress of critical research on the Etruscan civilization gave rise to the desire to summarize, through an exhibition, the most important aspects of the artistic heritage that had been collected. An article by Antonio Frova published in the magazine "Werk" in 1957 contains some comments on the exhibition layout designed for the different cities: «The Etruscan exhibition was organised through various implementations […] Those held in Zurich and The Hague were sober, clean, but a little sacrificed as to space; the exhibition in Paris at the Louvre was a model of bad taste. It seemed to bring together an exemplification of all that should never be done, an expression of an archaeological taste dating back to the last century. […] The show of Baldessari in Milan will remain as an example of rigour and purity»[5] (Frova 1957: 355).

[4] The Gregorian Etruscan Museum was inaugurated in 1837. Although the arrangement was far from being definitive, both for the exhibits and for the number of rooms intended to accommodate them, it presented materials detached from the original relics, but also exhibited a reconstructed tomb.

[5] The quotations of the texts in the original Italian language have been translated by the author.

Fig. 2. *Arte e Civiltà degli Etruschi Exhibition*, 1955, Floorplan (Luciano Baldessari Archive, Department of Design, Politecnico di Milano; signature ALB_AAE_D001).

Fig. 3. *Arte e Civiltà degli Etruschi* Exhibition, 1955 (Mosca Baldessari Private Archive, Milano; in process of pending in Luciano Baldessari Found, Mart, Rovereto; signature MART_AAE_scan268).

Surely Italy in those years was devoting considerable attention and research in the museographic and staging field, as described in the introductory essay by Agnoldomenico Pica to the volume edited by Roberto Aloi on exhibition design (1960). The text offers a clear reading of the changes in the exhibitions between the 1920s and 1940s through a significant historical survey: «At the beginning of the 20th Century, but more clearly after the First World War, exhibitions changed not so much in terms of style, taste, or order, but more about their most intimate sense» (Aloi, 1960: 5). The exhibition of Etruscan art and civilization, organized at the Palazzo Reale (Milan) and designed by the architect Luciano Baldessari, fits well within this critical trend (Bardi, 1931; Mazzucchelli, 1934; Giolli, 1938; Esposizioni, 1941).

Fig. 4. Franco Minissi, Villa Giulia à Rome (Aujourd'hui. Art et Architecture, 8, June 1956, 34).

The architect creates real sets that can arouse different emotions in the visitor. The setting up of the historical section was entrusted to architect Franco Minissi[6] who, at the same time, was dealing with the huge work of rearrangement of the Etruscan Museum of Villa Giulia in Rome. The intervention represents a second significant element in the definition of the exhibition choices of archaeological finds and was focused in particular on the transformation of the interior space to improve the museum distribution and increase the exhibition area, and on radical changes in the setting. The "showcase" became the central object of the path, greatly modified in its structure and conformation. The project was criticised but there

[6] Franco Minissi, architect and museographer (Viterbo 1919 - Bracciano 1996). He was involved in the restoration and conservation of historical and artistic heritage and museography. In addition to carrying out an intense project activity in this area, he was a professor of Set-up and museography and revitalization and adaptation of ancient buildings at the University of Rome "La Sapienza". Among his works: Villa Giulia Museum, Roma (1954-60); Antiquarium in the Villa Aurea in Agrigento (1960); Barche Faraoniche Museum, Gizah (1960); Etruscan Museum, Tarquinia (1962-67); Archaeological Museum in Himera (1970-78); Tesoro di San Pietro in Vaticano Museum (1975); New archaeological Museum Paolo Orsi, Siracusa (1970-81); Palazzo Della Penna Moden Art Museum, Perugia (1980-84); Palazzetto Venezia, Rome (1990).

were also supporters such as Bruno Zevi who, regarding the substantial contribution of transparency with the windows, objected: «[…] What was the capital to lay on? Perhaps on a false Etruscan wall in stone? Yesterday, reinforced concrete, today plastics or security glass are a source of insecurity for some people. But fortunately, not for everyone… There are good reasons to use perspex: it isolates the archaeological piece without arbitrary interventions; it allows to see the piece from all sides; it is light, modest matter, which nullifies itself thus facilitating a direct relationship between the exhibits and the space-environment that encloses them» (Zevi, 1955).

The Museum of Villa Giulia was the first of a territorial exhibition system on the Etruscan civilization. In the following years new collections opened: the archaeological museum of Cerveteri (1967) and the museum of Civitavecchia (1971), again set up by Minissi, finally the museum of Vulci (1975) and that of Civita Castellana (1977).

Fig. 5. Francesco Venezia, *Gli Etruschi a Palazzo Grassi* Exhibition (Casabella 686, February 2001, 7).

If the museums are more rooted in the territory and in the places of the excavations, the temporary exhibitions allow the dissemination of the Etruscan civilization through ever-new stories that reach as many cities as possible. Thus in 1966 a new travelling exhibition was proposed, passing through Vienna, Stockholm, Turin and Fiesole. In June 1967 *Arte e civiltà degli Etruschi* arrived in Turin at Palazzo dell'Accademia delle Scienze, an exhibition linked to the lucky discoveries of that decade. Meanwhile in Santa Barbara, California, *Etruscan Art from West Coast collections* was set up, curated by the University of California, and in Britain, at the Worcester Art Museum, *Master pieces of Etruscan Art* made its debut. These first exhibitions paved the way for other major events: the great *Etruscan Project* of 1985, the travelling exhibition *Les Etrusques et l'Europe* (Grand Palais, Paris and Altes Museum, Berlin 1992), the *Etruscan exhibition* (Palazzo Grassi, Venice 2000) and the new project of a Museum of Etruscan art (Milan 2020). The *Etruscan Project* represented an exceptional event that involved all the Etruscan centres and museums of Tuscany, but also the regions of Lazio, Umbria, Campania, Emilia Romagna and Lombardy, as essential parts of the territory occupied by the Etruscans. Among the exhibitions we shall mention those held in the Tuscan capital: *Civiltà degli etruschi*, curated by Mario Cristofani and set up in the Archaeological Museum by Adolfo Natalini with David Palterer and Giancarlo Mazzanti and *Fortuna degli etruschi* curated by Franco Borsi, Gabriele Morolli and Omar Calabrese in the Ospedale degli Innocenti with installation by Piero Castiglioni. Here the set-up themes became more complex and broke away from the lyrical aura of the first exhibitions of the Fifties. The travelling exhibition *Gli Etruschi e l'Europa*, curated by Massimo Pallottino passing through Paris and Berlin (1992), aimed to identify and illustrate the relationships between the Etruscan civilization and the cultural

experiences of the European world, trying to understand those elements that could have shaped the processes that led to European civilization.

The Etruscan exhibition organized at Palazzo Grassi in 2000 and set up by Francesco Venezia marked a return to the great Italian exhibition tradition: «Setting up is essentially the art of handing out; showing with measure and giving with kindness require attention and care» (Venezia 2001: 6). The atrium represents the culmination of the Venice exhibition research combined with Etruscan themes and languages: the atrium – the court of Palazzo Grassi – became a well of light enclosed in a volume that recalls the characters of the underground Etruscan space. The theme of the underground space typical of the Etruscan construction world is also found in the project for a museum of Etruscan art in Milan (2020), created by the will of the Luigi Rovati Foundation, and that represents an innovative piece in the museography history of this civilization[7]. The architect Mario Cuccinella designs a concave and convex space that recalls the tombs of Cerveteri, a space that envelops the visitor looking for a contact. Finally, as a last museographical approach, mention should be made of the interventions that in recent years have been dealing with the re-establishment of historical museums such as the Gregorian Etruscan Museum, that in 2010 reopened the collection of vases whose ordering was edited by Maurizio Sannibale, and the Museum of the Etruscan and Roman City of Cortona (Italy) set up on a scientific project of the Archaeologist Mario Torelli. This reconstruction shows the need and the deep interest to draw the exhibition history that characterized the Etruscan civilization from the first forms of collecting to the present day. A necessary reconstruction, because it is a core part of its existence: not only in terms of content but also for the choices of museums and exhibitions that have contributed to the development of the themes of exhibiting with the progress of the archaeological discipline. There is, in fact, no research to date that brings together themes and discoveries of the Etruscan world with their dissemination through exhibitions.

Fig. 6. Mario Cucinella Architects, Museum and Foundation Luigi Rovati, Milan, 2016 – in progress (MCArchive).

[7] «For this reason, under the three domes, we imagined a path with effects of lights and shadows» explains Cucinella, a metaphor for a civilization in a balance between earthly and non-earthly. «We want to create a suspended atmosphere, so even the vases are supported in mid-air by almost invisible stems, and the acoustics themselves contribute to transforming the visit into an emotional experience by preserving some sound reverberations, so that visitors hear their footsteps echoing or a whispering voice».

References

Alfieri, N., Arias, P.E., 1960. *Mostra dell'Etruria padana e della città di Spina*, Edizioni Alfa, Bologna, Italy.

Aloi R., 1960. *Esposizioni, architetture, allestimenti*, Hoepli, Milano, Italy.

Baglione, M.P., 2010. *Massimo Pallottino. Tre momenti nella vita di uno studioso: Veio, Pyrgi, Milano '55*, Università La Sapienza, Roma, Italy.

Bardi, P.M., 1931. Nuove esigenze delle esposizioni, in *L'Ambrosiano*, 20 March, Istituto Editoriale Italiano, Milano, Italy.

Camporeale, G., 2004. *Gli Etruschi. Storia e civiltà*, Utet, Torino, Italy.

Chiarelli, R., 1952. La scultura etrusca in una mostra a Firenze, in *Emporium* 693, pp.99-108, Istituto italiano di arti grafiche, Bergamo, Italy.

Cimoli, A.C., 2007. Un metteur en scene e una mostra 'friabile', in *Musei effimeri. Allestimenti di mostre in Italia 1947-1963*, pp.121-136, Il Saggiatore, Milano, Italy.

Ciagà, G. L., 2005. Luciano Baldessari e Milano, in *Progetti e realizzazioni in Lombardia*, pp.92-93, Comune di Milano, Milano, Italy.

Cristofani, M., 1985. *Civiltà degli etruschi*, Electa, Milano, Italy.

Dal Co, F., 2001. Una lezione sull'allestire: Francesco Venezia a Palazzo Grassi, in *Casabella* 686, pp.4-5, Arnoldo Mondadori Editore, Segrate, Italy.

Daylight for Etruria, 1955. Daylight for Etruria: the remodeled Etruscan Museum at the Villa Giulia, in *Contract Interiors* 115, pp.86-97, Billboard Publications, New York, USA.

De Sessa, C., 1990. Sei interventi museali dell'architetto Franco Minissi, in L'architettura: cronache e storia 417-418, pp.502-537, Canal & Stamperia, Venezia, Italy.

Esposizioni 1941. Esposizioni, in Costruzioni-Casabella 159-160, March-April, Arnoldo Mondadori Editore, Segrate, Italy.

Etruscan Art, 1964. Etruscan Art in Florence: a little-known field of Sculpture, in *The Illustrated London News* 780-781, Illustrated London News Group, London, UK.

Frova, A., 1955. La mostra di arte etrusca a Milano, in *Domus* 306, pp.61-63, Editoriale Domus, Milano, Italy.

Frova, A., 1957. Kunstausstellungen in Mailand, in *Werk* 10, pp.354-358, Verlag Werk AG, Wagen, Germany.

Giolli, R., 1941. Esposizioni da salvare, in *Domus* 128, August, p.53, Editoriale Domus, Milano, Italy.

Heurgon, J., 1992. Les Etrusques et l'Europe Exposition, in *Archéologia* 284, pp.18-24, Éditions Faton, Quetigny Cedex, France.

Ischia, U., 1985. Il "grand tour" etrusco, in *Casabella* 519, p.41, Arnoldo Mondadori Editore, Segrate, Italy.

Jaeger, F., 1999. Ridisegno delle sale espositive. Altes Museum Berlin, in *Domus* 811, pp.61-67, Editoriale Domus, Milano, Italy.

Füssli O., 1955. Kunst und Leben der Etrusker. Kunsthaus Zürich, Switzerland.

Laviosa, C., (Ed.), 1964. *Scultura tardo etrusca di Volterra*, La Strozzina, Firenze, Italy.

Mazzucchelli, A.M., 1934. Stile di una mostra, in *Casabella* 80, August, pp.6-9, Arnoldo Mondadori Editore, Segrate, Italy.

Minissi, F., 1955. Nuova architettura di un museo a Roma, in *Edilizia moderna* 56, pp.51-58, Arturo Demarchi Editore, Milano, Italy.

Minissi, F., 1956. Villa Giulia à Rome, in Aujourd'hui. Art et Architecture 8, pp.32-35, Paris Boulogne, France.

Musée etrusque, 1962. Musée etrusque de La Villa Giulia à Rome, in *Architecture française* 233-234, pp.86-89, Société d'éditions techniques, Paris, France.

Natalini, A., 1985. Nota sull'allestimento della mostra "Progetto Etruschi", in *Civiltà degli etruschi*, p.433, Electa, Milano, Italy.

Pallottino, M., (Ed.), 1955. *Mostra dell'arte e della civiltà etrusca*, Silvana Editoriale, Cinisello Balsamo, Milano, Italy.

Pallottino, M., (Ed.), 1967. *Arte e civiltà degli Etruschi*, exhib. cat. (Turin 1967), Accademia delle Scienze, Torino, Italy.

Pallottino, M., 1992. *Les Etrusques et l'Europe*, Reunion des Musées Nationaux, Paris, France.

Piazzi, S., 2000. Note sull'allestimento, in *Principi etrushi. Tra Mediteranneo ed Europa*, Bortoloni, G., (Ed.), pp.404-405, Marsilio, Venice, Italy.

Quaroni 1985. Quaroni e la mostra degli etruschi, in *Ottagono* 77, pp.70-71, Editrice Co.P.IN.A. srl, Milano, Italy.

Rava, C. E., 1956. La mostra dell'arte e della civiltà etrusca a Milano, in *Prospettive* 11, Milano, Italy.

Swaddling, J., 2018. Exhibiting the Etruscans in Pall Mall and Bloomsbury, in *An Etruscan affair: the impact of early Etruscan discoveries on European culture*, Swaddling, J., (Ed.), British Museum Press, London, UK.

Torelli, M., 2001. *Gli Etruschi*, Thames and Hudson, London, UK.

Venezia, F., 2001. Mostra gli Etruschi a Palazzo Grassi, in *Casabella* 686, pp.6-17, Arnoldo Mondadori Editore, Segrate, Italy.

Zevi, B., 1955. Polemiche nel museo, in *L'Espresso*, 17 May. Nuove Edizioni Romane, Roma, Italy.

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The Turkish Modernist Osman Hamdi Bey and his View on Artefacts

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Abstract

This paper aims at drawing attention to Osman Hamdi Bey's view on historical and heritage artefacts; to his establishing of the museum culture in Turkey as well as rendering these practices in his own paintings. Osman Hamdi Bey (1842-1910) was a Turkish painter, archaeologist and founder of the Istanbul Archaeology Museum. He is considered as the pioneer of the museum curator's profession in Turkey. Working in the modernization process, he emphasized the Ottoman heritage and its artefacts in the museum institutions, for the Ottomans themselves and also as a part of the European culture.

Keywords: Osman Hamdi Bey; museum curator; modernist; identity; heritage; antiquities

1. Introduction

Using the concept of cultural transfers, this paper sheds light upon Osman Hamdi Bey (1842-1910) as an agent. Osman Hamdi was a Turkish painter, archaeologist and founder of the Istanbul Archaeology museum. He is considered as the pioneer of the museum curator's profession in Turkey. Also, he is the founder of the Istanbul Academy of Fine Arts/*Sanayi-i Nefise Mektebi* (known today as the famous architectural, design and arts & crafts school *Mimar Sinan University of Fine Arts*) – the first art school in Turkey. In the academy, the students were trained in aesthetics and artistic techniques, an education following French way of art schooling. Before the establishment of the academy, artists in Istanbul in the 19th century were often trained in military schools.

In order to follow Osman Hamdi Bey, and the museum development, "intermediary studies" is used as a tool. In 2011, the Canadian associate professor in history, Natalie Rothman discussed the concept in her thesis *Brokering Empire* (Rothman 2011), which includes an understanding of how society and cultural connections change, how culture transforms, and who the "actors" are behind this process. Knowledge- and cultural transfer is thus defined by the actor who moves across a cultural border and appears in a new context. The actors may have different occupations as dragomans, diplomats, sultans, curators or artists. In common they carry important roles in crossing and transforming cultural boundaries. These persons adopt, translate and transfer various perspectives of knowledge and cultural values. In this process, knowledge is changed as different cultures come into contact and thus produce new knowledge.

Looking at the context of the time period, a series of governmental reforms were performed between 1839 and 1876. The so called "Tanzimât" was a reorganization of the Ottoman country, with political, institutional and social reforms. With Europe as a model, reforms were shaped on equal rights, regardless of everyone's social status, religious or ethnic affiliation; all inhabitants should be regarded as modern citizens, included by the same rules. Slavery was abolished. A new tax system was introduced, as well as postal, telegraph and rail networks, and a compulsory schooling for all people. After the Tanzimât period, the Russo-Turkish War lasted the years 1877-78, a conflict between the Eastern Orthodox coalition and the Ottoman Empire. However, after less than three decades of Tanzimât the sultan Abdülhamit II ruled the country, from 1878, in an autocratic way for the coming 33 years. Nonetheless, Tanzimât was the first time in Turkey to create a modernization in a Western way, later followed by the renowned Atatürk – Mustafa Kemal Pasha (1881-1938) – when he established the Republic of Turkey in 1923.

As a background, Osman Hamdi Bey started his education in Law in Constantinople (1856), and then moved to Paris (1860). In Paris, he quit the Law program, and decided to practice his interest in painting. He was trained by the French Orientalist painters Jean-Léon Gérôme and Gustave Boulanger. Back in Turkey in 1869, Osman Hamdi was sent to the Ottoman province of Baghdad, as a member of the administrative team. The very first excavations conducted by Turks were carried out by him. His digs included sites in Anatolia and Lebanon. In addition, he used his position as museum director to rewrite the laws concerning antiquities (1881). Osman Hamdi put forth legislation, aimed at regulating finds, made by various archaeological companies in the Ottoman Empire, and preventing the antiquities from being taken abroad. To deposit the antiquities, he initiated what today is the Istanbul Archaeology Museum.

2. The Imperial Museum

The very first archaeological museum in Istanbul, named Magazine of Antique Weapons, opened in 1846 in the Byzantine church Hagia Irene, as a result of the Tanzimât reform. The word "magazine" meant that artefacts and objects – armor and religious antiquities – were placed in the church in a way of a warehouse, less as an exhibition display. In 1869, with its name changed to the Imperial Museum, it was opened to the public. The collection contained two main parts: antique weapons and armor (military), and Helleno-Byzantine antiquities (archeology). Further, the museum housed a permanent collection of historic costumes and dresses. The exhibit of secular relics followed the idea of Tanzimat. The word magazine replaced by museum – or *müze* in Turkish – designated that the institution also held an interest of education. The word includes the teaching moment, and also involves the arranged display of artefacts in the room contrary to

showing the collection in a stock-keeping form (Shaw 2003: 31). In the summer of 1867, Sultan Abdülaziz (1830-76) became the first Ottoman sultan who travelled to Western Europe. He visited museums in Paris, London and Vienna and saw Greco-Roman artefacts on display. Impressed by the European museums Sultan Abdülaziz ordered the establishment of an Imperial museum in Constantinople. After the Abdülaziz journey to Europe, the Ottoman interest in antiquities started to accelerate. Further, with Osman Hamdi Bey's interest in education, in the 1880s the archaeologists changed from solely looking at the aesthetics of the sculptures and artefacts. Seeing from a didactic view, they began to place value on other types of objects as evidence for an understanding of material culture (Shaw 2003: 111).

When Osman Hamdi Bey took over the board of the Imperial Museum in 1882, he began to systematize and catalogue the entire collection. Further, he opened the Tiled pavilion (1472, *Çinili Köşk*) as a museum (figs. 1 and 2), preceding for a new archaeological museum to be built on the same courtyard. The Tiled pavilion was originally built by the Ottoman Sultan Mehmed II as a leisure palace. Architecturally, the palace has influences from Central Asia, in line with Persian tradition but also with similarities of the Venetian Renaissance. Accordingly, the edifice itself contained a heritage worth highlighting. The French architect Alexandre Vallauri was commissioned to the task and designed the new museum in 1891 as a "modern scientific institution" (Eldem 2014: 23). The neoclassical architecture of the museum building announced its membership in the Western family of museums (fig. 3). Greek and Roman-Byzantine antiquities had prominent places in the Imperial Museum, also Hittite and pre-historical items were now on display. But they didn't follow the Western museums way of constructing an evolutionary story of art-historical progress from the Greeks through the Renaissance to modern Western painting and sculpture. Instead, the new museum showed artefacts and told stories from the Ottoman's own order and perspectives.

The grow of the Imperial Museum, from a small collection of antiquities into a museum institution, was the work of Osman Hamdi Bey. From his different roles and positions he brought a row of new cultural activities into the Ottoman society.

Fig. 1. The Tiled Pavilion in 1905. Postcard by Max Fruchtermann. (Photography from the book *Osman Hamdi Bey Sözlüğü*, 2010).

Fig. 2. Images of the exhibition design in the Tiled Pavilion in 1909
(Photography from an exhibition sign in the Tiled Pavilion's exhibition of today).

The construction of a third wing of the Imperial Museum began in 1904, Osman Hamdi praised the sultan for allowing the museum to grow to be one of the biggest museums in Europe. Objects and artefacts were spatially arranged in the rooms, exhibited from an aesthetic point of view (fig. 3). The newspaper *Ikdam* (1903), a modernist publication with the motto "This is a Turkish newspaper", had reported from the opening of the second wing: «With the display of ancient fine arts decorating the various salons of the new wing of the Imperial Museum, a state of mutual equality with the museums of Europe has been gained, in light of both the classification and the representation [of the collection] …and thus will open on the day of victory of the [sultan] as a sign of the prosperity and rejoicing of the state» (quoted in Shaw 2003: 162).

The order of the items in the exhibitions, and the arrangement in space, and also the catalogue information were thoughts as parts of the education moment. For this reason, Osman Hamdi Bey contacted the Ministry of Education, asking for the French archaeologist Gustave Mendel to work with the exhibition catalogue, thus highlighting the importance to produce catalogues for museums:

«The preparation of a catalogue requires that each one of the antiquities in store be described in terms of its nature, the period and people and time to which it belongs, and that it be assessed in terms of its importance from the view point of the arts and of history; this in turn is possible only through the work of persons highly experienced in the science of archaeology who will study the objects in other museums and establish comparisons between them» (Osman Hamdi Bey in Eldem 2014: 39).

After almost ten years, Mendel published in 1914 an extensive catalogue of the museum's 1413 items on 1860 pages. The catalogue contains detailed descriptions of the artefacts and their backgrounds, all drawn and photographed.

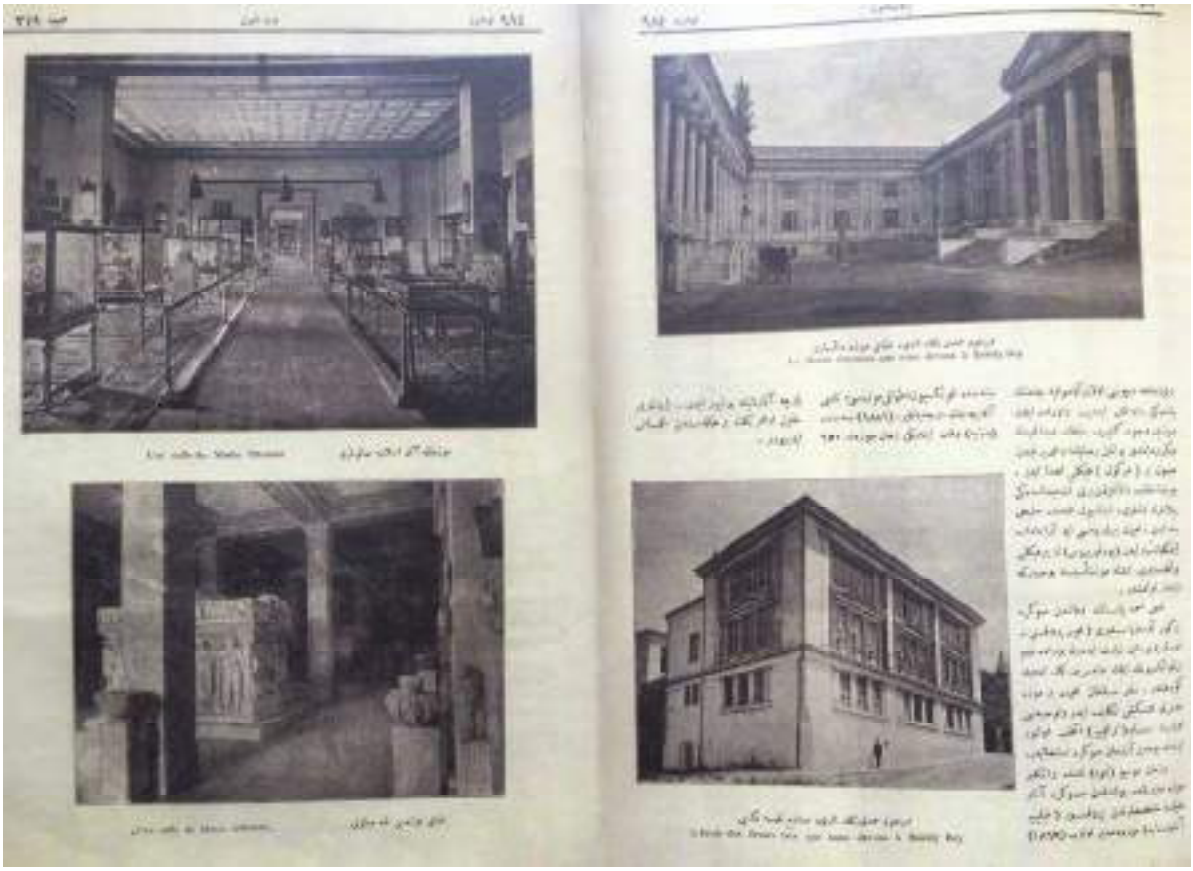

Fig. 3. Images of the exhibition design in the new Imperial Museum published in the Servet -i Fünun magazine in April 1910 (Photography from the book *Osman Hamdi Bey Sözlüğü*, 2010).

3. A start with the Elbise documentation

Before Osman Hamdi Bey entered the role as a museum director, he was involved in the Ottoman part of the Vienna Exposition in 1873. It was a World Fair with focus on Culture and Education. The Exposition held an exhibition including a large collection of Ottoman costumes, a documentation of ethnical and religious dresses from different cultures and geographical parts of the Ottoman empire. It was conducted by Osman Hamdi together with Victor Marie de Launay, a French artist and (amateur) historian. Marie de Launay worked in the Ministry of Trade and Public Works employed by Ibrahim Edhem Pasa, the father of Osman Hamdi. In addition, Ibrahim Edhem Pasa was the director of the Ottoman commission to the Vienna Exposition (Ersoy 2003: 190). Said as a beside, also Sweden contributed to the Exposition, with Swedish folk costumes from different provinces in the country. The displayed outfits were representations of Swedish culture.

These traditional Ottoman clothes were exhibited and published in the photographic book *Elbise-i 'Osmaniyye/Les Costumes populaires de la Turquie* (1873). The *Elbise* includes 74 photographic plates with live models dressed in regional outfits. The idea behind the project was, for Osman Hamdi and Marie de Launay, to show realistic representations of traditional costumes or dresses – to show the span of regional, ethnic, social and religious variations (Ersoy 2003: 191). The photographical documentation was conducted by Pascal Sébah (1823-1886), the leading photographer in Istanbul. Sébah's career took place at the same time as the intense Western European interest in the "Orient" flourished. His career was also accelerated through his collaboration with Osman Hamdi. Sébah was engaged for five years documenting the antiquities in the museum. For the *Elbise* project, Sébah took photographs of two or three models in groups – the models were ordinary people grabbed from the streets – all dressed up in the traditional outfits. In total three published

works were presented showing the Ottoman world in ethnographic, architectural and archaeological angles. Besides the *Elbise*, *Der Bosphor und Constantinople,* a sort of guidebook on Istanbul, was highlighting Byzantine and Ottoman monuments for the European traveler. The third publication was the *Usül-i Mi màrï-i ´Osmànï: L'Architecture ottoman,* a book focused on the history and theory of Ottoman architecture (Ersoy 2003: 190-193). The Vienna Exposition became a sign for the European visitors of cultural modernization and westernization of the Ottoman empire.

4. Interest of the Antique era in the mid 19th century

The birth of archeology and scientific excavations were a new beginning for the interest of antiquities. In the German art historian J.J. Winckelmann's (1717-68) *Geschichte der Kunst des Altertums* (1764) was Greek art – not Roman – for the first time placed in the centre of attraction. Winckelmann viewed the artwork from a changed perspective. Instead of studying art based on the works' similarity to the exemplary nature, Winckelmann, influenced by Montesquieu's *Climate Theory* (1748), saw the artworks as an expression of culture, social condition and climate. Europe's interest in Greek art through the classics was apparent, and Ancient Greece became a model for the 19th century. From the 1820s, an archeology on a scientific basis was formed. A systemization of findings was made by the Danish C.J. Thomsen (1788-1865). He introduced in 1836 the so-called three-age system, the division into a Stone Age, a Bronze Age and an Iron Age. The German architect Gottfried Semper (1803-1879) on his part, described in *Der Stil* (1860), with polychromy (the Greek word for multicolored painting) and textile as starting points, the development of architecture. In his theory of development, Semper saw a stream of cultures in the ancient times, instead of only one highlighted single culture. This approach broke the conventional academic view. In addition, in the 1880s the Swedish archaeologist Oscar Montelius (1843-1921) developed a so called diffusionist chronology for human civilization which placed the dawn of civilization in the Near East. In his typology, constructed for the study of artefacts from different cultural circles, Montelius managed to synchronize the Nordic Bronze Age sections with historically datable events in the Mediterranean and Near East. His view was controversial since it directed interest to the Christian biblical view of world history, contrary to the idea of the Darwinian evolution (Shaw 2003: 62). The research of older ages combined earlier historical time with contemporary and present times.

The new knowledge from archeology, and a growing European interest in the antiquities found on Ottoman soil, aroused interest of the Ottoman government of the domestic heritage. This means a greater understanding for their own rich heritage. The same attitude was found in Greece; the country constructed an identity from their Antique heritage. Wendy M. K. Shaw, professor of the Art History of Islamic cultures, explains: «Looking from the Greek's point of view, it suggests that they were not seeking a return to a classical *past* but instead of an inclusion in the European *present*» (Shaw 2003: 66). We see the two parts of identity, to find the country's own roots and to fit into a bigger context, thus with Europe.

With the growing collections of antiquities from the excavations, a need for protection was necessary. In the middle of the 19th century, the Ottoman Empire followed the European idea that establishing museums was the best way for collecting and protecting valuable items (Shaw 2003: 37). Different ways of collecting items have been used during history. Already in the 17th century, Europeans began to collect Greek and Roman antiquities from Ottoman soil – often in private collections. In Europe, museums emerged from the idea of a Wunderkammer or a Cabinet of curiosities, i.e. a whole room filled with collections of objects, not only of art and antiquities, but also of natural history, geology, ethnography and relics. For the Ottomans, earlier private imperial collections were often a start for a museum collection. From a historical perspective, all land in the Ottoman tradition belonged to the sultan. In the modern age, following the Tanzimat modernization, this changed so that all territory belonged to the state. No individual could assume ownership of an found antiquity without a permit from the government. On the excavation sites the excavator and a representative of the museum were to keep notebooks of finds. This was to protect the items from being stolen or moved abroad (Shaw 2003: 112f). Osman Hamdi Bey had rewritten the laws concerning antiquities, preventing the latter from being taken abroad. Despite this, the sultans had still the possibility to use the antiquities as personal gifts. Already when the sultan Abdülhamit II ruled the empire (1861-76, thus during the Tanzimat period), he used the antiquities to make deals with the Europeans. The period Osman Hamdi built up the role

of the museum as an educational institution for the Ottoman public, he was bothered about the export of antiquities. In his artistry, his approach to the dispersal of antiquities is interpreted in his paintings. We will come back to this.

5. The influence of photography

The introduction of the camera in Europe in the 1860s inspired artists to paint pictures of momentary motifs. Artists began to explore reality in a new way. The camera can obviously not be compared to the eye, but it became a tool to catch the moment (as we often say). In the Ottoman Empire photography began as an instrument used to captivate the orientalist fascination and to produce touristic postcard. Pascal Sébah, the already mentioned photographer and the Swedish photographer Guillaume Berggren (1835-1920), operated two of the most successful and professional studios in Constantinople (Çelik, Eldem 2015: 82). Guillaume Berggren worked in Turkey/Ottoman Empire from 1866 until his death. In the early 1870s, Berggren opened the studio *The Little Sweden* in the Grande Rue de la Pera. He combined portraits of travelers and dignitaries in studio with architecture and everyday pictures of the city and of working people. Under the reign of Sultan Abdülhamid II (1842-1918), photography moved from having the focus on art into being a be part of documentation. Abdülhamid II stressed that «Every picture is an idea. A picture can inspire political and emotional meanings which cannot be conveyed by an article of a hundred pages» (quoted in Shaw 2003: 143). Osman Hamdi Bey followed this suggestion and documented his excavation sites and findings. By using the new technique, he took photographs of places, buildings, settings and objects and later used them as patterns or models for his paintings. Photos of himself, in different outfits and poses, were taken by Pascal Sébah.

Fig. 4: Osman Hamdi Bey in the excavation site of the Mont Nemrud in 1883
(Photography from the book *Osman Hamdi Bey Sözlüğü*, 2010).

In 1883, Osman Hamdi visited the excavation of the tumulus of Antiochus of Commagene on Mont Nemrud in Anatolia (fig. 4). From that journey he brought home a hundred glass plate negatives (Çelik, Eldem 2015: 220). They reproduced not only the sites and the findings but also people working with the excavation; that is the new profession as archaeologists. Later on, he also used the photographs as templates for his paintings. The site on Mont Nemrud holds a number of large 8-9 meters high statues around a royal tomb from the 1st century BC (since 1987 a Unesco World Heritage Site). Another example is the Alexander Sarcophagus in stone from the 4th century BC Hellenistic time, excavated by Osman Hamdi in 1887.

A well-preserved stone sarcophagus with rich adornments, found in a necropolis near Sidon in Lebanon. Three more massive stone sarcophagi were excavated at the same time. A third example is the discovery of site Nippur in Mesopotamia, an ancient Sumerian city with temples in brick on the plateau. University of Pennsylvania Museum of Archaeology and Anthropology holds Osman Hamdi's oil painting *Excavations at Nippur* (1903).

Fig. 5: Osman Hamdi Bey *Two musician girls* (1880), Pera Museum, Istanbul (Photography Google Art Project)
Fig. 6: The same room today as Osman Hamdi painted in 1880, *The Green Mosque* (1419) in Bursa (Photography Gertrud Olsson)

The Turkish art historian Belgin Demirsar Arli points out the method used by Osman Hamdi, how the canvas of his paintings are sketched in a grid system. The motif is transferred from a photograph divided into sections with a pencil to the canvas (Demirsar Arli 2000: 196). Despite his professional career as museum director, Osman Hamdi continued to paint throughout his life. About 200 paintings from him are known today. In his paintings, he highlighted the early Ottoman culture. He particularly chose to paint the architectural settings, the interior decorations, the tiles and the carpets.

Osman Hamdi rendered the objects with high precision in his paintings. Thus, Osman Hamdi created paintings with a documentary quality, showing the beauties of the East, particularly the Turkish once. His

attention and expression were divergent to other painters of the Orient. The 19th century Ottomans were forced to handle conflicting poles of identification, due to their historic striving towards political and cultural westernization. The modernization of the Ottoman individual involves the complex duality of being a European as well as, so to say, a genuine Ottoman. Osman Hamdi's artistry mirrored the questions on identity.

Looking at his compositions in the work of Osman Hamdi, large-scale figures are seen for the very first time in Turkish art. His depicted people are self-confident, captured thinking and working. They take place in the architecture and use the space. Notable for the time, women are depicted on equal terms. He displays the soul of daily life during the Ottoman period in the compositions, for example the activity around the mosque. The Green Mosque and the tomb in Bursa are important in early Ottoman architecture and culture (fig. 6).

An example is the painting *Two musician girls* (1880), two girls playing the mandolin and the tambourine respectively, depicted in Bursa's Green Mosque (figs. 5 and 6). The room is painted inside the mosque, it is possible to identify the tiled wall, the frieze on the right, "the fence" adorned with carved stars, and the cabinet for sandals. The two girls – one standing playing the mandolin, and the other sitting, accompanying on the tambourine – are placed on an Anatolian woven carpet with the sandals removed to the floor next to it.
The musicians are dressed in kaftan-like clothes suitable for the newly awakened Ottoman interest. At the same time, they are contemporary in the late 1800s in terms of body language, behavior and appearance. In use of technical precision and realism, Osman Hamdi is a modern agent displaying the traditional culture, not only in museums but also emphasizing historical monuments as 15th century Ottoman mosques. The figures in the paintings of Osman Hamdi, are often people close to him, and in the majority of cases the artist himself. In survived photographs, he is dressed in different chosen costumes in order to fit into his own paintings. He is an intermediator showing the Ottoman culture (with all their attributes) – largely forgotten in this period of modernizing and secularization – also for the people in his own country. Even more important, Osman Hamdi conveys to the West another perspective of the Orient.

The situation in his painting *The tortoise trainer* (1906) is placed in a room upstairs in the Green mosque from 1419. The room is clad in tiles in the two colours of medium blue and dark azure. The painting both gives a realistic picture of the early Ottoman mosque including its architectural values and tells a parallel story. Following Wendy M. K. Shaw's interpretation, this is an image showing frustration of the export of the museum collections. Osman Hamdi himself is depicted as an educator teaching his pupils, i.e., the tortoises. He feeds them with leaves. He has two tools, a flute and a leather prong. With the flute he can instruct them and with the prong he can punish them. But since the tortoises have no ears they can't hear, and with the hard protecting shell they can't be beaten. The conclusion of the painting's message can be an allegorical reference to Osman Hamdi's role as an educator in the Ottoman society, incapable to change the new legislation system (Pera museum; Shaw 2003: 124).

Osman Hamdi Bey was both a painter and a collector, spreading cultural narratives in different media. An interior from the Tiled Pavilion is depicted in the painting *The Fountain of Life* (1904), where the archaeological collections were housed while the new museum was completed. Osman Hamdi himself is painted reading the Holy Scripture, a teacher's role. Several objects help to illustrate the content and symbolism of Osman Hamdi's images and recur from painting to painting. These artefacts from the Islamic collections and archaeological excursions, had Osman Hamdi access to thanks to his position as museum director. Among other things, we find oil lamps, candlesticks, carpets, bookshelves and envelopes for the Quran; these are now in the collections of the museums (Demirsar Arli 2000: 197f). Archaeological objects from around the empire were thus twofold on display, in the museum and in the paintings. For the sake of antiquity and the sake of modernity, they formed and constructed the modern Ottoman identity. At the same time including the moment of education of the historical past.

6. Conclusion

Looking at Osman Hamdi Bey as an Ottoman envoy, like a consul or a dragoman, Constantinople and Turkey become the sights of the intermediation, but also with a certain relation to Paris and French culture. Osman Hamdi moves between Constantinople and Anatolia, as the leader of the excavations. In a metaphorical way he transplants the objects from the excavations into the new open museum. In addition, Osman Hamdi mediates the

physical room of the mosque through his paintings. Provided with the newly emerged photo technique, he captures the early Ottoman room through eyes of the 19th century. Osman Hamdi worked in a network with different partners, archaeologists, photographers, French and Turkish artists, the Ottoman bureaucracy, etcetera. As an educator he brings knowledge and documentation of the artefacts, and the Ottoman society as such, manifesting intermediation and a will to share the heritage with the contemporary world.

References

Çelik, Z., Edhem E., (Eds.), 2015. *Camera Ottomana – Photography and Modernity in the Ottoman Empire 1840-1914*, Koç University Press, Istanbul, Turkey.

Demirsar, V.B., 1989. *Osman Hamdi Tablolarında Gerçekle İlişkiler, Sanat Eserleri Dizisi: 12, Kültür Bakanligi*, Ankara, Turkey.

Demirsar Arli, B., 2000. Osman Hamdi and pictoral art, in *From Orientalism to contemporary Turkish painting*, Toprakbank, Istanbul, Turkey.

Eldem, E., 2010. *Osman Hamdi Bey Sözlüğü. Kültür ve Turizm Bakanlığı Yayınları*, Ankara, Turkey.

Eldem, E., 2014. *Mendel–Sebah: Documenting the Imperial Museum/Mendel–Sebah: Müze-i Hümayun'u Belgelemek*, Archaeological Museums/ İstanbul Arkeoloji Müzeleri Yayını, Istanbul, Turkey.

Ersoy, A., 2003. A Sartorial Tribute to late Tanzimat Ottomanism: The Elbise-i ʿOsmaniyye Album. Muqarnas 20, 187-207.

Inankur, Z., Lewis, R., Roberts, M., (Eds.), 2011. *The Poetics and Politics of Place: Ottoman Istanbul and British Orientalism*, Pera Museum Publication, Istanbul, Turkey.

Olsson, G., 2017. Osman Hamdi Bey och berättandet genom historiska lager, in *The Swedish Research Institute in Istanbul annual Dragomanen* 19, pp.57-70, Swedish Research Institute in Istanbul, Turkey.

Rothman, N., 2011. *Brokering Empire*, Cornell University Press, New York, USA.

Shaw, M.K.W., 2003. *Possessors and possessed: Museums, Archeology, and the visualization of History in the Late Ottoman Empire*, University of California Press, Los Angeles, USA.

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Renzo Piano, Dominique de Menil and the Artifice of Intimacy

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Abstract

The Menil Collection in Houston (1982-1986) was a pivotal project in Renzo Piano's biography and career.
After the pyrotechnic and provocative Centre Pompidou, this was the building in which he established the main qualities of the exhibition spaces that in the following decades come to characterize the many other American and non-American museums he designed. The paper seeks to stress the strategic role that Dominique de Menil played in this evolution.
When they met in the early Eighties, Piano was a young and talented architect in front of one of the world's most refined art collectors. Dominique de Menil was deeply involved in the Menil Collection's design process: she attended many of the meetings and discussed intensely with Piano and the Arup engineers Peter Rice and Tom Barker. The sharing of ideas about what an exhibition space has to be, and the subtle but decisive influence of the Menil House and the Rothko Chapel, both in Houston, fostered Piano's interest in sober plans and calibrated proportions for the galleries, the use of natural light, the careful studies on materials, and to a close relationship between the new building and the urban context. All aspects of a programme that, according to Dominique de Menil, had to create an aura of "intimacy" that could ease the appreciation of the works of art. This was a way of conceiving the exhibition spaces unrelated and contrary to the Centre Pompidou that will characterize Piano's later museums such as the Fondation Beyeler in Basel, the Nasher Sculpture Center in Dallas or the Chicago Art Institute.

Keywords: Renzo Piano; Dominique de Menil, Menil Collection, Museum, Natural light.

In 2007 Renzo Piano came back to Houston to give a talk at the Menil Collection (1980-1987), commemorating the museum's twentieth anniversary. He spoke less about the design of the building, or the fame that the institution had gained in the last decades, devoting almost the entirety of his speech to the special relationship he had at the time with the customer, advocating that if «architecture is in a way the mirror of the client... this building is a portrait of Dominique de Menil» (Piano, 2010: 218).

Piano pronounced this speech when he had just started the design of the Kimbell Art Museum Expansion in Fort Worth (2007-2013) and the Whitney Museum of American Art in New York (2007-2015). He was also building the Isabella Stewart Gardner Museum in Boston (2005-2012), the Harvard Art Museum (2006-2014), the Chicago Art Institute (2000-2009) and the Los Angeles County Museum of Art (2003-2010), and he had completed the Nasher Sculpture Center in Dallas (1999-2003) and the Atlanta High Museum expansion (1999-2005), among the others. An impressive body of work that made the Italian architect one of the leading figures for the American museums in the last decades (Bucci, 2011).

The great part of this fame dates back to the Menil Collection. This essay aims to explain how, at the beginning of the Eighties, the encounter between the young architect and the old, elegant, and cultivated Dominique de Menil (1908-1997) was a pivotal moment in the Renzo Piano's career.

After the completion of the Centre Pompidou (1970-1977) he had dismantled the partnership with Richard Rogers, coming back to Genoa with a small group of collaborators and little work. It was thanks to the commission of the Menil Collection that, in 1981, he was able to set up his firm – the Renzo Piano Building Workshop – hiring some of the most trusted partners that still work in the office today (Carroll, 2009). And, if the Centre Pompidou was a pyrotechnic and provocative gesture, it was also thanks to the intense discussions with Dominique de Menil that Piano tuned the tones of his well-known museum spaces made of sober geometries, natural light, and calibrated glass walls in order to merge the internal spaces with the surrounding natural and urban context (Newhouse, 2007).

Fig. 1. From the left: Lois, Georges and Dominique de Menil, Walter Hopps, Renzo Piano and Adelaide de Menil during one the frequent design reviews of Menil Collection's project in Houston, 1986 (Renzo Piano Foundation, Genoa).

Dominique Schlumberger (1908-1997) came from a catholic family who gained a considerable fortune through the Société de Prospection Électrique, founded in 1926 by her father and uncle, that discovered and patented a new way of using electricity to detect oil fields. A society in which her husband started to work as well – Jean (later John) de Menil (1904-1973) – soon after their marriage in 1931 (Middleton 2018: 84-87, 193-194). During the Thirties, the couple started to buy pieces of western and non-western art simply following their interest, also commissioning a portrait of Dominique (1932 ca.) to Max Ernst and buying African and Oceanian masks during John's voyages around the world (van Dyke 2010). Since the early years of marriage Dominique also developed a great passion for furnishing their apartments, entrusting the modernist architect Pierre Barbe (1900-2004) to renovate their houses at the château in Kolbsheim and in rue Las Cases in Paris, where she started to set up and show the paintings they had bought (Minnaert, 1991: 54-57).

The following years saw the growth of the collection, in particular under the advice of Father Marie-Alain Couturier (1897-1954). Couturier educated the eyes of the couple towards contemporary art and the spiritual influence that the works of those artists could exercise in an appropriate architectonic environment (Middleton, 2018: 185-187; Lion 2005). And when during the war the couple and their children decided to move to New York and then to Houston – the American location of the Schlumberger company – one of their first decisions was to build a new house (Middleton, 2018: 327-350). A building intended not simply as a private residential accommodation, but rather a place for receiving artists and guests, and «a mechanism to display» the hundreds of works of art in their collection (Webb, 2008; Vassallo, 2015). Dominique and John de Menil decided to hire Philip Johnson (1906-2005). Despite that, at the time, he had not accomplished the construction of any building, he was associated at the Museum of Modern Art in New York since 1932 so, in the vision of the couple, he could introduce modern architecture in Houston, linking the provincial city to the most prominent American centre for artistic experimentation. In addition, because of Johnson's lack of experience, Dominique could exercise a more pervasive influence in the design of the house rather than facing off against a famous architect. In fact, she had precise ideas about the house and, as it will be for all the other buildings that the couple decided to fund in the following years, she was deeply involved in the design process alongside the architect[1].

In 1937 Dominique wrote two articles for "L'Art Sacré" – the small publication led by Couturier and Maurice Denis on art, architecture and contemporary creation linked to sacred spaces – about a chapel built in Kolbsheim and a small church in Japan (de Menil, 1937a; de Menil, 1937b). Those two articles clearly show what she appreciated in a building.

The chapel built in the village of Kolbsheim was a small construction, made entirely with stone blocks from local quarries. Avoiding any traces of emphasis or monumentality, «une des qualités de cette construction – wrote Dominique – c'est d'avoir été faites avec de moyens simples et par les artisan du pays... Tout est simple aussi et le charme de cette chapelle provient seulement de l'excellence de ses proportions et de la finesse des détails» (de Menil, 1937a: 90). In opposition to the «construction faussement audacieuses, où la plus déplorable fantaisie s'allie au plus stérile conformisme», the interior space of this small construction is pervaded only by the «sobriété et sensibilité ambiante» and the crucifix and the tabernacle are simply hung on the wall without any further decoration (de Menil, 1937a: 91). In the Karuizawa chapel as well, Dominique de Menil appreciated «la connaissance parfaite des qualités matérielles et spirituelles des matériaux» (de Menil, 1937b: 118). The careful design of sober and proportionated space, the respect of the environment through low height and the use of local and well-crafted materials, and the avoiding of any excess in decoration can convey - according to her judgement - the perception of a building that seems «simple», in which the visitor can breathe an atmosphere of «intimité» (de Menil, 1937a: 91). The enduring preoccupation to convey this artifice of "intimacy" – that she thought as the better condition for penetrating the meaning of a work of art – was the recurring request to the architects she hired, and to Philip Johnson *in primis* (Welch, 2000: 40-57; Smart, 2010: 26).

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[1] The couple made large donations to the University of St. Thomas and the Rice University for establishing new programs and new buildings and, beyond the Menil Collection, they financed the construction of the Rothko Chapel, the Cy Twombly Pavilion, the Byzantine Fresco Chapel, and Richmond Hall, all in Houston.

Fig. 2. The Menil House designed by Philip Johnson (Courtesy of the Menil Archives, The Menil Collection, Houston).

Dominique requested to the architect a single-story house, with the front to the north and a patio in the middle, in which she wanted to plant a series of lush vegetation reminiscent of the period that the couple spent in Venezuela during the war (Fox, 2010: 203). Moreover, she demanded some black inexpensive ceramic tiles for the floors, and generous glass walls toward the garden. The house is a rectangular volume, clad with red bricks, of approximately 50 per 21 meters, with flat roof and ceilings of 3,65 meters height. The private part of the house is confined in the rear and, after looking at the first version of the project, Dominique asked Johnson to avoid a dining room and to considerably enlarge the atrium, which became the veritable entrance gallery of the house, with works of Yves Klein, Giorgio de Chirico and René Magritte displayed on the walls. As a further demonstration of her clear ideas and independence from the architect, Dominique didn't request Johnson's advice for the interiors, instead hiring the fashion designer Charles James (1906-1978) for that purpose, and designing some of the furniture herself, as the heptagonal ottoman for the living room[1].

The entrance hall and the living room of the Menil House were the first experiments that Dominique made to find a way to convey such an "intimacy" for observing her collection. She mixed ancient and contemporary art, western and not-western pieces, large seats, and the direct and constant view toward the tropical patio and the garden. Approximately thirty years later, she made almost the same requests to Renzo Piano, to which, during their first encounter in Paris in November 1980, she asked for an anti-monumental and almost "domestic" museum that had to be «small on the outside and big on the inside» (Piano, 2010: 218). It was Pontus Hultén (1924-2006), first director of the Centre Pompidou, that suggested to Dominique de Menil (member of the Acquisition Committee of the Parisian cultural center since 1974) the name of Renzo Piano as an architect able to "listen" the requests of the client.

1 Despite a diplomatic approach, Johnson distanced himself from the house after the appointing of Charles James as interior designer and refused to include the Menil House in later publications of his works.

Figg. 3-4. The strict connection between the oceanic sculptures as displayed by Dominique de Menil in her house and by Renzo Piano at the Menil Collection (Renzo Piano Foundation, Genoa).

And, as for the house, Dominique de Menil had precise ideas for the museum as well. The project of a place to show their private collection dates back to the early Seventies, with an initial commission to Louis Kahn – interrupted by his death in 1974 and the death of John de Menil one year earlier – and later studies by Howard Barnstone (Loud, 1989: 245-247). And if at the time of the Menil House Dominique was a relatively young and inexperienced collector, in the late Seventies she had accumulated a strong expertise as curator since 1964, when she succeeded Jermayne McAgy (1914-1964) as director of the Houston Contemporary Arts Association through which she organized and set up several exhibitions (Smart, 2010: 26-27). Dominique assembled a working team – composed by, amongst others, the future museum's directors Paul Winkler and Walter Hopps – which established a facility program for the museum, before involving an architect. The complete report with all the museum's spaces, their dimensions, position in the general plan and condition of light was delivered in January 1980, while Piano was only in charge of the project starting the following November[2].

Dominique did not need an architect that proposed or imposed his vision, rather she looked for a sort of builder who could give a material substance to her personal ideas about what the Menil Collection had to be. In Renzo Piano, Dominique probably recognized a young and promising architect, with little experience but keen in listening, understating and – in the architect's words – «concerned and able to help build *her* building, rather than mine» (Farrelly, 1987: 34).

When on January 19, 1981, Piano moved to Houston for the first time, he lived at the Menil House (Ishida, 1987: 69). In the following meetings Dominique insisted to host Piano again, in order to talk about the project while breathing the atmosphere she infused in the house and amongst some pieces of the collection. She explained to Piano that, as she did for the Menil House, she wanted to be closely involved in the design process of the museum and, giving the architect wide freedom on the general design of the building, she wanted to retain the right to oversee the design of the galleries (Middleton, 2018: 585).

Dominique disliked the Centre Pompidou. She asked Piano to respect the visual and urban unity of the neighborhood in which the museum had to be inserted, made almost entirely of one or two-story wooden bungalows that she had bought during the previous years in order to host the ancillary functions of the Menil Foundation and museum (Middleton 2018: 575). She looked at a horizontal building, not as aggressive as the Centre Pompidou, with dark floors and full of natural light. According to Dominique, the Menil Collection had to be different than the other museums she visited extensively prior to giving the commission to Piano (Middleton, 2018: 533-534). She did not want a café or a bookstore in the main building, nor explanatory text or curatorial remarks on the walls, except for the name of the artist, the title of the work, the medium and the year (Smart, 2010: 27; Middleton 2018: 4). The works of art had to be hung at a lower height, with no visual filters

[2] The report is kept at the Renzo Piano Foundation Archives, Menil, Pfitz/MEN/001.

or physical barriers in front of them. The architect had to avoid an emphatic entrance, and in the foyer the name of the museum and the names of the donors were not to appear. She requested the same domestic proportions, understatement on the outside and "intimacy" on the inside that characterized the Menil House, with the galleries interrupted by the same lush patios (de Menil, 1987: 62).

Piano was able to fully adhere to the vision of the client, mixing his design approach with the specific requests of Dominique de Menil.

He designed a two-story building with a rectangular plan. The ground floor hosts the galleries, the library and the conservation laboratory, while the first floor is devoted to the "treasure house" where the main portion of the collection could be preserved in ideal light and humidity conditions, open to scholars, students, and art lovers. A metal structure, painted in white, is filled by a series of Louisiana cypress boards painted with the same pale grey that Dominique de Menil adopted for the nearby bungalows.

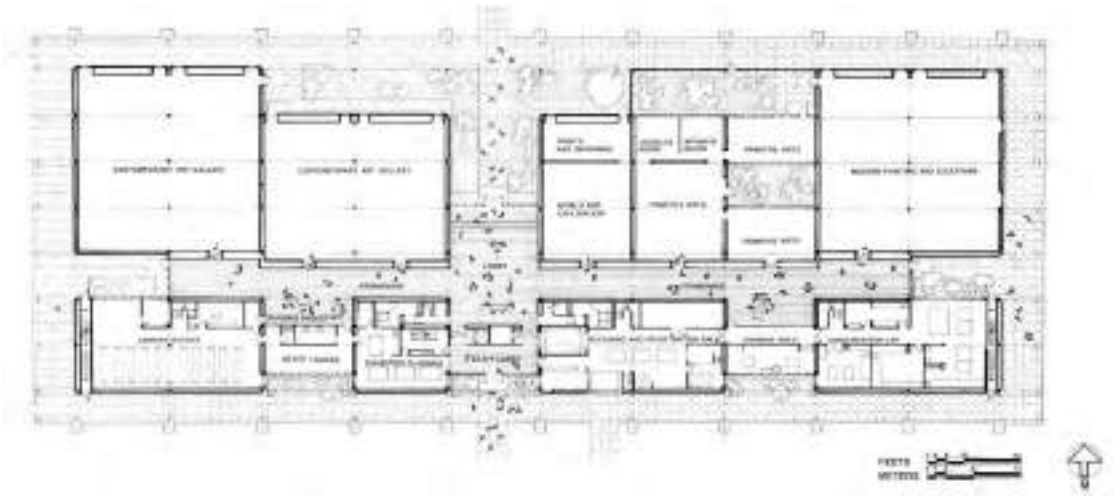

Fig. 5. Menil Collection's ground floor plan (Renzo Piano Foundation, Genoa).

A tripartite glass door breaks the quite opaque long façade almost at the middle, leading not to a conventional lobby, but rather to a bigger version of the entrance gallery of the Menil House. To reinforce this close connection Dominique suggested a similar black colour for the floors – here in pine boards – and she designed a new version of the ottoman placed in the living room of the house. At the entrance of the Menil Collection there were no information or ticket desks, no cloakrooms or bookshop. As the visitors enter the house of the collector, they are directly plunged into a gallery with four works of art: Barnett Newman's *Now II* (1967) and *Anna's Light* (1968) facing two sculptures from Congo (Middleton, 2018: 17-18).

This entrance gallery is crossed by a long corridor that, as is typical in a common house, divides a series of rooms on the left and on the right. Six galleries were placed on the north: two large exhibition spaces for 19th and 20th century modern art on the left of the lobby, and a large space for modern paintings and sculptures with smaller galleries for primitive, classical, and oceanic art on the right. On the south of the central spine Piano placed the library, the research rooms, and the preservation and conservation laboratory. Due to a precise request from Dominique de Menil, those complementary spaces were given the same importance as the exhibition galleries, with large glass screens that encouraged people's curiosity from inside and outside the museum (Ishida, 1987: 67).

To reinforce this domestic aura of "intimacy" all the plant machineries, such as the electricity generator and the boiler – noisy, smelly and in danger of explosion – were housed in a separate "energy room", placed at the southern corner of the site, beyond some of the bungalows, and connected to the museum through underground ducts. Nothing had to distract the visitors' attention and appreciation of the works of art.

Figg. 6-7. On the left the ottoman designed by Dominique de Menil for the living room of her house and, on the right, the Menil Collection's lobby through the east corridor in his original setting, with a new version of the ottoman, again designed by madame de Menil (Courtesy of the Menil Archives, The Menil Collection, Houston; Renzo Piano Foundation, Genoa).

As in the Menil House, the museum's rectangular plan is fragmented by a series of patios and small gardens that convey all the possible views to the outside. At the ends of the central spine, two small gardens are cut out into the museum's side walls. And three similar oblong green areas are placed to the rear façade – in front of the staff entrance and the conservation workshop – and to the main façade, in front of and next to the main entrance. Finally, a small patio – with the same tropical plants that characterized the Menil House – is placed between the primitive art galleries. In particular, Piano focused his attention on the way of filtering natural light asked by Dominique de Menil. She experimented the changing beauty and delicate modulation of natural light during the design and the construction of the Rothko Chapel (1964-1971), along the same street where the Menil Collection was to be built (de Menil, 1970; Barnes 1989; Dohoney, 2019).

Figg. 8-9. On the left, the lobby through the main entrance and, on the right, the primitive art gallery between the patio and the rear garden (Renzo Piano Foundation, Genoa).

Rothko's New York studio presented a large skylight in the centre, and he used to paint and appreciate his work under the natural light that he could modulate as well (Middleton, 2018: 478). In 1964 John and Dominique de Menil commissioned Rothko to realize ten mural paintings for a new ecumenic chapel they wanted to build in Houston. He asked to be involved in the project and insisted that his work has to receive only natural light. For this reason, both the first project by Philip Johnson and the definitive one by Howard Barnstone and Eugene Aubry presented a large central octagonal skylight made of steel and glass. However, just after the inauguration of the chapel, it was realized that the intense light of Texas was too strong for Rothko's paintings, and a dark diaper was added under the glass opening in order to decrease and better diffuse the light.

Piano visited the Rothko chapel with Dominique de Menil during his first trip to Houston, and he studied the roof structure of the nearby Louis I. Kahn's Kimbell Museum as well. In November 1980, under the advice of Pontus Hultén, Piano visited with Dominique de Menil a small museum in the Ein Harod kibbutz in Israel, that adopted a similar solution of one-piece monolithic diaphragm just under the skylights.

Piano refined the plastic-prefabricated roof structures he built during the Sixties and, with the advices of Arup structural engineer Peter Rice (1935-1992) and services engineer Tom Barker (1936-), adopted a slightly different solution for the Menil Collection. He fragmented the roof structure into a series of different and superimposed layers, carefully studying a "piece" for diffusing the light that could be mass produced and assembled on site. Those three hundred ferro-cement "leaves" represented the lower layer of the roof structure, hooked to ductile-iron reticular trusses that also bear the skylights on top[3] (Dal Co, 2014: 154-155). Here, for the first time, Piano adopted a strategy that will later become one of his signatures: charging the roof structure not only for functional reasons, but treating it as the aesthetic mark of the building. This was evident in the decision of posing the ferro-cement leaves inside and not outside the skylight, where the *brises-soleil* are usually placed. A choice that weakened the water-proofing of the skylights and trapped the heat inside the building, producing an extra-cost for the air condition. But, in doing so, this carpet of leaves is always visible from the inside of the galleries and the outside walkway along the external perimeter of the museum, as a modern reinterpretation of a Renaissance palace's *cornice* (Ingersoll, 2010: 227).

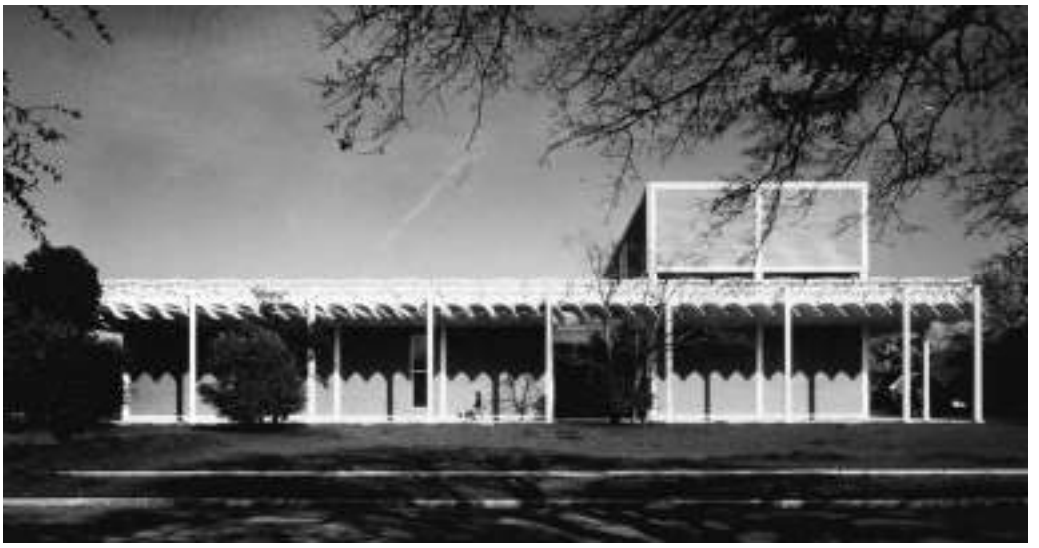

Fig. 10. The Menil Collection's ferro-cement leaves as a modern *cornice* (Renzo Piano Foundation, Genoa).

[3] The construction of the ferro-cement leaves was undertaken by Ferrocement Laminates Ltd of Leeds, while the ductile iron trusses, a particular type of cast iron – spheroid graphite – were made at the Crown Foundry in Northampton. The minutes of meetings and field reports between Piano, the local firm Richard Fitzgerald and Partners and the general contractor E. G. Lowry Inc. are kept at the Renzo Piano Foundation Archives, Menil, Pfitz/MEN/006.

The reception of the Menil Collection was highly positive. Critics pointed out the «domestic scale» of the building and how it was «unpretentious» (Glancey, 1983: 61-62; Davey 1987). Unlike the Centre Pompidou, the Menil Collection seemed to «derive its strength from its concept rather than the memorability of its form» (Ingersoll, 1987: 40). And Reyner Banham, who visited the construction site several times before the completion, spoke about «a structure that doesn't even try to look like a museum» marked by a light of «ethereal beauty» (Banham, 1987: 125, 128).

The Swiss art dealer Ernst Beyeler (1921-2010) was so impressed by the museum that a few years later requested Piano to design a similar building for displaying his collection in Basel. The same was for Raymond Nasher (1921-2007), for whom Piano designed a sculpture center in the downtown of Dallas, adopting the same strategy he set up in Houston: simple plans, closed walls along the streets, glass panels open to internal gardens or patios, dark floors, and a layered roof structure for conveying the exact amount of natural light that the works of art requested. A museum that does not impose its presence but rather disappears with discretion under the skyscrapers of the nearby downtown (Self, 2004).

Figg. 11-12. On the right, the layered roof structure of the Fondation Beyeler in Basel as a reinterpretation of the Menil Collection's one, on the left (Renzo Piano Foundation, Genoa).

The vision of Dominique de Menil – the artifice of "intimacy" that the galleries convey, and the primacy of the artworks over the spectacularism of the building – completely change the "image" that Renzo Piano derived from the Centre Pompidou. In later articles and publications, Piano was able to stress the crucial role that Dominique de Menil played in the design process, implicitly suggesting to the others collectors and museum directors that the architect has not to impose his style and mark, but rather to adopt and interpret the requests of the client (Farrelly, 1987). If other American museums completed during the Eighties – Richard Meier's High Museum of Art in Atlanta (1980-1983) or Arata Isozaki's Museum of Contemporary Art in Los Angeles (1980-1986) – were characterized by highly photogenic exteriors and impressive foyers and circulation spaces, Piano proposed a quite different way, focusing on the quality of the light, the feasibility of the galleries, and the inclusion of the urban context, following the path traced by Dominique de Menil.

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References

Banham, R., 1987. In the Neighborhood of Art, in *Art in America* 6, pp.124-129, Brandt Art Publications, New York, USA.

Barnes, S., 1989. *The Rothko Chapel. An Act of Faith*, University of Texas Press, Austin, USA.

Bucci, F., 2011. In the Age of Piano, in *Casabella* 797, pp.69-70, Arnoldo Mondadori Editore, Segrate, Italy.

Carroll, M., 2009. L'età dell'innocenza, in *Abitare* 497, pp.134-135, RCS MediaGroup, Milano, Italy.

Couturier, M.A., 1983. *L'Art Sacré*, Menil Foundation, Herscher, Houston, USA.

Dal Co, F., 2014. *Renzo Piano*, Electa, Milano, Italy.

Davey, P., 1987. *Menil Museum*, in *The Architectural Review* 1081, pp.36-42, Metropolis International, London, UK.

de Menil, D., 1937a. *Remarques sur une chapelle*, in *L'Art Sacré* 17, pp.90-91, Ed. du Cerf, Paris, France.

de Menil, D., 1937b. Leçon d'une chapelle japonais, in *L'Art Sacré* 18, pp.117-119, Ed. du Cerf, Paris, France.

de Menil, D., 1970. The Rothko Chapel, in *The Art Journal* 3, pp.249-251, College Art Association, New York, USA.

de Menil, D., 1987. The Menil Collection and Museum, in *a+u* 11, pp.62-63, Shinkenchiku-Sha Co., Tokyo, Japan.

Dohoney, R., 2019. *Saving Abstraction: Morton Feldman, the de Menils and the Rothko Chapel*. Oxford University Press, Oxford, UK.

Farrelly, E.M., 1987. Piano Practice. Picking Up the Pieces (and Running with Them), in *The Architectural Review* 1081, pp.32-35, Metropolis International, London, UK.

Fox, S., 2010. Dominique and John de Menil as Patrons for Architecture, in *Art and Activism. Projects of John and Dominique de Menil*, Helfenstein, J., Schipse, L. (Eds.), pp.199-217, The Menil Collection/Yale University Press, Houston/New Haven and London.

Glancey, J., 1983. Piano Pieces, in *The Architectural Review* 1059, pp.59-63, Metropolis International, London, UK.

Helfenstein, J., Schipse, L. (Ed.), 2010. *Art and Activism. Projects of John and Dominique de Menil*, The Menil Collection / Yale University Press, Houston / New Haven and London.

Hopps, W., 1984. *La rime et la raison. Les collection Menil Houston-New York*, Galeries Nationales du Grand Palais, Paris, France.

Ingersoll, R., 1987. Pianissimo: The Very Quiet Collection, in *Texas Architects* 3, pp.40-47, Texas Society of Architects, Austin, USA.

Ingersoll, R., 2010. The Porosity of the Menil Collection, in *Art and Activism. Projects of John and Dominique de Menil*, Helfenstein, J., Schipse, L. (Eds.), pp.223-232, The Menil Collection/Yale University Press, Houston/New Haven and London.

Ishida, S., 1987. Toward and Invisible Light: Design Development, in *a+u* 11, pp.64-70, Shinkenchiku-Sha Co., Ltd., Tokyo, Japan.

Lion, A. (Ed.), 2005. *Marie-Alain Couturier. Un Combat Pour L'Art Sacré*, Editions du Cerf, Nice.

Loud, P.C., 1989. *The Art Museums of Louis I. Kahn*, Duke University Press, Durham.

Middleton, W., 2018. *Double Vision. The Unerring Eye of Art World Avatars Dominique and John de Menil*, Alfred A. Knopf, New York.

Minnaert, J.B., 1991. *Pierre Barbe architecte*, Mardaga, Liege, Belgium.

Newhouse, V., 2007. *Renzo Piano Museums*, The Monacelli Press, New York, USA.

Ouroussof, N., 2009. Renzo Piano Embraces Chicago, in *The New York Times*, May 13, The New York Times Company, New York, USA.

Piano, L. (Ed.), 2007. *The Menil Collection*, Renzo Piano Foundation, Genova, Italy.

Piano, R., 2010. Working with Light: A Portrait of Dominique de Menil, in *Art and Activism. Projects of John and Dominique de Menil*, Helfenstein, J., Schipse, L. (Eds.), pp.218-221, The Menil Collection/Yale University Press, Houston/New Haven and London.

Piano, R., 2017. *The Complete Logbook*, Thames & Hudson, London, UK.

Self, R., 2004. A Museum Without a Roof, in *Texas Architects* 3, 2004, 25, Texas Society of Architects, Austin, USA.

Smart, P.G., 2010a. Aesthetics as a Vocation, in *Art and Activism. Projects of John and Dominique de Menil*, Helfenstein, J., Schipse, L. (Eds.), pp.21-40, The Menil Collection/Yale University Press, Houston/New Haven and London.

Smart, P.G., 2010b. *Sacred Modern. Faith, Activism and Aesthetics in the Menil Collection*, University of Texas Press, Austin, USA.

van Dyke, K., 2010. Losing One's Head: John and Dominique de Menil as Collectors, in *Art and Activism. Projects of John and Dominique de Menil*, Helfenstein, J., Schipse, L. (Eds.), pp.119-137, The Menil Collection/Yale University Press, Houston/New Haven and London.

Vassallo, J., 2015. Doll's House, in *AA Files* 70, pp.19-23, Architectural Association School of Architecture, London, UK.

Webb., B.C., 2008. Living Modern in Mid-Century Houston: Conserving the Menil House, in *Journal of Architectural Education* 1, pp.11-19, Taylor & Francis/ Routledge, London, UK.

Welch, F.D., 2000. *Philip Johnson & Texas*, University of Texas Press, Austin, USA.

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Renzo Piano and his Project for the Vedova Foundation in Venice

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Abstract

Throughout this research, we would like to focus on the Emilio and Annabianca Vedova Foundation in Venice. The Foundation's Museum was opened to the public in 2009 and dedicated exclusively to the work of the Venetian artist. It is situated in the suggestive headquarters of the Salt Warehouses, one of which was saved from destruction and used as a studio by Vedova in the last part of his career. The restoration of this medieval space and its new destination as a museum was entrusted by the painter himself to his long-years friend architect Renzo Piano. They knew each other from 1983 when they cooperated to realize the scenography for Luigi Nono's opera *Prometeo*. The Genoese had already a vast experience of creator and builder of monographic museums at the time of Vedova's commission. He then began to realize an atypical project, where the protagonist is a mechanical device with the task of extracting from a cage-deposit the painter's works and bring them to the visitor's attention along the gallery of the former warehouse.

After a short introduction to Emilio Vedova's art, it will be important to discuss his friendship with the architect. This is extremely useful to understand the relationship that Piano had with the artist's legacy and how he transferred his interpretation to the building. Subsequently, I will focus on the device itself, which is not unique in the architect's career. Furtherly, it is possible to find in the project another important characteristic that is common to other Piano's museums: the 'Treasure House'. In conclusion, I will try to find analogies and differences between the Vedova Foundation and the previous monographic museums, trying to outline, if possible, a common approach used by the RPBW to the critical problem of designing a building devoted to a single artistic legacy.

Keywords: Museum, Machine, Traldi, Paintings Discovery

1. Introduction

In this paper, we aim at analysing a very particular museum within the contemporary realm: the Emilio and Annabianca Vedova in Venice[1]. The Foundation's exhibition space opened to the public in 2009 and it was dedicated, in its permanent collection, exclusively to the work of the Venetian artist, who died in 2006. It is situated in the suggestive headquarters of the Salt Warehouses. Among the nine historical environments, the first of them hosted the painter's studio for the last part of his career. The large and long rectangular space of the *squero*[2] was saved by the intervention of Emilio Vedova. He succeeded in interrupting a project of dismantling and reconversion initiated by the City of Venice. The restoration of the warehouse and its new destination as a museum dedicated to the memory and exhibition of the works of Vedova was entrusted by the painter himself and by his wife Annabianca to his friend, the architect Renzo Piano. The two artists met in 1983 and collaborated on Luigi Nono's *Prometeo*. The Genoese had already, at that time, a vast experience of museum architecture, from the first, the almost legendary Centre Pompidou in Paris (1971-1977), to the most recent Paul Klee Zentrum in Bern (1999-2005). Since 2000, he began to realize a museum for the Foundation, choosing to develop an extremely original and atypical project, entrusting the paintings' display to a mechanical device (Piano 2016). This robotic arm is designed to extract from a cage deposit the painter's artworks and bring them, through the gallery of the former *squero,* at the sight of the public.

It is necessary to clarify that the main purpose of this research was to identify and study the museum characteristics of the Foundation within the vast production of Renzo Piano, mainly in the context of his career as a museum architect. This is due to the fact that today we can find an almost total absence of references to this singular project in the vast bibliography on Renzo Piano. At the same time, the analysis could not proceed without a preliminary study on the artistic figure and works of Emilio Vedova. Understanding Vedova's art allows us to enlighten Piano's approach to his inheritance. It is also extremely important to research the professional relationship intercurred between them from 1983 to 2000. Through the study and comparison of their respective careers we will try to analyse this interesting museum evaluating it under two fundamental aspects: first, as one of the most original contributions by Renzo Piano to contemporary museology and museum-technique; besides, as an extremely efficient cultural institution, which succeeds in the complex task of exhibiting the work of one of the most important Italian contemporary artists.

2. The Emilio and Annabianca Vedova Foundation: the spaces of display

The Salt Warehouses are located in Venice, in the area of the historic *Punta della Dogana*, at the end of the rafts. Built by the Serenissima during the fourteenth century for the use of commercial storage of salt, they also appear in the famous map of Jacopo de Barbari, dating back to 1500 (Celant, 2009). Around the third decade of the 19th century, the Habsburg government commissioned the renovation of the building to Alvise Pigazzi, who rebuilt the façade in a pure neoclassical style. In the course of the first years of the twentieth century, after a period of utilization as *squeri*, they fell in a state of degradation. Consequently, at the beginning of the Seventies, the City Council of Venice began to think of a new function for these spaces. Precisely at that time, on his return from a trip to Cuba, Emilio Vedova, who had known the warehouses in their original status during his childhood, found the bulldozer ready to destroy them. The public administration had accepted a project of reconversion, in

[1] This research was based on the general bibliography written on Renzo Piano and Emilio Vedova including the fundamental volumes published by the Foundation edited by Germano Celant in 2009 and 2019 (Celant 2019). The first is focused on the birth of the museum and the relationship between the two men (Celant 2009). I have consulted Vedova's writings and Piano's testimonies. In addition to that, the consultation of the Atelier Traldi's archives in Milan was fundamental to understand the project's development. In Milan, I also had the opportunity to interview the architect Alessandro Traldi, partner of the RPBW in the project.

[2] In Venetian dialect, the word 'squero' identifies a small shipyard, especially for little rowing boats.

view of the construction of a swimming pool and a sports centre on the place of the ancient buildings. Following these events, in 1974 Vedova began his battle against the City Council for the rescue of the warehouses (Biasin, 1974). He was soon supported by scholars, artists and intellectuals from all over the world, as well as by a relevant sector of the Venetian citizenship. The art historian Giulio Carlo Argan sent urgently an important notification to the President of the Superior Council of Fine Arts, emphasizing the qualities of the building: «exceptional documents of ancient industrial architecture» (Argan, 1974[3]). In the same document, he claimed that the destruction could have been an outrageous crime without precedents in the city.

Alongside the attention to the historic and artistic point of view, the rescue of the building was fundamental for Vedova for other essential reasons: «it happens that the architectures that bear a name in the history of art are always studied, the glories of the untouchable architectures of the powerful – singles and not –, and in the glory of the powerful they are visited in admirative processions! These constructions instead, […] monuments-presence […] of the work of the masses that made possible – in simultaneous – the official and celebratory architectures, these are destroyed» (Vedova, 1974: 218[4]).

Vedova remained affectioned to his childhood memories and to the popular dimension of the place. For him, those walls represented the fatigue and efforts of entire generations of the Venetian working classes, the real face of Venice, with its relationship between the sea and the lagoon (Vedova, 1974: 211). Finally won the battle, thanks to the special concession by the City of Venice, Vedova established his workplace in the first of the nine environments, which would have become his studio and atelier until his death in 2006. After having met Renzo Piano in 1983, during the works for Luigi Nono's *Prometeo*, Vedova established a lasting friendship with the Genoese architect, in particular during his years in Berlin in the same decade. About this period, Piano remembers: «on various occasions it happened to talk about the Salt warehouses, the speech emerged from the shadow. […] between the 1980s and 2000 we met there at least two or three times. […] there was always the idea that this magical place, this Ali Baba' cave, […] could one day become the home for his works» (Celant and Piano, 2009: 48[5]). Moreover, the same Vedova states at the beginning of the Nineties: «in the same places, I hope the Foundation museum will find its abode. I mentioned this to my friend Renzo Piano, who, I hope, is willing to cooperate. Piano – an architect of land and water- from Genoa to Osaka, from Amsterdam to Berlin…. to Venice?» (Vedova in Bianchini, 2009[6]).

A key-date in the history of the place is certainly 2000, when Vedova accepts with enthusiasm Piano's preliminary draft for the museum. Unfortunately, the artist could not see the opening of its monographic museum in 2009, due to his death on October 25th, 2006.

The Foundation is composed of several spaces close to each other, which the warehouse remains the most important, separated from the ticket office and the temporary exhibition wing. The access is from the original wooden door, from which you enter a perspective gallery made in the same brushed and bleached larch wood that constitutes the floor (Milan 2009) (figs.1-2). This is a sort of introductory narthex which allows the visitor to enter the vast longitudinal space of the warehouse itself. This wooden access space introduces the public to feel a spatial and emotional detachment between the exterior of the rafts and the museum's interior, characterized by a profoundly different atmosphere. The natural light of the Venetian lagoon is reduced to faint rays that weakly filter through the wooden insole. Once distanced from this scenographic entrance, the visitor can feel the inclination of four degrees towards the top of the floor, which returns perfectly horizontal only at the height of the cage deposit. Below the new wooden floor, Piano has placed all the plant engineering systems of the building.

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[3] «Eccezionali documenti di architettura industriale antica». Every English translation in the text is curated by the author.

[4] «Si vanno sempre a studiare le architetture che portano un nome nella storia dell'arte, i fasti delle intoccabili architetture dei potenti – singoli e no –, e in gloria dei potenti le si fanno visitare in processioni ammirative! Queste costruzioni invece, […] monumenti-presenza […] del lavoro delle masse che hanno reso possibile -in simultaneo-, le architetture ufficiali e celebrative li si distruggono».

[5] «In varie occasioni è accaduto di parlare del magazzino del sale, il discorso emergeva dall'ombra. […] tra gli anni ottanta ed il 2000 ci siamo stati almeno due o tre volte. […] c'era sempre l'idea che quel luogo un po' magico, questa caverna di Alì Baba, […] sarebbe potuto diventare un giorno la casa per le sue opere».

[6] «Negli stessi luoghi mi auguro trovi spazio la parte museale della Fondazione. Ne ho accennato all'amico Renzo Piano, che, spero sia disposto a collaborare. Piano -architetto terra/acqua- da Genova ad Osaka, da Amsterdam a Berlino…. a Venezia?».

Figs. 1-2. Magazzino del Sale, 2014 (© Fondazione Emilio e Annabianca Vedova, Venice).

Solving a functional problem, he obtains an outstanding museological solution: the visitors experience a progressive approach towards the art of Vedova, as a journey in a dimension which is completely different from the real world outside the museum. The floor, slightly detached from the two brick walls, does not follow the irregularities of their surfaces, in order to hide the vents of the geothermal heating collocated below. The inclination of the wooden boards can be modified in the case of special displays through a system of horizontal platforms. The two brick walls are very different from each other, as the one on the left of the entrance is more or less regular and smooth, while the one on the right retains the original buttresses that had to support the thrusts of the material deposited there in the past. The building is covered by the original wooden truss roof, perfectly restored. Beyond the floor and the entrance framework, the only element that alters the ancient space is the iron archive cage from which starts the aerial track with the mechanical arms and the artificial lighting system that constitutes the display device. The machine was designed by Renzo Piano and realized thanks to the collaboration of the engineer Maurizio Milan and the Milanese architectural studio of Alessandro Traldi, together with the professional company Metalsistem (Celant, 2009; Milan, 2009). It is important to underline that the project is the result of a complex team: the design is mainly attributable to the Building Workshop, while the technological and technical side was brought to reality by experts in the field, under the supervision of the architect.

The archive is a rack-mounted structure, which is a grid-shaped metal box through which the stored works

are perfectly visible, placed in row, inside special racks. From this repository starts the display machine, which consists of a metal channel with mobile devices which is able to extract the works and bring them to the visitor's attention along the entire longitudinal axis of the former warehouse (fig.3). The mechanical engines allow an extremely flexible display, as there is large freedom of movement in the space. The selection and settings of the works are therefore completely managed by the curator, who adapts the machine to the ever-changing needs of the public and the succession of events and temporary exhibitions. This flexibility is assisted by a system of spotlights controlled by a console that allows adapting the light conditions to the minimum displacement of the works. This complex system creates a display that "presents itself" to its audience, which sublimates the musealization in bringing the works to the attention of the visitor, who finds himself at the centre of a world that could have never imagined at the entrance of the Foundation. At the same time, the attention towards the integrity and conservation of the works is preserved, so that the dynamic museum does not sacrifice one of its main missions: to promote and preserve the legacy of the Foundation and the works of Emilio Vedova to posterity.

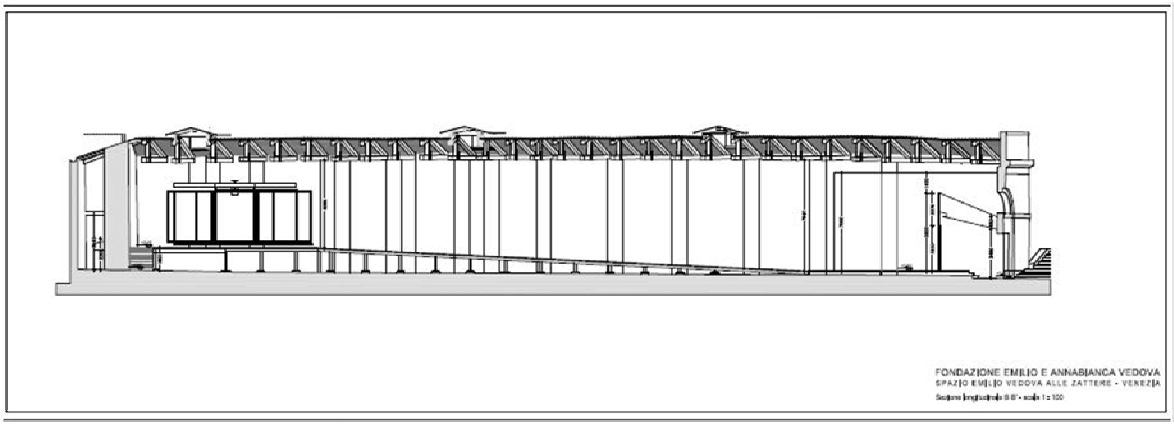

Fig. 3. Magazzino del Sale, 2014. Section 1-100 (© Fondazione Emilio e Annabianca Vedova, Venice).

3. Emilio Vedova and the Salt Warehouses

The aim of this research is not an overview of Vedova's work, too heterogeneous, variegated and complex to be summarized in a few lines. On the contrary, our interest is to understand the relationship between the art of the Venetian master and the museum space dedicated to him. In this regard, it is therefore useful not only to analyse the relationship between the artworks and the place where they were created and displayed to a selected audience, but also how it was the connection between Emilio Vedova and his workplace, an environment that he fought so hard to save. We have underlined how for the painter the warehouses represented the last witnesses of a long Venetian tradition of building and hard working. Several times, in the bibliography on Vedova, it is emphasized that the artist has never been separated from the politician and that Vedova's art – within the *Absurdes Berliner Tagebuch '64* and *Chi brucia un libro brucia un uomo* are the most famous examples – is imbued with contemporary history and lasting coherent political faith (Rorro and Barbuto, 2007: 27-32). So, for the artist, the *Magazzini* become a real symbol of the Venetian proletariate, the *S. Marco of the last* (Vedova, 1974: 218[7]).

It is important to consider, that one of the main characteristics of the *Zattere*'s building, most dear to Emilio Vedova, was its relationship with the lagoon, its size of "cave", in which you enter from the sea and to the sea you return once out. It is for him an architectural metaphor of Venice, of its diaphragmatic relationship between land and sea. In various painter's notes, this idea returns, in which we can see as the artworks are extremely related to the unique location of the studio and its own architectonic features: «continuum- /visual references-

[7] «San Marco degli Ultimi».

/nostalgic mirrors-/water-/simultaneity/co-presences-/crooked walls […] time = wall… silence-» (Vedova, 1987-1988[8]). For him, the Zattere's fog creates always a perfect atmosphere for thinking (Vedova, 1987-1988).

In the book published for the Foundation's opening, Fabrizio Gazzarri emphasizes how Vedova was attached to his workplace, where he remained to "fight with the beast" as he called the artistic process (Gazzarri, 2009a[9]). The architect Alessandro Traldi sustains: «the very close relation between Vedova's work and the space of the Warehouses certainly influences his artworks but could also lead to overlap the physical characters of the former and the latter arriving to confuse them. […] The space […] is a dark cave that is there waiting to devour you, exactly as Vedova told it was his relationship with the great canvases: a sort of "devouring"» (Traldi, 2009: 163[10]).

It should also be emphasized that, especially from the Seventies onwards, Vedova's artistic career began to focus on great cycles. There were installations that the longitudinal environment of the *squero* could accommodate in all their complexity and in the relationship of the single piece with the others, without problems of space. From the *Plurimi* onwards, the character of fusion between painting and sculpture became a primary need in Vedova's artistic creation. Invading the third dimension and unravelling the traditional spatial set-up in its relationship with the spectator was an important side of his painting process, which took place inside the warehouse. Consequently, this environment was essential to Vedova's art, not only because it was influent to his work every day, but also because he often displayed inside the warehouse. The artist forced his guests to wait there while he was bringing the artworks that he wanted to show (Celant, 2009).

4. The relationship between Emilio Vedova and Renzo Piano: Luigi Nono's *Prometeo*

The friendship between Emilio Vedova and Renzo Piano began in 1983 when, together with Massimo Cacciari and Claudio Abbado, they were contacted by the great Venetian musician Luigi Nono for the realization of his opera *Prometeo*. Claudio Abbado, director of the Scala orchestra, was in charge of the musical aspects. On the other side, Emilio Vedova and Renzo Piano had to deal with the scenography together. Specifically, it was up to the architect to design the space that Nono had in mind for his music. Piano recalls: «Gigi wanted to create a musical space where the audience could be at the centre and the musicians all around. We also talked about the possibility of playing with colours, with slides, and Emilio, who certainly had no problems in inventing, immediately brought me some slides of the Expo in Montreal to project them everywhere. That's how it started» (Celant and Piano, 2009: 47[11]).

It should be remembered that Emilio Vedova had the first experience of collaboration with Nono in 1961, when they brought on stage at the Teatro La Fenice *Intolleranza 60*, a revolutionary musical work inspired by the Russian avant-garde. On that occasion, Vedova had used a scenography entrusted to the effects of light, projecting a series of images conceived by him (Rorro and Barbuto, 2007). In this artistic and musical experience, the audience found itself directly involved in something completely new: artist and musician had transformed the traditional relationship of enjoyment of a musical composition and Vedova had started his research of using the light through the projection to invade the space. This artistic process would have led him to realize *Spazio/Plurimo/Luce* for the Montreal Expo in 1967 (Eccher, 1996). In that situation, the painter created an installation for the Italian Pavilion in which glass painted plates were projected on the walls.

Returning to *Prometeo*, Piano designed what it was defined as an ark, a large wooden structure that could be easily disassembled and reassembled (Dautrey, 2007). This design fulfilled the flexibility requested by Nono. It could host in his interior 400 spectators, who were surrounded by musicians, seated on galleries along the ark's

[8] «Continuum- /rimandi visivi-/specchi di nostalgie-/acque-/simultaneità/ compresenze-/sghembe pareti […] parete=tempo… silenzio-».
[9] «Lottare con la bestia».
[10] «La strettissima relazione dell'opera di Vedova e lo spazio dei Magazzini investe certamente i suoi lavori, ma potrebbe portare anche a sovrapporre i caratteri fisici dell'uno e degli altri fino a confonderli. […] Lo spazio […] è un antro oscuro che è lì in attesa di divorarti, esattamente come Vedova raccontava essere il suo rapporto con le grandi tele delle sue opere: una sorta di "divoramento"».
[11] «Gigi voleva creare uno spazio musicale in cui il pubblico fosse al centro e i musicisti tutti attorno. Parlammo anche della possibilità di giocare con i colori, con diapositive, ed Emilio, che non aveva certo problemi nell'inventare, subito mi portò alcune diapositive dell'Expo di Montreal da proiettare dappertutto. Cominciò così».

walls. Located inside the former Church of San Lorenzo, the structure gave the impression of a large ship stranded in the heart of the Venetian monument. At the same time, it became an impressive musical instrument thanks to the use of lamellar wood as suggested by the violin makers tradition (Piano, 2016: 68). In the beginning, Nono thought that Vedova's contribution could have been, as in 1961, the projection of a series of images. In accordance with the composer, Vedova chose to reuse some of the Murano glass plates designed for the Expo. However, after the first rehearsals, the artists realized that the effect could distract the audience from the intensity of Nono's music and to create a «sons et lumière» (Piano and Celant, 2009: 47) effect that was not suitable for the tragedy. At that moment, Vedova wholeheartedly accepted that his intervention would be reduced to turn on and off the lights, creating only a subtle and refined atmosphere to the musical experience. Consequently, the audience found itself surrounded by music and flashes of light created by the painter. Piano's ark made possible a partial rotation of the chairs. The public could follow the flow of sounds through the wooden structure.

It is pivotal to recall the episode of this first collaboration between Renzo Piano and Emilio Vedova. Even if it has often been transformed into a sort of myth, this story reveals the basis on which the relationship between the two men started. In addition, it is possible to see in the project of *Prometeo* some strong conceptual and poetic analogies with the future display for the Foundation. However, this work represents an important stage in the architect's career rather than in Vedova's or in a process of sharing ideas between the two artists. Therefore, the painter's influence on the exhibition space designed by his friend must be perceived in other moments of his art.

5. The Foundation museum space

The Vedova Foundation, alongside the critical reception from art historians, architects and critics after the museum opening in 2009, focused everybody's attention on Vedova's contribution to the project. It was considered essential to the idea of a moving machine for his own space. Beyond its effective participation, which undoubtedly existed, it is stated that the art and ideas of the Venetian master deeply pervaded the work of his friend Renzo Piano. He was seen almost as a mere executor, although indisputably brilliant, of an architecture faithful to Vedova's conception. For this reason, it will be analysed Emilio Vedova's participation in the museum project, mainly through Renzo Piano's words. The architect, interviewed by the curator Germano Celant, clarifies some coordinates of his initial relationship with the painter, especially regarding the space of the warehouse. It is also relevant to highlight some affinities between Vedova's art and biography and the main characteristics of the museum opened in his name, without forgetting the differences, which are often more significant.

At the beginning, it was Vedova himself who turned to Piano for the realization of the museum, insisting first of all on the idea that the Genoese friend was similar to him, an artist between "land and water" perhaps because of his Ligurian origins: «I am Venetian - You Genoese… light-movement-water towards the open outside… We are people of the open sea» (Vedova in Bianchini, 2009[12]). On the painter's contribution to the idea of a dynamic museum, as it will then result in the final project, Piano states: «it was clear that it was not a matter of displaying the works as you normally do. […] In my imagination it could be like a dark hold, where there was everything all around. Hence, the idea that the viewer […] is in the middle of the work» (Celant and Piano, 2009, 48[13]). And then, again on the question works' mobility in the space and around the visitors: «I'm not sure if I've talked to Emilio about it, but the possibility of having not a static museum but a real warehouse, from which to extract one piece at a time, one after the other, was certainly an idea he had in mind. I honestly don't remember dealing with him on the subject explicitly, but I think so. […] The idea was in the air, and we should not forget that the warehouses are narrow and long, so it was sensible to imagine that in the bottom […] the deposit could be placed and that from this, as if by magic, the works could come out» (Celant and Piano, 2009, 48[14]).

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[12] «Io veneziano - tu genovese… luce-moto-acqua verso l'aperto… siamo gente da mare aperto».

[13] «Era chiaro che non si trattava di mettere le opere come si fa normalmente. […] Nel mio immaginario era una stiva un poco oscura e attorno c'era di tutto. Da qui viene l'idea che lo spettatore […] stia in mezzo all'opera».

[14] «Non sono certo di averne parlato con Emilio, comunque la possibilità di avere non un museo statico bensì un vero magazzino, dal quale estrarre un pezzo alla volta, uno dopo l'altro, era certamente un'idea che lui aveva in mente. Onestamente non rammento di aver affrontato l'argomento con lui in maniera esplicita, ma credo di sì. […] L'idea era nell'aria, e non si deve dimenticare che i magazzini sono stretti e

In addition to Piano's words, it is useful to recall this anecdote witnessed by the painter's collaborator Fabrizio Gazzarri: «It was fantastic to hear him [Piano] explaining the poetic sense of his project […] this gigantic cave still crossed and lived… from Vedova's world in transit, in provocation. Vedova, proving once more to be a dynamic and avant-garde man, immediately sensed the brilliant idea and was deeply impressed and fascinated. He did not have time enough to follow the developments and eventual corrections» (Gazzarri, 2009b[15]).

Reporting these words is pivotal because, according to the most recent researches, they constitute the only direct documents that help to reconstruct which was the exchange of ideas between Piano and Vedova on the future museum. They also give some information about the painter's creative contribution. From what we can know from these testimonies, that appear to agree with each other, despite some preliminary ideas, the conception of the cave/hold from which the artworks, deposited in a real warehouse, had to be extracted and be shown, is essentially due to Renzo Piano.

Even if the architect specifies, he does not remember if he had spoken directly with his friend Emilio about the design he had in mind, Gazzarri describes the painter "impressed and fascinated" from the project's sketches. This interpretation can lead us to think that the idea had not been particularly discussed with the architect until that moment. Consequently, it seems more likely that the dynamic project of the museum, also in its mechanical organization of the paintings' movement, can be attributable to Renzo Piano, although certainly influenced by conversations previously held with the artist. After having analysed *Intolleranza 60* and the *Interventi/luce* for *Prometeo* – the two collaborations between Vedova and Nono – alongside the beginning of the painter's friendship with Piano, this research will try to understand how the Venetian artist related his art with the exhibition space. In 1958, Vedova began his experimentations in the three-dimensional space for an exhibition in Warsaw, where he placed a painting in the ceiling. The year after, at Palazzo Grassi, the artist created site-specific artworks to be included in the displaying structures curated by the architect Carlo Scarpa (Celant, 2019). However, it was in 1963, with the great cycles of *Plurimi*, that Vedova began the process of research, transfiguration, invasion of space beyond the traditional two-dimensional painting, which would have marked his career for the following decades.

«The Plurimi are not sculpture or non-objective painting: they are structurally new paintings, conducted on many levels, with many eventualities of vision. […] a stereo-visive painting. […] pure spatial fragments, arrhythmic and aspatial, if time falls apart like space there is no continuity, it means that there is no eternity» (Argan, 1963: 42-46[16]). This is Giulio Carlo Argan's definition of *Plurimi* in 1963, highlighting their theatrical and scenographic characteristics. The *Plurimi* are slices of life, exploded shards, errant fragments, invading the same space in which they meet again in a state of almost fatalist eventuality. The influence of Tintoretto's painting on the young Vedova can be felt also in his later work, pervaded by a similar conception of history, seen as an ever-lasting tragedy enlightened by sudden thunders of miracle light (Argan, 1981: 11). These mobile forms, bound together by a hinge that at the same time unfolds and blocks them, involve directly the spectator with their action (Haftmann 1963: 52). They exist only in relation to each other, in a dimension of open possibilities to the public, who becomes an active participant in this theatrical event. Vedova's *Plurimi* are paintings of gesture and sign, directed to the observer who places himself in dynamic relationship with the artworks: «Not 'sculptures' to be turned around […] but moving characters that invite to dialogue, that provoke the others to move them, to create new conditions, relationships: to establish necessary dialogues– to transform spectators […] into active participants» (Vedova, 1961-5: 224[17]).

In the apparent chaos of colour and space, created by the artworks, it is up to those who observe to find their

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lunghi, per cui era sensato immaginare che nel fondo […] ci fosse il magazzino e che da questo, come per magia, venissero fuori le opere».

[15] «Era fantastico sentirlo [Piano] spiegare il senso poetico del suo progetto […] questa gigantesca caverna attraversata e vissuta, ancora… dal mondo vedoviano in transito, in provocazione. Vedova, dimostrandosi una volta di più uomo dinamico e di rottura, intuì subito la geniale idea e ne rimase profondamente colpito e affascinato. Non fece in tempo a seguirne gli sviluppi e le eventuali correzioni».

[16] «I Plurimi non sono scultura né pittura ridotta all'oggetto: sono pittura strutturalmente nuova, condotta su molti piani, con molte eventualità di visione. […] una pittura stereovisiva. […] frammenti spaziali allo stato puro, sono aritmici e aspaziali, se il tempo va in pezzi come lo spazio la continuità non c'è, vuol dire che l'eternità non c'è».

[17] «Non "sculture" da girarci attorno […] ma personaggi moventi che invitano al dialogo, che provocano altri dal pittore a muoverli, a creare nuove condizioni, rapporti: ad allacciare necessari dialoghi – fare dello, degli spettatori […] più partecipazioni attive».

own point of view and angle of observation, following the flow of paintings. In *Plurimi* there is certainly the most daring and violent moment of Vedova's invasion within that space "beyond", *Oltre* as defined by the philosopher Massimo Cacciari (Cacciari, 2009). In later experiences, including the installation of Montreal Expo in 1967, which have already been briefly discussed, and above all, in the cycles of *Plurimi/Binari*, it is possible to find similar artistic research. However, in *Plurimi/Binari* the paintings are more anchored to the earth, bound within their iron tracks, forced into constraints: those which were once the *Plurimi*'s fragments, in the *Binari* are certainly in a ground-rooted position. The theatrical dimension, as well as Vedova's gestural mobility towards the observer, remain an invitation to enter an immersive field of vision. Even if the space is always crushed in monads, in the *Plurimi/Binari* and in the following cycles of *Dischi*, *Oltre* and *Non-Dove*, the paintings seem more alone and melancholic, closed in themselves, without that overpowering aggressiveness towards the outside that characterizes the artworks of the early Sixties. However, in the early Nineties, Vedova conceived the vast cycle …*continuum*…, similar to *Plurimi* for his spatial dimension. The contrast between white and black was the main protagonist in artworks which became «free from the verticality and horizontality of space; they have become without point of gravity, […] a dialogue/clash with darkness» (Oberhuber, 1991: 112-113[18]). The installation curated by Vedova gave freedom of interpretation to the public, who enters in a circular work of art, *in continuum*; perhaps the last creative impulse of the artist towards an art projected to the infinity of space and time (Rorro and Barbuto, 2007: 170-171).

It has been just a brief analysis of Emilio Vedova's career, especially from the point of view of his cycles in which the relationship between painting, sculpture and architecture is stronger. From this short overview, we can notice a series of differences and similarities with Piano's museum. Several times, in the bibliography about the Vedova Foundation, or in the reviews after its opening (Collavo, 2009; Celant, 2009; Celant, 2010), the relationship between Vedova's art action in space and the architect's machine is emphasized. This original idea is often attributed to the painter. There is however a risk of misunderstanding the concept of mobility in the art of Vedova. In 1956, the artist explained his ideas: «All that building in the light, those dynamic surfaces appear to tell of a mobility that is similar to contemporary space. Every epoch has evidently specific characteristics and ours, for various reasons, is, according to me, characterized by a sense of measureless, by the expiration of all classical "a priori", by a perpetual mobility: the opposite of the pure concept, of the constituted default, of the immovable law» (Vedova, 1956: 220[19]).

The painter described mobility starting from the analysis of the similarities he found between the Baroque era and the contemporary world. This theatrical, scenographic, violent and rebellious concept of movement, in contradiction to the traditional perspective spatiality, can be perceived mainly in *Plurimi* and not in other cycles. We consider that this cycle is certainly the one which could have been more influent on Renzo Piano's dynamic approach to the warehouse's space. It differs from later cycles precisely because of the concept of mobility underlying the cycle itself. Regarding *Plurimi,* in the RAI broadcast *Vedova visto da vicino*, Vedova states: «I had felt the need to come out from the Albertian box» (Rorro and Barbuto, 2007: 114[20]). These characteristics of *Plurimi* seem irreconcilable with the austere procession, composed of simple calibrated geometries, generated by Renzo Piano's device, that the architect himself calls «leonardesque» (Bianchini, 2009). It seems that Piano takes only some secondary characteristics of Vedova's mobility: the use of pulleys, the up and down movements of some *Plurimi* – used both in 1967 and 1984 –, and the sonority of the mechanism. The sound is always present as an important track in the background to Vedova's cycles, both of the pulleys themselves but also from musical pieces created or chosen specifically for the works. Piano recalls also one of Vedova's interests, which was precisely the noise that could have been generated by the museum machine (Celant and Piano, 2009). The circular spatiality, tending to infinity, to perpetuation, in different ways, is much more conceptually similar to… *continuum*… than to *Plurimi*. Here the shape of the fragment and the absence of a clear spatial definition dominates. Nevertheless, Piano's project follows Vedova addressing directly the public, who is violently involved by the artworks' arrival and amazed by their manifestation. The art historian Maurizio Fagiolo agrees

[18] «Liberate della verticalità e della orizzontalità dello spazio; sono diventate senza punto di gravità, […] dialogo/scontro con le tenebre».
[19] «Quel tutto costruire nella luce, quei piani dinamici mi pare dicano di una mobilità che è affine allo spazio contemporaneo. Ogni epoca evidentemente ha specifiche caratteristiche e la nostra, per molteplici dati, mi pare caratterizzata da un non-misurabile, dallo scadere di tutti gli 'a priori' classici, da una perenne mobilità: il contrario del concetto puro, della mora costituita, della legge inamovibile».
[20] «Avevo sentito la necessità di uscire dalla scatola albertiana».

that «Vedova throws the paintings into the spectator's arms, the true *Plurimi* arbiter» (Fagiolo, 1975: 195[21]). The gestural and magical aspect, on which is based the artist's relationship with his audience, is understood and honoured by Piano even if it is translated to the calm and austerity of eternity and repetition, so different from the aggressiveness and rebellion of baroque Vedova's painting. Anyway, there is another contradiction: mobility and space similar to piranesian prisons (Vedova, 1989), a labyrinthic Venetian space in Vedova's mind (Bertelli, 2006: 15), against the project of his friend, pursuing more Renaissance's rigour and clarity. In conclusion, Piano strengthens the relations between the artworks, the same dialogue carried on by the artist in most of his cycles until the end of his life. He does so with the utmost sobriety and lightness. He realizes, consciously perhaps, the artist's directives, who, in 1956, had discussed the relationship between painting and architecture, wrote: «my works are at home in these spaces where there is a flow of multiple relationships. […] my paintings in a "wholly possessed" space does not breathe. […] Any exclusivism, any imposition cannot be the space for the artwork conceived as an autonomous, free statement» (Vedova, 1956: 221[22]).

6. Renzo Piano's project

Regarding the analogies and differences between Vedova's art and the new exhibition space created by Renzo Piano, according to the available sources, it is clear the painter's essential extraneousness to the project. Consequently, it seems difficult to argue that Piano had no place as a protagonist or that his personality as an architect cannot be appreciated in comparison to other of his buildings. Therefore, it is possible to understand which were the most direct sources of inspiration that led him to the original ideas for Vedova's environment. First of all, the architect sees in the *Salone* an affinity with a cave, with a ship's hold, perhaps remembering the ark of *Prometeo*. In the long and rectangular warehouse, Piano had to recall Vedova's idea for which it is not the spectator that goes to the painting, but it is the painting that goes to the spectator. Germano Celant suggests an analogy between the artist's way to display the paintings to his guests and Piano's device (Celant and Piano, 2009: 49): as he brought the artworks from a deposit into the *Salone,* while his public was waiting there, the same action is carried nowadays by the machine, almost a metaphor of Emilio's arms. Piano does not confirm or deny, but he merely states: «an artist's atelier is always an interior scene with an artist at work. [In the warehouse] there is the same atmosphere, it was sought and desired. It is Emilio who put it there» (Celant and Piano, 2009: 49[23]).

The architect also emphasizes that from the sun and the Venetian light that reverberates on the Zattere's water, the public enters a dark environment, which seems longer because of a visual illusion created by the inclined floor. This counter position between light and dark, between Venice and Vedova's own world, this deliberate demarcation of the two spaces, external and internal, seems to create a not negligible crasis with the original inspiration of the painter. He desired a museum in relation to Venice and the lagoon; that was what he expected from an architect expert in connecting buildings with water. Moreover, beyond the machine, the large wooden scaffolding of the entrance and the raised floor have not only the functional purpose of containing the services, but they have specific aesthetic qualities. For these reasons, they are certainly the strongest intervention within the old Salt Warehouse. The architect totally covers every trace of the original floor in *masegne* below, whose visual absence is even more evident after the visit of one of the other old warehouses still used as *squeri*. Operating in this way, Piano uproots Vedova's *Salone* from his context in the city, creating a world apart, the secret hold of a ship – the wood as the predominant material cannot be a coincidence –, in which it is possible to assist to the ever-lasting epiphany of the artist's works, as well as their eternal rest. If something of Venice remains, it is just the image of its docks, certainly not its relationship with water: the idea of the ship can be seen as the only strong concession of the architect to the Venetian world, in addition to the building of the warehouse in its historical appearance.

In fact, Piano cared about the conservation and the conceptual importance of the *Magazzino*: «On the bottom

[21] «Vedova scaraventa il quadro nelle braccia dello spettatore, il vero arbiter di questi Plurimi».
[22] «Un mio lavoro sta bene in questi spazi dove è insito un fluire di molteplici relazioni. […] un mio quadro in uno spazio "tutto posseduto" non respira. […] Qualsiasi esclusivismo, qualsiasi imporre non può essere lo spazio per il quadro concepito come fatto autonomo, libero».
[23] «Un atelier d'artista è sempre una scena di interni con artista al lavoro. [Nel magazzino] c'è la stessa atmosfera, è stata cercata e voluta. È Emilio che ce l'ha messa».

[…] it is placed the warehouse, where the works are stocked. Artworks that wait and doze quietly, because they have eternity in front of them. […] It is […] a magical place because it is where the artwork comes out of the flowing time and enters a dimension that is out of time. It is a metaphysical place» (Celant and Piano, 2009: 50[24]).

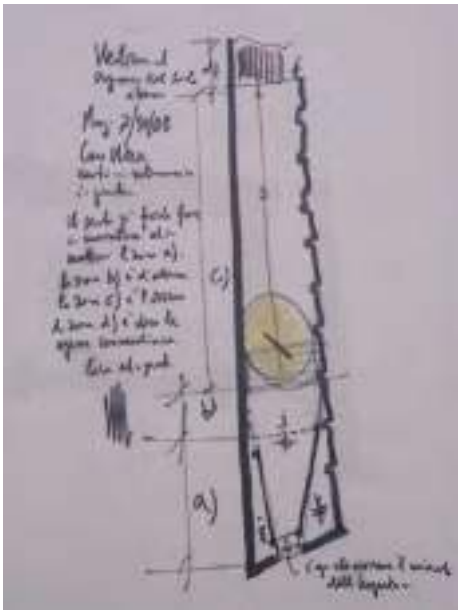

Fig. 4. R. Piano's sketch. 7.10.2008 (Traldi Atelier Archives).

However, it would be meaningless without the dynamic device, which is based on Piano's desire to create an open mechanism. The museum in the conception of the Genoese architect must be dynamic, alive, an organism that changes according to the public needs, preserving, in this case, its mission to honour Vedova's legacy. For this reason, as we shall see also for other museums he has created, Piano emphasizes the analogy between the museum and the factory. Moreover, in this case, it is also a reference to the original working function of the place. It can be added that industrial environments are often considered particularly suitable for contemporary art, precisely because they do not conflict with the artworks. In recent years, there have been monumental cases such as the Tate Modern in London, which has combined industrial archaeology and contemporary art.

Inside the archives of the Traldi Atelier in Milan, it is possible to consult some important sketches by Piano regarding the Foundation project[25]. In one of the first, it is clear that the first architect's idea was to create a bigger museum using two warehouses instead of one, a project almost immediately set aside in favour of the definitive use of a single *Salone*. This preliminary approach is confirmed also by Alessandro Traldi, who followed the works with the RPBW from the beginning. These sketches also show how Piano adopted immediately a rotating mechanism of display. This approach allowed a continuous replacement of the paintings without occupying the walls. The fact that these ideas appear immediately in the creative process gives further proof of Piano's authorship on the mechanism and the museum design. Traldi assures in its testimony the fact that Piano and Vedova did not discuss at length the project of the museum and that their relationship was concentrated mainly during the Eighties and the Nineties[26]. A further suggestion that could confirm that the architect was influenced by other sources besides Vedova's art for his mechanical arm's design is the analogy

[24] «Sul fondo […] è collocato il magazzino, in cui sono poste le opere. Opere che attendono e sonnecchiano tranquillamente, perché hanno l'eternità davanti a loro. […] È […] un luogo magico perché è dove l'opera esce dal tempo che scorre ed entra in una dimensione che è fuori dal tempo. È un luogo metafisico».
[25] Traldi Atelier Archives, Milan, Fondazione Vedova. Progetto definitivo, 2008.
[26] Alessandro Traldi interviewed by William Cortes Casarrubios, April 11, 2018.

between the Foundation and an important Frederick Kiesler's scenography for *Emperor Jones* by Eugene O'Neill, set up in 1924. For that piece, the artist devised a system of curtains and rotating screens in order to manage the dramatic action (Haines Cooke, 2009).

The most interesting among Piano's drawings are commented and addressed by letter to the Traldi Atelier, the first dated 20 May 2008 and the second 7 October of the same year[27]. In both the architect emphasizes the importance of the entrance space. In a marginal note, he wrote: «it is here where the miracle of discovery takes place»[28] (fig.4). The same attention was already present in another preliminary sketch, undated, in which Piano focuses on the introductory small wooden telescope placed after the entrance door. For him, it is very important that the only ray of natural light enters right there, where the visitor has the first impression of *Ali Baba's cave*, an expression that appears in one of his drawings. The character of mystery that surrounds the museum is underlined by its closure to the outside, and the major impact is felt in the small foyer before the gallery, where the public first appreciates the long space of the warehouse. Waiting for the mechanical arm is part of the visitor's experience, which continues from the moment of stasis lived at the beginning of the visit. This interpretation is confirmed by the architect's words.

Piano suggests some similarities between the Foundation and its previous museums. One of the most important, thinking about the rack store, relies on the idea of *Treasure House* (Piano, 2007). This idea was first suggested by his client Dominique de Menil, who in the early Eighties commissioned him his second museum and the first as RPBW. The Menil Collection in Houston (1981-1987) represents the return to the museum architecture after the Centre Pompidou's exploit. One of the architectural and museographical concepts that permeated the whole project was the use of natural light in all exhibition spaces, which host a temporary selection of the vast collection. In the meanwhile, the other artworks are kept in an elevated space above the museum ground floor with perfect environmental and microclimatic conditions, known as *Treasure House*. To obviate the inconvenience of Texas natural light, which allowed to display only a small part of the whole collection for brief periods, the client suggested a solution to Piano: an optimal place, open to scholars on request, as permanent deposit, from which a part of it could be extracted for the public display during short periods. According to a principle of rotation, another group of works could be selected every time. This concept of *Treasure House*, where the art is waiting to be revealed to the public only for a short time, and then returns to "rest" in favourable conservative conditions, can be seen as a *leitmotif* in Piano's museum career, with revisions and slight modifications. At the Pinacoteca Giovanni e Marella Agnelli in Turin (2000-2003), inserted in the wider renovation and conversion of Matté Trucco's *Lingotto*, Piano realizes a suspended box to house the permanent collection. For this aspect of "container", of art spaceship landed on the roof of the old building, Piano adopts the appellative *Scrigno* – treasure chest –, emphasizing the value of a secret and magical place where art is preserved for eternity (Buchanan, 1997; Piano, 2016).

As for the dynamics of the Vedova Foundation device, Piano recalls the Pontus Hulten Gallery in Stockholm (2006-2008) (Celant and Piano, 2009; Piano 2016). In this small room, the paintings are already hung on mobile walls, aligned in a deposit under the roof, from which they are dropped down to the visitor's attention. But the architect reveals his love and passion for the artworks in movement to his friend Jean Tinguely. He had met the French kinetic artist at the time of the Centre Pompidou opening, where they cooperated with the director and curator Pontus Hulten. Piano remembers how the relationship with Tinguely was born in relation to the display of some of his more complex works such as *Crocodrome*. They led him to think about the dynamic sliding panels of the first Beaubourg museum space. He also relates this particular experience to his research on artworks movement on the occasion of Alexander Calder's Turin retrospective (1983). In this context, Piano designed the entire itinerary centred on the use of artificial light, seeking an emotional atmosphere for the visitor, that was open, free and emotional. Moreover, mobility and flexibility are at the basis of many museums by Renzo Piano, since its first famous Parisian architecture: the museum must always be alive, focused on its public, in dialogue with the contemporary and herald of novelty. For this reason, it must go against the rigidity and static nature of the traditional

[27] Traldi Atelier Archives, Milan, Fondazione Vedova. Progetto definitivo, 2008.
[28] «È qui che avviene il miracolo della scoperta».

museum in order to become a factory of culture, place of production, not only a place of storage and exhibition.

The Cy Twombly Gallery (1991-1995) and the Atelier Brâncuşi (1992-1997), are two important cases: for the first time, Renzo Piano is designing museums that celebrate the memory of a single artist, conceiving a monographic exhibition. The Vedova Foundation and the almost contemporary project for the Paul Klee Zentrum in Bern (1999-2005) are the confirmation of the architect's great ability to create museum realities perfectly in accordance with an artist's legacy, without being rhetorical and at the same time preserving his personality as an architect. These are four projects that have many affinities despite their obvious differences in context and collection. In Paris, Piano had the task of recreating the original environment of Brâncuşi's atelier. He had bequeathed his artworks to the State with the condition that they should remain within his studio, destroyed shortly after. Piano chose to recreate the layout of sculptures set by Brâncuşi as a *Gesamtkunstwerk*. The environment was reconstructed inside a larger building resembling a modernist "white cube", in dialogue with the Beaubourg *plateau*. The reconstructed studio can be seen through a glass, illuminated by a large zenithal skylight, as it was at the time of the sculptor. The problem of giving a new museum life to artists' studios recurs in Venice, but Piano decided, also for reasons of logical diversity between the two situations, not to follow an ideological reconstruction as in Paris, but to create a new, dynamic and original mechanism. This approach of free homage and not of pure reference is not perhaps a chronological coincidence. In those same years, in Bern, Piano transformed the visual signs and forms of Klee's paintings into a structure of artificial hills that pays homage to the naturalistic sensibility and imagination of the Swiss artist. A further important affinity binds the Foundation and the Paul Klee Zentrum: these are the only two situations in which artificial light is preferred by Piano to natural light, the *leitmotif* of his museum career. If this choice is due to purely logistic reasons and above all to the conservation of the works, it is interesting to notice the aesthetic and metaphorical connotations: the museum becomes a hidden wonderful place – *Ali Baba's cave* – where the visitor discovers the beauty of art.

The Foundation and the Atelier Brâncuşi have another important affinity. In both, the architect creates a space where the public can experience the *miracle of discovery*, an expression already seen in a sketch of the architect for the Vedova museum. This space, already described above in the analysis of the Foundation, is understood by the architect as an intermediate place of passage between the public dimension, profane, that the visitor experiences outside the museum, and the definitive entry into the sacred place, into the *Treasure House,* the *Scrigno*. In the case of the Atelier Brâncuşi, the presence of this place is even clearer and well defined: the descending staircase through which the public is able to enter the museum represents the first element of detachment from the vital world gravitating between Rue Rambuteau and the Beaubourg *plateau*. If the external staircase and the immediate room of entrance, completely white, constitute the intermediate place of passage, once you have passed the safety turnstile, you enter in the ambulatory from which the view towards Brâncuşi's *Gesamtkunstwerk* is completely open and outstanding. It is useful to identify also in other Piano museums the same motif, characterised by the relationship between a place of passage before a sudden sense of wonder. This is certainly an indicator of the relationship that the architecture of the Genoese establishes with its public. The most obvious example is the MUSE in Trento. At the entrance of the Science Museum, there is a great Lobby, conceived as a passage space. It is in fact freely accessible and connects the Albere Park to the new district of the same name along a north-south axis. After purchasing the ticket, it is possible to enter in the museum, when, suddenly, after a brief staircase, the *miracle of discovery* appears: the visitor finds himself immersed in the show created inside the Big void, a large empty space between the various floors of the building, where a cable system allows the suspension of dozens taxidermized animals belonging to the MUSE collection.

A last important affinity that allows us to identify the Foundation as in line with other projects of the architect is the rethinking of the traditional museum gallery. The Genoese is certainly not the first to face the transfiguration of the gallery, true *topos* of the museum architecture since the Second World War. From the 'mobile walls' of Beaubourg, to the arrhythmic and pulsing galleries of the Beyeler Foundation (Buchanan 2000), he can surely be recognized as the creator of some of the most interesting solutions. In Venice, because of the longitudinal space of the *Magazzino*, he has faced a similar problem, solved in a totally different way. In Paris and in Basel, as well as in similar interventions like the Menil Collection and the Nasher Sculpture Centre in Dallas, he shaped the space by transforming the museum plan, in which the traditional asset of the gallery is still visible within a more varied and freer path for the public. However, in Venice, also because of the impossibility of altering the context, the artworks themselves elude the traditional exhibition space. The dynamic

museum transforms the gallery in a place where the paintings create the visitor's path.

In conclusion, this unique concept is perhaps the characteristic that makes the Foundation a valuable project within the career of Piano, an innovative museum characterized by its experimental eccentricity and an avant-garde approach in the contemporary panorama.

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References

Argan, G.C., 1963. I Plurimi di Vedova, in *Emilio Vedova*, Eccher, D., (Ed.) 1996, pp.42-48, Hopefulmonster, Torino, Italy.

Argan, G.C., 1974. Telegramma di Giulio Carlo Argan a Guglielmo de Angelis, in *I Saloni alle Zattere: documentazione degli interventi per la conservazione*, Biasin, L., Ed. Il Cavallino, Venezia, Italy.

Argan, G.C., 1981. Presentazione, in *Vedova Compresenze*, pp.11-13, Electa, Milano, Italy.

Bertelli, C., 2006. *Emilio Vedova*, Charta, Milano, Italy.

Bianchini, A., 2009. Presentazione, in *Emilio Vedova/Renzo Piano*, Celant, G., Fond. Emilio e Annabianca Vedova, Venezia, Italy.

Biasin, L., 1974. *I Saloni alle Zattere: documentazione degli interventi per la conservazione*, Ed. Il Cavallino, Venezia, Italy.

Buchanan, P., 1997. *Renzo Piano building workshop: opere complete, vol. 3*, Allemandi, Torino, Italy.

Buchanan, P., 2000. *Renzo Piano building workshop: opere complete, vol. 4*, Allemandi, Torino, Italy.

Cacciari, M., 2009. Presentazione, in *Emilio Vedova/Renzo Piano*,Celant, G., Fond. Emilio ed Annabianca Vedova, Venezia, Italy.

Celant, G., 2009. *Emilio Vedova/Renzo Piano*, Fond. Emilio e Annabianca Vedova, Venezia, Italy.

Celant, G., 2010. Emilio Vedova Scultore. Fond. Emilio e Annabianca Vedova, Venezia, Italy.

Celant, G., (Ed.) 2019. Emilio Vedova, Marsilio, Venezia, Italy.

Celant, G., Piano, R., 2009. Renzo Piano e Germano Celant in conversazione, in *Emilio Vedova/Renzo Piano*, Celant, G., pp.47-57, Fond. Emilio e Annabianca Vedova, Venezia, Italy.

Collavo, L., 2009. Il nuovo spazio espositivo della fondazione Vedova a Venezia: oltre la sfida, nella storia della città. Arte, in *Documento* 25, pp.273-281, Italy.

Dautrey, J., 2007. Une hétérotopie musicale: la collaboration entre Renzo Piano et Luigi Nono sur Prometeo, in *Rue Descartes* 56, pp.8-20, Presses Universitaires de France, Paris, France.

Eccher, D., (Ed.), 1996. *Emilio Vedova,* Hopefulmonster, Torino, Italy.

Fagiolo, M., 1975. Vedova, in *Emilio Vedova 1935-1984*, Celant, G., pp.194-197, Electa, Milano, Italy.

Gazzarri, F., 2009a. I luoghi di Emilio Vedova, in *Emilio Vedova/Renzo Piano*, Celant, G., pp.25-29, Fond. Emilio e Annabianca Vedova, Venezia, Italy.

Gazzarri, F., 2009b. Presentazione, in *"Emilio Vedova/Renzo Piano"*. In: Celant, G. Fond. Emilio e Annabianca Vedova Venezia, Italy.

Haftmann, W., 1963. Vedova, in *Emilio Vedova*, Eccher, D., (Ed.), pp.50-54, Hopefulmonster, Torino, Italy.

Haines Cooke, S., 2009. *Friedrich Kiesler: Lost in the Century*, Cambridge Scholars Publishing, Newcastle, UK.

Milan, M., 2009. Dal Prometeo ai Magazzini del Sale, in: http://www.fondazionevedova.org/spazi-espositivi/magazzini-del-sale/approfondimenti [accessed on March 2017].

Oberhuber, K., 1991. Il bianco e nero di Vedova, in *Emilio Vedova…continuum…,* pp.109-113, Electa, Milano, Italy.

Piano, R., 2007. *The Menil Collection*, Fond. Renzo Piano, Genua and Florence, Italy.

Piano, R., 2016. *Giornale di Bordo. Autobiografia per progetti. 1966-2016*, Fond. Renzo Piano Genua and Florence, Italy.

Rorro, A., Barbuto, A., 2007. *Emilio Vedova. 1919-2006*, Electa, Milano, Italy.

Traldi, A., 2009. Per uno spazio dinamico nell'antico magazzino del sale, in *Emilio Vedova/Renzo Piano,* Celant, G., pp.163-168 Fond. Emilio e Annabianca Vedova, Venezia, Italy.

Vedova, E., 1956. Un pittore giudica l'architettura, in *"Emilio Vedova. 1919-2006"*. In: Rorro, A., Barbuto, A. Electa, Milan, 220-221.

Vedova, E., 1961-65. Da Quaderni studio a Plurimi, in *Emilio Vedova. 1919-2006*, Rorro, A., Barbuto, A., pp.223-224, Electa, Milano, Italy.

Vedova, E., 1974. Fermiamo il piccolo demolitore, in *Emilio Vedova 1935-1984*, Celant, G., pp.218-226, Electa, Milano, Italy.

Vedova, E., 1987-88. Appunti da quaderni-studio, in *Emilio Vedova Scultore*, Celant, G., p. 176, Fond. Emilio e Annabianca Vedova, Venezia, Italy.

Vedova, E., 1989. Appunti da quaderni-studio, in *Emilio Vedova Scultore*, Celant, G., p.148, Fond. Emilio e Annabianca Vedova, Venezia, Italy.

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The International Consultation for the New Exit on Via dei Castellani and the "Nuovi Uffizi" Project: a Missed Combination

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Abstract

This paper will explain how the contemporary project and construction site have been adapted to the Uffizi historical building, continuously transformed over the centuries. This paper will examine the "Nuovi Uffizi" project, starting from the preliminary project (1964-65) up to the definition of the distributive aspects and the identification of the museum routes (1989). The issue of vertical links, which characterized the building over the centuries, due to its peculiar "U" shape and to the different functions coexisting in the building, is still to be defined: if in the west wing the staircase by Adolfo Natalini has already been completed (2010), in the east wing the difficult insertion of the staircase in the Romanesque church of San Pier Scheraggio remains to be defined. Arata Isozaki & Associates' winning project by way of an international design consultation for the new exit of the Uffizi in Piazza Castellani, launched by Ministry of Cultural Heritage and Activities and the Municipality of Florence in 1998, is also waiting for its carrying out. Ministry and Municipality proceeded together with the consultation but with different final purposes: the Municipality was interested in the revaluation of the square that was of its own property. The Ministry was more interested in the Gallery exit. If the issue of the exit had been treated together with the entrance and the internal circulation routes within the Uffizi itself, it would have been possible to solve all the issues of this stratified and complex building and project giving a huge help to the "Nuovi Uffizi" project. Although not required by the consultation requests, the by project Norman Foster's group went in this direction.

Keywords: Uffizi; "Nuovi Uffizi" project; consultation for the new exit of the Uffizi in Piazza Castellani; project by Arata Isozaki & Associates; project by Norman Foster & Partners, Space Sintax Laboratory, University College of London.

1. Giorgio Vasari's Uffizi and the overhanging Gallery

The artistic collection of the Medici family, formed from the mid-fifteenth century and long kept in the family palaces, in 1581 finds place in the loggia, the Gallery, running above the Uffizi. The Uffizi, Florentine for *offices*, were built to house thirteen Arts and Magistrates of the State that Duke Cosimo was re-organizing. The front is articulated by an U-shaped and porticoed façade built around the courtyard-road, an extension of Piazza della Signoria. The porch figuratively uniforms thirteen offices, actually different in terms of size and spatial distribution in relation to their functions, bureaucratic burdens, number of employees: six small offices in the short western side; seven wider in the east wing. On the east wing the Nove and the Mercanzia offices have, for example, almost double surface than the others in the west side (Conforti, Funis, 2016: 15-20).

The Uffizi occupy an area of over one hectare. It is the biggest building site in the second half of the Cinquecento in Florence. The Uffizi were built in a very short timeframe, "twenty years and five months": it is a very brief period, both in relation to the size of the site and the complexity of the place, directly placed on the Arno river. The construction speed depended on the peculiarity of Vasari's project (1560-1574; finished in 1581 after Vasari's death) that is composed of two wings including an huge court. This empty space, easily accessible from every point of the building site, is the fulcrum where it was organized the building yard for twenty years (Conforti, Funis 2016: 15-20).

The strategic functionality of this opened and internal square has been repeatedly verified during the contemporary restoration works. The building yard of the "Nuovi Uffizi", like it happened for the historical one, is indeed taking advantage of this central square, fulcrum of the project and the yard of Giorgio Vasari.

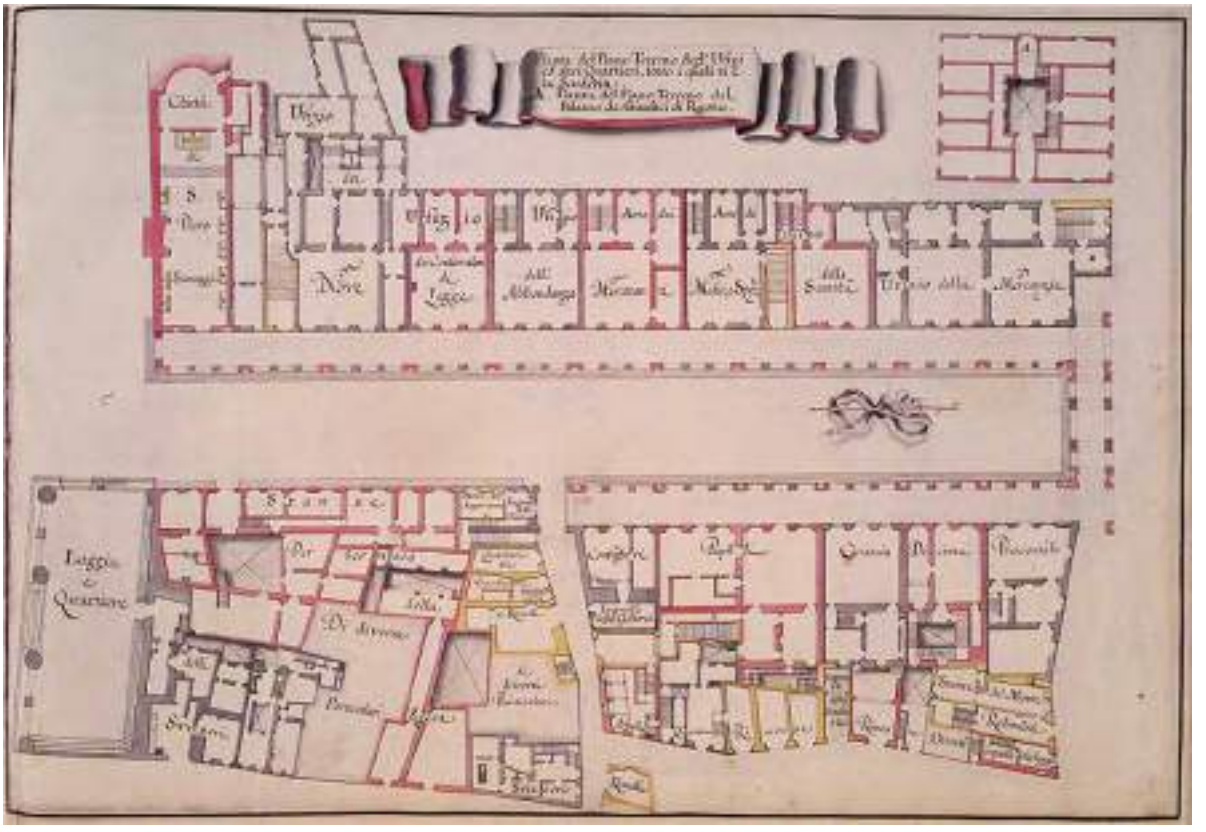

Fig. 1. Giuseppe Ruggieri, Ground floor plan of the eastern Uffizi (BNCF, Palat. 3. B. 1.5, striscia 1439, G.F. 181, c. 8r; 1742).

2. The lack of vertical links

The "Nuovi Uffizi" project involves the doubling of the Museum area, identifying its exhibition way, setting up the paintings following an order for periods and regional schools and creating vertical routes. Given the singular "U" shape of the building, one of the priorities of the project is the creation of vertical links in the east and west wings.

As soon as the building was completed, the direct vertical links from the ground floor loggia to the second floor Gallery did not exist.

Or better, they did not have to exist. In fact, the different functions coexisting, for four centuries, in the different floors of the building did not have to come into contact with each other.

At the ground floor there were the Uffizi, the architectural masterpiece by Giorgio Vasari, seat of the offices of thirteen Arts and Magistrates of the Duchy. At the ground floor, the porch, a sort of outdoor waiting room, gave direct access to the office main hall, the "Udienza" (Conforti, Funis, 2016: 39).

Between the offices at the ground floor and the first floor there were no vertical links which instead served exclusively to reach the mezzanines, at the back of the east wing.

The offices did not occupy the first level therefore staircases had no reason to exist. In the first floor of the complex, near Palazzo Vecchio, it was built the hall for Magistrates' meeting, adapted in the sixteenth century into a Medici theatre. In the other rooms at the first floor, the prestigious ducal manufactures were installed in 1588 (Conforti, Funis, 2016: 15-20).

So how did they reach this level? In the eastern wing of the Uffizi, next to the church of San Piero Scheraggio, there was the only vertical link between the ground floor and the first floor: the so-called Vasari staircase, built in 1572, led to the big hall for the Magistrates meetings and was the only access to the whole first floor (Conforti, Funis, 2016: 63-65).

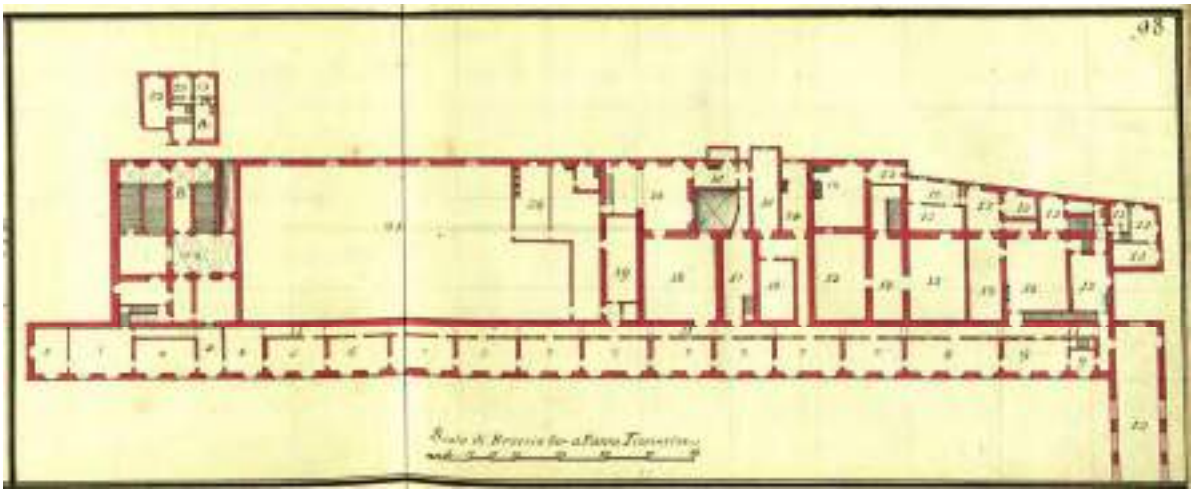

Fig. 2. Plan of the first floor of the eastern Uffizi (Praga, Národní archiv, fondo Archivio Familiare degli Asburgo di Toscana, Mappe e piante, B.A. 49, c. 98).

The second floor Gallery was built later. In 1574, the protagonists of the largest building site in Florence in the second half of the Cinquecento, the Uffizi, die, at a distance of only a few months from each other: Cosimo I de' Medici on the 21st April 1574, Giorgio Vasari on the 27th June 1574. On the 27th of August on the last floor of the Uffizi, a loggia was built.

In fact, the Gallery was initially a continuous passage through the air, narrow and long. At first, there is a U-shaped open loggia getting light from the east and the west: in fact, the rooms were added later at right angles to the passageway (Conforti, Funis, 2016: 71-74).

This loggia, built in 1574 on the top floor of the building, was an exquisitely private passage of the Medici family. It was an appendix to Palazzo Vecchio: from here it was only accessible through the overpass on Via della Ninna, thorough the Vasari Corridor, built in 1565 and going from the ducal apartments of Palazzo Vecchio to Pitti (Funis 2018; Funis, 2020). The direct vertical links from the first floor to the second floor Gallery did not exist. As already explained, the public domain of the first floor (meeting hall and manufactures) and the private dimension of the Gallery did not have to come into contact with each other.

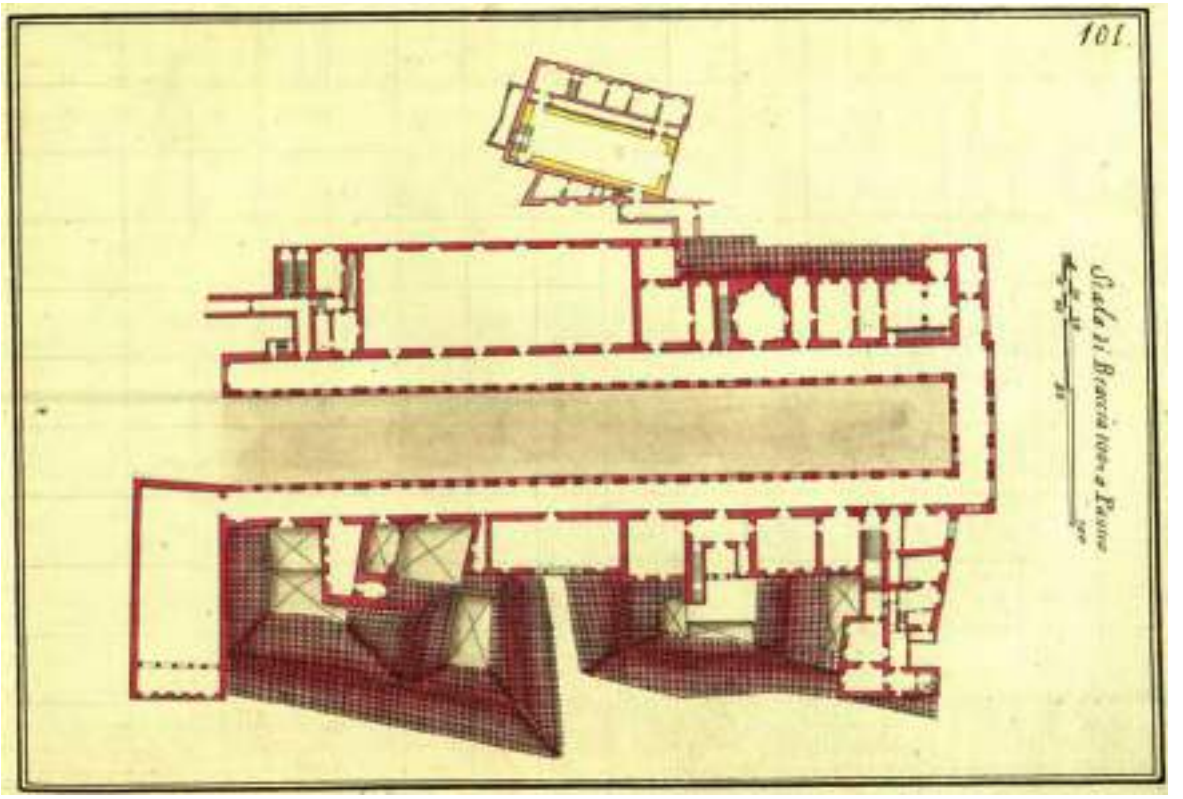

Fig. 3. Plan of the Gallery at the second floor (Praga, Národní archiv, fondo Archivio Familiare degli Asburgo di Toscana, Mappe e piante, B.A. 49, c. 101).

In this space which is a straight line, open and full of light, from as early as 1581 Francesco starts transferring marble statues, mainly antique, which until that moment had been "dispersed here and there". In 1588 they were joined by the superb antique statues collected by cardinal Ferdinando de' Medici (1587-1609), and coming from the villa Medici in Rome (Conforti, Funis, 2016: 19, 72-73).

This long, narrow and private passageway becomes the ideal place to enjoy statues. In the loggia on top, which is covered, but with open sides, during this first stage, there are only statues. It is not until 1582 that the top loggia, screened by glass windows, is transformed into a private Gallery; from then on, various kinds of works of art were placed there, starting with the portraits of illustrious men, from the series of the bishop, Paolo Giovio (Conforti, Funis, 2016: 19, 27, 73, 118).

In 1769 the Grand Duke Pietro Leopoldo of Lorraine opened the Gallery to the public. It become necessary to directly connect the entrance at the ground floor with the third level of the building. At that time the Gallery was in fact accessible from Palazzo Vecchio in the east side, and by a narrow and uncomfortable staircase, in the west arm in via Lambertesca, the Buontalenti staircase. In 1782 the Vasari staircase, leading to the meeting hall, was extended with monumental ramps up to the Gallery level by the architect Zanobi del Rosso. The current configuration of this staircase and the Gallery vestibule at the second floor is finally the result of the

intervention of Luigi del Moro at the end of the 19th century. The new Magliabechiana library, opened in 1747, finally required the construction of an additional staircase (Conforti, Funis, 2016: 125-126).

In 1852 the rooms at the first floor were destined to the Florence State archive by the Grand Duke Leopoldo of Tuscany. Thus, from 1581 to 1987, three functions coexisted in this building: the offices on the ground floor; the artisan manufactures then State archive (1852-1987) on the first floor; and at the top of the building, on the second floor, the Gallery was attracting an increasing number of visitors. The lack of vertical links between the three levels, today only partially solved by the "Nuovi Uffizi" project, arises from the peculiarity of this historic building and from the different functions that coexisted inside it (Conforti, Funis, 2016: 15-20).

It is therefore evident why one of the most important part of the "Nuovi Uffizi" project concerns the creation of vertical links.

3. The "Nuovi Uffizi" project

In March 1965 Nello Bemporad, head of the Soprintendenza ai Beni Ambientali e Architettonici, presented a preliminary study for the doubling of the Gallery exhibition area, using the rooms of the State Archive of Florence below. Since 1852 the Archive had occupied the intermediate floor of the building and partly the ground floor. This is the "Grandi Uffizi" program, which later was called "Nuovi Uffizi" (Paolucci, 2007: 25).

In September 1965, the preliminary project was presented at the XIV Congress of History of Architecture held in Brescia and published in the Engineers Bulletin the following year (Grifoni, 2007: 71).

The project proposed the following main aspects (Paolucci, 2007: 25; Grifoni, 2007: 71-72, 84-86):

- Transferring of the State Archive from the Uffizi headquarters to another location to be identified;
- Doubling of the display surface;
- Exhibition of many masterpieces hitherto preserved in deposits;
- Reorganization of the services, the museum itinerary and the new arrangement of the museum;
- Removal of the vehicular traffic from the Uffizi square to be returned to an exclusively pedestrian and "tourist" accessibility;
- The spaces on the ground floor of the building, i.e. the Magistrates' rooms, the portico and the square, previously used as archives and parking lots, will obtain greater dignity;
- One-way visit and new visitor access and outflow systems;
- The creation of a new "mass tourism" pedestrian access from piazza de' Castellani (long Uffizi, north-eastern corner). This entrance would have been accessible via a double ramp staircase to be built on the back of the building to bridge the gap between the entrance to the museum and the lower road level reached by the tourist buses of the visitors (on the back, precisely in via de' Castellani);
- The construction of a new exit from the Gallery (short Uffizi, halfway up the western arm on via Lambertesca) located at the end of the visit and reachable through the recovery of an existing vertical link, the Buontalenti staircase;
- The bus area would have been delimited by a high wall that would have surrounded a large area of via de' Castellani.

During the debate for the drafting of the project, a dramatic event required a first revision of the project: the flood of the Arno in November 4, 1966. Volumes, parchments, papers and files, produced by the Arts and Magistrates that had written the history of Florence over time, were seriously damaged when they were not missing. It was evident that the archive – like any other work of our cultural heritage – could not occupy the ground floor of the building and the vaults extrados of the Uffizi, where the Arts and Magistrates had initially deposited their writings. In 1967 the first of several design adaptations was sent to Rome (Grifoni, 2007: 71-72).

The last of these variants got final approval in 1979 and closed this first long phase of the "Grandi Uffizi" project. This final project followed that of 1965. It differed in some aspects. The idea of the high wall surrounding the bus area in via dei Castellani, which was dangerous in the event of floods, was abandoned. Furthermore, in the meantime, some "urgent and possible" works of "Grandi Uffizi" project had been carried out (Grifoni, 2007: 71-73):

- The new place for the State Archives in via Giovine Italia was nearing completion;
- The one-way visit had already been established (1967). It was necessary for the growing number of visitors of the Gallery;
- Due to the presence of a single vertical link in the building, the Vasari staircase, the Gallery had been already declared unusable by the "Vigili del Fuoco";
- In the meantime on the west side, the Buontalenti staircase had been restored (1967) by proposing the forms of the old (before 1782) vestibule of access to the Gallery on the second floor. The ramps, abandoned over the centuries, had been restored and a new exit had been built from the porch.

The new State Archive building in via Giovine Italia was completed by Italo Gamberini in 1988. The State Archive and its archival records, production of those Arts and Magistrates for which the Uffizi were created, leave their ancient place. Army trucks went back and forth between the Uffizi and Viale Giovane Italia for a whole year in order to moving the documents produced by the Arts and Magistrates hosted in the Uffizi. Thus the passageway, built in 1574 as private road of the Medici family on the top of a public building, in four centuries managed to dominate the whole "Uffizi system".

In 1989 the Director of the Uffizi Gallery, Annamaria Petrioli Tofani, together with the directors of the departments, Caterina Caneva, Giovanni Agosti, Alessandro Cecchi, Antonio Godoli and Antonio Natali, carried out a museum project for the "Nuovi Uffizi". The team worked on the distribution aspects and on the identification of the routes, with particular attention to the fundamental vertical links. The place for two new vertical links, one to the east in the long Uffizi and one to the west in the short Uffizi, plus an underground east-west one, was approximately identified. This plan represented the premise to the executive phase of the "Nuovi Uffizi" intervention (Godoli, 2007: 91).

Compared to the variation to the preliminary design (1979), the 1989 museum project had overturned the access to the Gallery: the historical entrance from the east porch had to be maintained while the passage on the back, on via Castellani, became the exit from the Gallery (Godoli, 2007: 92).

The maintenance of the entrance in the Vasari loggia, that was the main front of the building and its peculiar feature, is one of the cornerstones of the new project (Petrioli Tofani, 2004: 37). The passage on via dei Castellani, designed to be the entrance (1964), becomes the exit (1989). Instead of the access stairway foreseen in the preliminary project, on the back, in via de' Castellani, the architect Guglielmo Malchiodi, in charge of the Uffizi project from 1986 to 1989, designed a huge reinforced concrete ramp: from the lowest point in via dei Castellani the ramp climbs for twenty meters, overcoming the difference in height (3-4 meters) with the vicolo dell'Oro, at the higher level at the exit of the Gallery. This ramp, then built in the rustic, was one of the fundamental assumptions of the competition (1998) for the design of the exit on via dei Castellani (La nuova uscita, 1998: 54-55).

The Gallery had to be reached via the Vasari staircase, prolonged by one level in the Lorraine era and finally modified by Luigi del Moro at the end of the 19th century. At the Gallery level the route had to follow an hourly circuit starting from the Lorraine vestibule, located in the north-eastern corner and following the U-shaped building up to the northwest corner near the terrace on the *Loggia dei Lanzi*. The visit to the collections had to start from the top floor, the Gallery, precisely where the first statuary collections had been exhibited as far back as 1581. This fundamental assumption was connected with the history of the complex and the display of the Medici collections: at this level the collecting history in the Uffizi complex had begun and four centuries of the history of the Medici collections had taken place here. This historical reason was also linked to the advantage of placing the collections on the two highest floors of the building. The ground floor was destined to ancillary services such as entrance, exit, ticket office, auditorium, cloakroom, bookshop, educational section, photographic cabinet, cafeteria, restaurant, services and a minimal part of the collections that would not have run any risk in case of flood of the Arno: sculptures of modern art, statuary of the Loggia dei Lanzi (Petrioli Tofani, 2004: 41).

In the Gallery, the paintings should have set up following an order for periods and regional schools: from the "Primitivi" Halls, Giotto, Duccio and Cimabue, already set up by the museum project of Carlo Scarpa, Giovanni Michelucci and Ignazio Gardella, the museum itinerary would have found the following Halls: International Gothic and all the fifteenth century divided by regional schools distributed in the east side rooms

up to the river. After passing the "verone", the south side of the building facing the Arno river, the museum itinerary would have found the Halls of the second half of the fifteenth century with Ghirlandaio, Leonardo then the Flemings. This arrangement was inspired by the didactic criterion that the director Giuseppe Pelli Bencivenni and the abbot Luigi Lanzi had followed for the Uffizi, ordering the collections for schools (Petrioli Tofani, 2004: 38): this criterion was aimed at proposing the Gallery as a sort of "museum university": by grouping the works by age and by school, the visitor would have been didactically and critically educated to recognize other works from the same period and from the same regional school.

After following the hourly path in the Gallery up to the last stretch adjacent to the *Loggia dei Lanzi*, the exhibition path should have moved to the first floor. Already in this phase, this area was identified as the most suitable for the insertion of a newly designed vertical link, consisting of stairs and lifts. This area had not been affected by the Vasari project of the Uffizi: it is the only portion of the building where the porch and the Magistrates' offices are missing. This area was occupied by the Florentine Mint: built in this place in the early fifteenth century, it will continue to mint the gold "Fiorino" until the Unification of Italy (1861), even if with a reduced coinages period (1808) and some interruptions (1740-1768) (Conforti, Funis, de Luca, 2011, VII.1: 232-233).

When Florence became the capital of Italy, the mint rooms were transformed into the "Reali Poste", the Royal Post Office, that moved here in 1866 from the headquarters under the Loggia dei Pisani in Piazza Signoria. The Post Office had a large internal courtyard used for the postal sorting. This courtyard was identified for the most appropriate location of a vertical link from the Gallery to the loggia.

Inside the postmen courtyard the west staircase was built on a project by the architect Adolfo Natalini and completed in 2010. The staircase was designed as if it were a stone tower with large vertical openings. Through the gray stone of the tower you can see the bearing structure in steel covered with bronze sheet, steps in natural stone, wooden handrail. This tower is the place where the staircases and lifts are located (Natalini, 2007: 287-288). Within a complex so densely layered over the centuries, a courtyard was a perfect space for inserting vertical links.

Through this new staircase, visitors will be able to reach the ground floor from the Gallery. In the rooms of the old Royal Post Office, the restoration project have placed a restaurant that is currently under construction (Il Progetto dei Nuovi Uffizi, 2004: 70): the restaurant is accessible from the Gallery and also directly from the old entrance to the Postal Office at the ground floor.

Through this new staircase, visitors can also choose to continue the exhibition itinerary at the first floor by following an anti-clockwise route, from the northwest corner to the northeast corner of the building (how it is already possible nowadays). In this floor, the museum project (1989) envisaged to distribute the rooms of the Germans of the fifteenth and sixteenth centuries, the Foreign Schools, then the Tuscans of the Cinquecento, Raphael and artists active in Rome in the first half of the sixteenth century, the Tuscans of the seventieth and eighteenth century and then continue beyond the "verone" on the Arno river with Caravaggio and Caravaggeschi, finally closing with the Venetians of the seventieth and eighteenth century in the rooms inside the Romanesque church of San Piero Scheraggio (Petrioli Tofani, 2004: 39-40). In this area it would have been necessary to insert a further vertical link with stairs and lifts to reach the ground floor and the exit in via de' Castellani.

At first, an external courtyard at the back of the Romanesque church of San Piero Scheraggio had been identified for the eastern staircase. In a second moment the vertical link was planned inside the southern nave of the church itself. The church of San Piero Scheraggio had lost its physiognomy from very distant times. The church consecrated in 1068 had a basilica shape with three naves and a curved apse. Its northern aisle was demolished in 1410. With the construction of the Uffizi (1559-1581) the church suffered extensive damage and remained permanently mutilated: during the construction of the Uffizi loggia, in December 1562, the façade and the first span of San Piero were demolished from the foundations to the roof. The church therefore lost its shape and was incorporated into the Uffizi loggia. However, San Piero continued to be officiated until 1784 when the ancient church, divided into floors, was transformed into an archive in 1786 (Conforti, Funis 2016: 126-127). The architectural structure of the Romanesque church was completely lost. The east staircase as in Adolfo Natalini's project (Il Progetto dei Nuovi Uffizi, 2004: 62-63; Natalini 2004: 52-53) was made up of a load-bearing structure in steel covered with bronze sheet. Like the western staircase, the eastern one would have built with the same materials. The insertion of this project in the context of San Piero, although

already irreparably compromised throughout history, led the Soprintendenza to re-evaluate the external courtyard adjacent to the church to finally propose a different project (2019).

4. The exit on via de' Castellani

In the years 1989-90 while the Director of the Uffizi together with the directors of the departments were working on the museum routes, Giovanni Michelucci was asked to propose an idea for the exit on via Castellani. This back of the Uffizi presents heterogeneous volumes, non-unitary and non-aligned fronts, irregular roofs for dimensions and thicknesses. Here the growth process of the building has continued over time for decades and even centuries, abundantly beyond the date conventionally assumed as completion of the building in 1581.

Fig. 4. The back façade of the Uffizi with the exit in via de' Castellani.

In this area the very last expropriations (under the law 2359/1865 due to public utility) were carried out at the time of Florence as capital of Italy: in 1865 some houses were acquired and demolished to provide adequate access to the Senate room that was located in the original meeting hall of the Magistrates. This heterogeneous and jagged front, settled over the centuries, where the architect is not Vasari but Time, needed to be characterized. From September 1989 to summer 1990, almost at the age of one hundred, Giovanni Michelucci (Pistoia 1891-Florence 1990), together with Bruno Sacchi, worked on a proposal for Piazza Castellani. Michelucci underlines a fundamental aspect concerning that front on via Castellani. The wall is bare and thick: a backside without character.

Fig. 5. The roofs of the Uffizi complex.

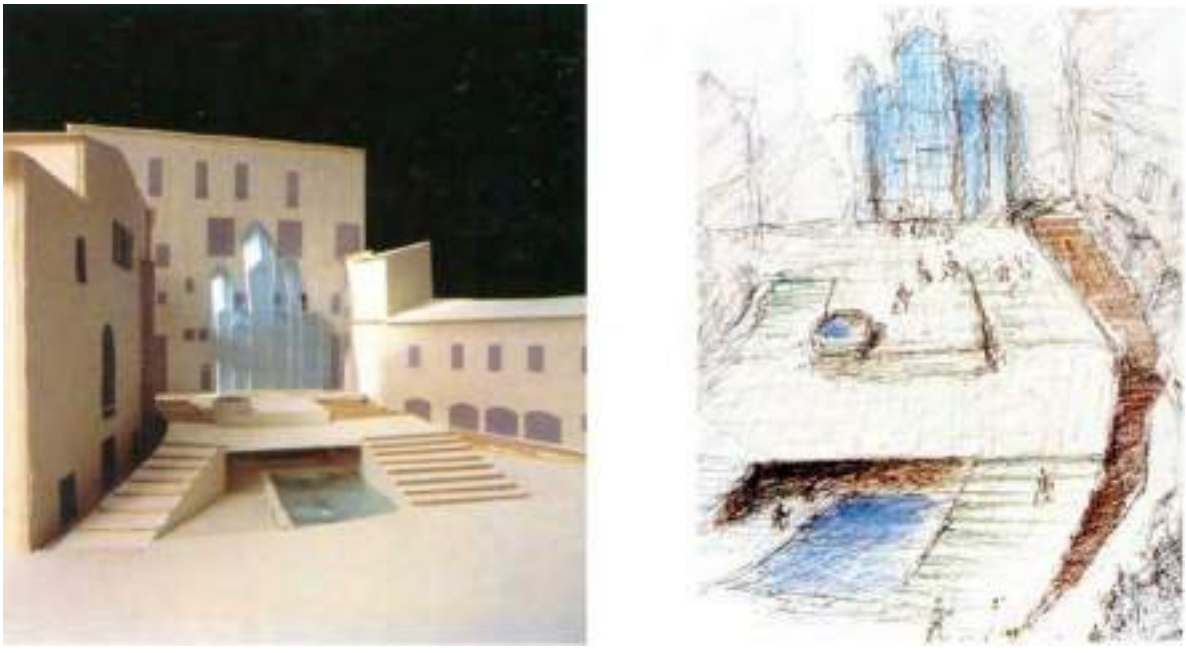

Fig. 6. The «door to a fantasy world full of fairy tales». Project by Giovanni Michelucci, 1990.

So how was it possible to highlight the importance of «the enormous heritage of artworks and history contained beyond that thick wall»? Michelucci himself explains: «Then in front of the large façade I feel that something should act as a landmark, to emphasise the importance of the enormous heritage of artworks and history contained beyond that thick wall. A magical construction immediately came to mind, a priceless, multi-faceted lantern similar to a quartz crystal, a diamond: the door to a fantasy world full of fairy tales. The steeples and spires of the frames of those Medieval paintings, gave me the idea of the steeple-shaped towers of varying heights, crowing the glass construction resting on the Uffizi façade in Piazza Castellani» (Michelucci, 1998: 45). The architect's death closed the door of this magical construction.

The "Nuovi Uffizi" Ministerial Commission, already appointed in 1995 and then integrated the following year, which was working on the distribution project, agrees on the desire to proceed to an international consultation for the new exit on via dei Castellani (Moro Petrangeli, 2007: 48; Paolucci, 2007: 26).

In 1998, following the understanding protocol between the Ministry of Cultural Heritage and Activities and the Municipality of Florence, owner of the square on via dei Castellani, an international consultation was launched to design the Gallery exit on the Castellani square. The consultation was addressed to the most obvious and most famous international architects: Tadao Ando, Gae Aulenti, Mario Botta, Norman Foster, Frank O. Gehry, Vittorio Gregotti, Hans Hollein, Arata Isozaki, Richard Meier, Rafael Moneo, Jean Nouvel, I. M. Pei, Renzo Piano, Richard Rogers, Alvaro Siza (Godoli 1998: 25). Among these only Gae Aulenti, Mario Botta, Norman Foster, Vittorio Gregotti, Hans Hollein and Arata Isozaki responded to the consultation and sent a project.

The consultation, launched by Ministry of Cultural Heritage and Activities and the Municipality of Florence in 1998, had as its theme only the rear exit, the rear front and the square in front. The consultation was not addressed to the museum project which was carried out by the commission itself.

It is clear that the interest of the Municipality was directed to the square that was of its own property. But perhaps the Ministry of Cultural Heritage could have been more forward-looking and could direct the call to a wider perspective that involved the entire system of museum.

The poor parameters for the design were reported in the letter that the Superintendent of Artistic and Historical Heritage, Antonio Paolucci, and the Head of Culture of the Municipality of Florence, Guido Clemente, sent to the invited architects (La nuova uscita 1998: 54-55):

- The surroundings of the square are characterized by these pre-existences: the back façade of the Uffizi, the fourteenth-century loggia degli Stipendiati, the block of the building which was originally a theatre and later became the library of the Grand Dukes in the eighteenth century;
- The rustic central ramp in reinforced concrete cannot be totally demolished but must integrate better with the new construction;
- The square will be the place where visitors are on their way out of the museum... It is a space where urban and museum life meet and take place;
- Six reference tables are attached, a brief review of the events in Piazza Castellani and photographic documentation in order to make the knowledge of the area clearer.

With these small data, therefore, Tadao Ando's answer is not surprising: «Since we have received your generous invitation to participate in this important competition, we have researched and studied hard many options in order to develop a design solution that would respect and enhance the urban context. After a thorough consideration, we do not feel we have sufficient knowledge of the local context to propose a design that would do justice to the great building. This project is very important, and we feel we have to be fully confident in the design if we are to propose an addition to this architecture of significant cultural heritage. We therefore find ourselves having to decline the opportunity to further participate in the competition. I hope you will accept my apology for our declination and the consequent inconvenience it may cause» (Godoli, 1998: 25).

The six projects received are judged by the Uffizi Commission itself, the Mayor of Florence and the Heads of two departments of the same Municipality. On March 1999 the working group proceeds to identify the winning project, that of Arata Isozaki & Associates.

4.1. Project by Arata Isozaki & Associates: Piazza Castellani as an urban space

Arata Isozaki & Associates' revaluation project of Piazza Castellani is composed of two parts: a flat part and an inclined part. The flat part, eight metres wide, is at the same level of the museum exit and closed to it. It is the immediate exit for visitors. This level is then connected to the lower Castellani street level by the inclined part that is the old concrete ramp. The project intended to create an urban space emphasising the design of the rear façade. The urban space, connecting the building with the city, is completely covered by a Loggia, 30 metres long on Via de' Castellani, sustained by four columns at the corners of the Piazza. «The roof of the Loggia consists of a series of longitudinal beams, arranged radially from the rear façade of the Uffizi with transparent skylights» in moulded polycarbonate (Isozaki, 1998: 129-141). The structure of the Loggia is in steel, faced with pietra serena stone. The protection of the Loggia permit to use the Piazza in all weathers. This space could be used for museum events and exhibitions. «Just as the Loggia de' Lanzi was originally the place from where authority addressed the citizens, so the new Loggia will become for the museum an instrument for communicating with the city» (Isozaki, 1998: 129-141).

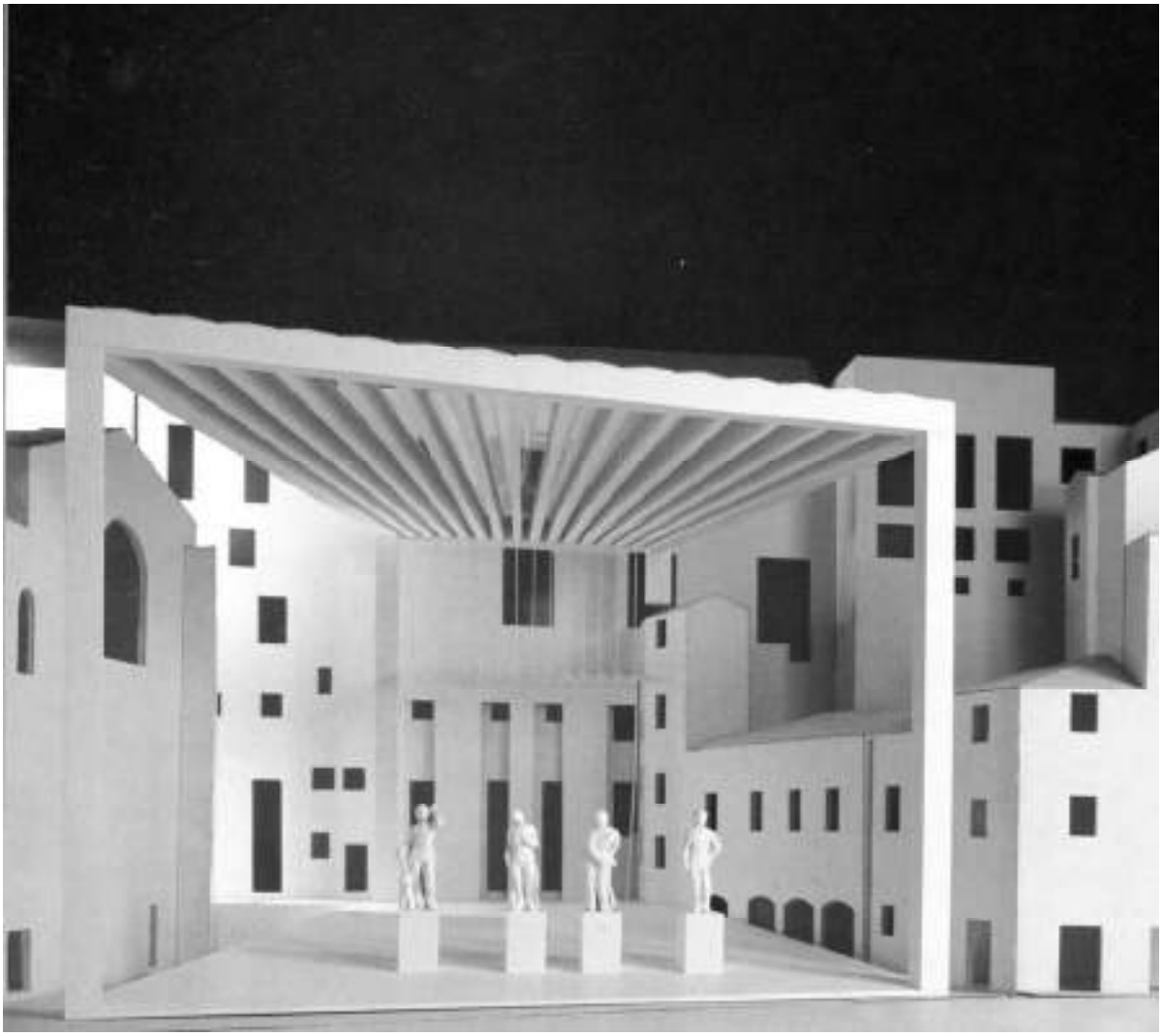

Fig. 7. Piazza Castellani as an "urban space". Project by Arata Isozaki & Associates, 1998.

The Loggia is spaced from the rear façade of the Uffizi thorough a steel and glass shelter, permitting access to the Piazza in bad weather. «The exit become in this way the main focus of attention in the Piazza, integrating it with the Uffizi. The rhythm of the façade is recalled in the series of four sculptures in the Piazza, arranged according to the order of the exits» (Isozaki, 1998: 129-141).

In line with Florentine tradition, pietra serena is the most used material of this project. Pietra serena is used to pave the urban space, to face the steel structure, the counter-façades of the exits, the lateral walls and stairs (Isozaki, 1998: 129-141).

The project by Arata Isozaki & Associates fully meets the requirements and parameters for the design. Among the projects presented, it is perhaps the only one to dialogue so tightly and deeply with the urban place and at the same time with the rear front of the Uffizi. It certainly represents a clear, decisive sign with respect to that bare and non-aligned front, the "B" side of the Vasari Uffizi. But weren't the Uffizi, at the time of their construction, a very strong sign compared to the medieval fabric in which they went to be inserted?

I do not want to go into the merits of the choice, but I want to underline a more general aspect connected with the needs of the building and of the "Nuovi Uffizi" project. Ministry and Municipality proceed together but with different purposes: the Municipality was interested in the revaluation of the square which it owns. The Ministry was more interested in the Gallery exit. Maybe the members of the commission could perhaps evaluate an aspect that would have solved, together with the project of the Piazza dei Castellani, of the rear front, of the exit also another issue: the vertical link to close the ring of the "Nuovi Uffizi" project.

It was not asked for or even contemplated in the parameters for the design. However, the project by Foster's group was able to revaluate the square, to plan the exit and at the same time also to include several lifts, just placed in the most strategic point, exactly where they were needed. This project is a more organic reasoning that has managed to go beyond the parameters of the competition, taking the issue of the building: the lack of vertical links. This design is a lifting engine that rests on the front by redesigning it: a light intervention, perhaps even reversible.

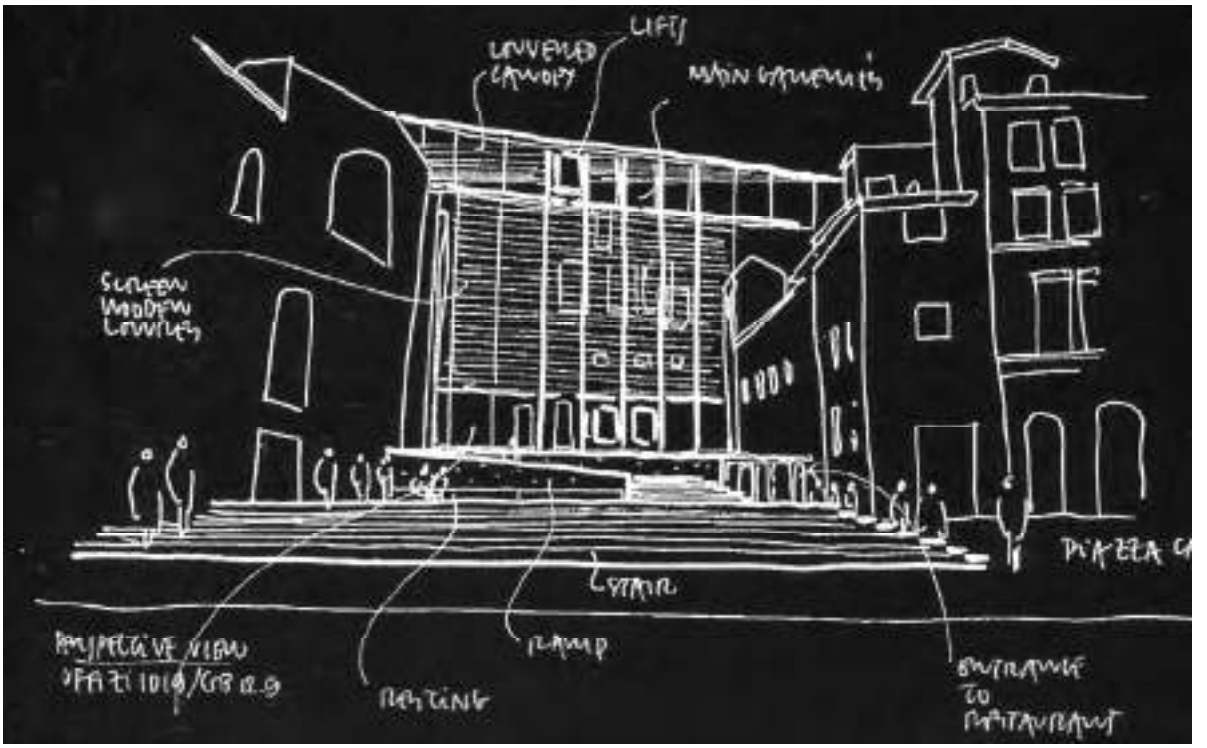

Fig. 8. Piazza Castellani as an "engine room for the Uffizi". Project by Foster&Partners, Space Sintax Laboratory, University College of London, 1998.

4.2. Project by Norman Foster & Partners, Space Sintax Laboratory, University College of London: Piazza Castellani as an "engine room for the Uffizi"

The group of architects gathered under the aegis of Norman Foster proposed some alternative design options that were able to rework the urban space of Piazza Castellani within the Uffizi circulation pattern. In their opinion «the issue of the "exit" cannot therefore be separated from those of the entrance and the internal circulation routes within the Uffizi itself» (Foster 1998: 87 -99). They started from an analysis of Uffizi routes issues that were: long queues of visitors waiting, congestion in the ticket hall, relatively few personnel in the galleries in relation to the extensive exhibition area, lack of vertical circulation, to create a new interface between the Uffizi and the City of Florence. Foster's group wonders if this space should be considered «the correct location for the exit to the Uffizi or should it be considered as part of the Uffizi, as an extension of the museum itself» (Foster 1998: 87-99).

Well, this project would have helped the museum and the circulation within it to function better. With this purpose Foster's group proposed two/three alternative design options, that were: to create a «quiet, secluded, private, enclosed space in which to contemplate, sit, read, discuss»; or «an "engine room" for the Uffizi, which works hard and allows the historic fabric of the existing building to "relax" a little»; or both of them (Foster 1998: 87-99).

The opportunities offered by the competition for Piazza Castellani could have been exploited to successfully regulate the circulation model of the galleries. Foster's group used the competition to place three lift, restricted in size, on the back of the Uffizi. The project would have been a huge «assistance be given to visitors moving to the second floor of the galleries - the principle floor of the Uffizi». In the project by Foster's group, that would have been very helpful for the Uffizi museum, Piazza Castellani was seen as a sort of «engine room for the Uffizi» (Foster 1998: 87-99). A group of new lifts «large, like small rooms, capable of moving considerable numbers of people at any one time» would have been installed on the existing new platform (Malchiodi, 1986-1989) at the top of the ramp in the Piazza Castellani. The lifts would have given access for visitors to the basement level (under Malchiodi ramp), to the ground level and to the second floor, but also to the first floor.

This proposal of the Uffizi circulation pattern would not have changed the "Nuovi Uffizi" project but would have given a powerful help to it: entrance from the porch and the new ticket halls, through which visitors could pass on the back in via Castellani, to climb through the lifts up to the level of the Gallery, follow the path already identified from the "Nuovi Uffizi" project, then go down (first floor-ground floor) through the lifts themselves or, alternatively, through the Vasari staircase.

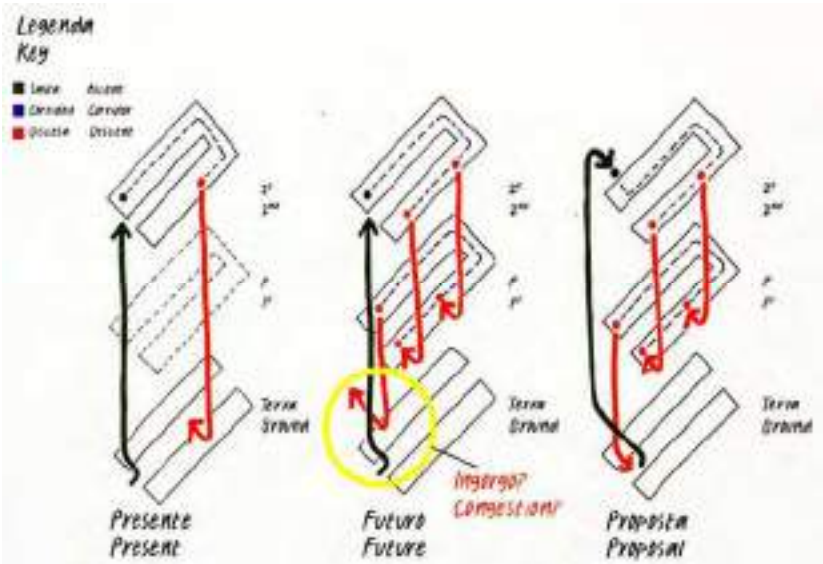

Fig. 9. Study of the Uffizi circulation models (present, future and a new proposal). Project by Foster&Partners, Space Sintax Laboratory, University College of London, 1998.

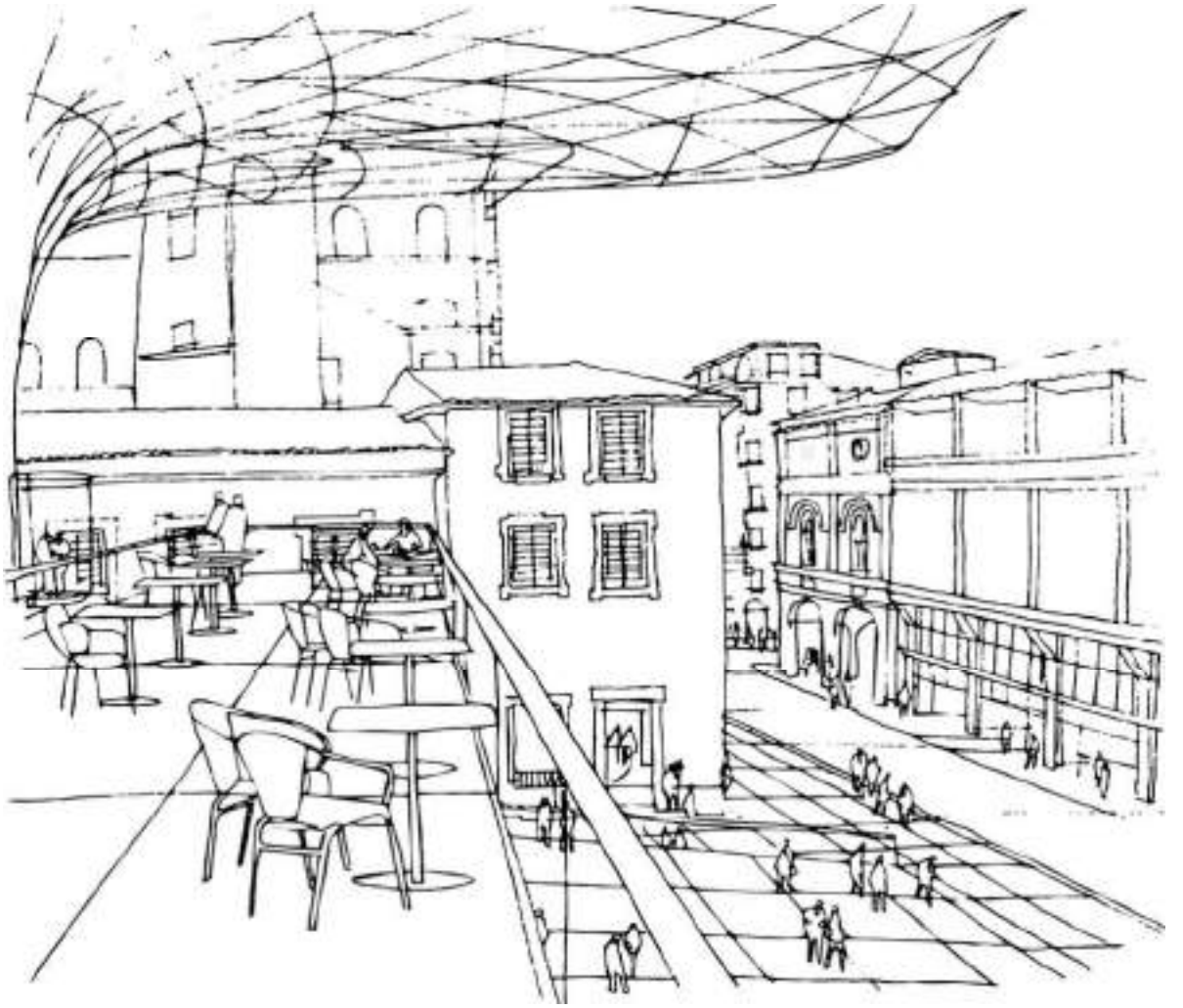

Fig. 10. The suspended Terrazza. Project by Foster&Partners, Space Sintax Laboratory, University College of London, 1998.

«The lifts could be for either access or egress to the collections of the Uffizi we prefer the use as access, allowing the Vasari staircase to be used for egress – a more civilised solution in the height of the summer [...] The construction of the historic Gallery makes it difficult to avoid the tortuous and winding route from the ticketing hall to the Vasari stair. We have taken advantage of the available space in the Piazza Castellani to provide a generous, vertical link to the second floor galleries. The implication is that the sequence of circulation is through the ticketing halls, across the depth of the Uffizi into a large lift foyer, up to the second floor galleries, using the Vasari stairs as the return route, culminating as the visitor leaves the Piazzale» (Foster 1998: 87-99).

Other proposals were made by Foster's group if it were acceptable to demolish part of the ramp currently in the square. Unfortunately the ramp was one of the fundamental assumptions of the consultation. The second step of this project would have proposed a raised and more private open space to be created as an extension of the existing platform with a new suspended Terrazza to be used as cafe for the Uffizi (Foster 1998: 87-99).

In conclusion we could say that the "urban space" by Arata Isozaki & Associates mainly met the needs of the Municipality. While the "engine room" by Foster's group offered the opportunity to improve circulation inside the Uffizi building, allowing the «historic fabric of the existing building to 'relax' a

little» (Foster 1998: 87-99).

In any case the promoters of the competition agreed on the winner and in March 1999 they proceeded to identify the winning project, that of Arata Isozaki & Associates. More than twenty-one years have passed and we are still waiting for the execution of this project. It seems incredible to think that in the Cinquecento a shorter timeframe, "twenty years and five months", was necessary to complete all the Uffizi complex, from the foundations up to the Gallery.

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References

Conforti, C., 1999. Gli Uffizi: a piccoli passi verso un futuro incerto? in *Casabella* 664, pp. 2-3, Arnoldo Mondadori Editore, Milano, Italy.

Conforti, C., Funis, F., de Luca, F. (Eds.), 2011. *Vasari gli Uffizi e il Duca*, Giunti, Firenze, Italy.

Conforti, C., Funis, F., 2016. *La costruzione degli Uffizi, nascita di una Galleria*, Ermes Edizioni, Ariccia, Italy.

Foster, N., 1998. Progetto: Foster&Partners, Space Sintax Laboratory, University College of London, in *La nuova uscita degli Uffizi/The new exit for the Uffizi*, Godoli, A., (Ed.), pp.87-99, Giunti, Firenze, Italy.

Funis, F., 2018. *Il Corridoio Vasariano, una strada sopra la città*, Sillabe, Livorno, Italy.

Funis, F., 2020. *The Vasari Corridor, a road above the city*, Sillabe, Livorno, Italy.

Godoli, A. (Ed.), 1998. *La nuova uscita degli Uffizi/The new exit for the Uffizi*, Giunti, Firenze, Italy.

Godoli, A., 1998. Il museo e la città: un tema museografico, in *La nuova uscita degli Uffizi/The new exit for the Uffizi*, Godoli, A., (Ed.), pp.21-25, Giunti, Firenze, Italy.

Grifoni, P., 2007. Galleria degli Uffizi 1900-2000. Trasformazioni, ampliamenti e progetti, in *Cantiere Uffizi*, Cecchi, R., Paolucci, A., (Eds.), pp.47-90, Gangemi, Roma, Italy.

Isozaki, A., 1998. Progetto: Arata Isozaki & Associates, in *La nuova uscita degli Uffizi/The new exit for the Uffizi*, Godoli, A., (Ed.), pp. 129-141, Giunti, Firenze, Italy.

Il Progetto, 2004. *Il Progetto dei Nuovi Uffizi*, Press conference, Florence 24 February, Gangemi, Roma, Italy.

La nuova uscita, 1998. La nuova uscita degli Uffizi: un progetto per piazza Castellani a Firenze, Consultazione Internazionale. 1998, in *La nuova uscita degli Uffizi/The new exit for the Uffizi,* Godoli, A., (Ed.), pp.54-55, Giunti, Firenze, Italy.

Moro, L., Petrangeli, P., 2004. Natura e destinazione d'uso degli spazi. Il sistema di fruizione, in *Il Progetto dei Nuovi Uffizi*, Press conference, Florence, 24 February, pp.44-48, Gangemi, Roma, Italy.

Paolucci, A., 2007. Introduzione, in *Cantiere Uffizi*, Cecchi, R., Paolucci, A., (Eds.), pp.25-27, Gangemi, Roma, Italy.

Petrangeli, P., 2007. "Storia" e aspetti di un progetto, in *"Cantiere Uffizi"*. In: Cecchi, R., Paolucci, A., (Eds.), pp.1-162, Gangemi, Roma, Italy.

Petrioli Tofani, AM., 2004. Cenni sul Progetto dei Nuovi Uffizi, in *Il Progetto dei Nuovi Uffizi*, Press conference, Florence, 24 February, pp.37-43, Gangemi, Roma, Italy.

Michelucci, G., 1998. Una proposta per piazza Castellani/A proposal for Piazza Castellani, in *La nuova uscita degli Uffizi/The new exit for the Uffizi*, Godoli, A., (Ed.), pp. 45-49, Giunti, Firenze, Italy.

Natalini, A., 2004. Sul Progetto dei Nuovi Uffizi, in *"Il Progetto dei Nuovi Uffizi"*. Press conference, Florence, 24 February, pp.52-53, Gangemi, Roma, Italy.

Natalini, A., 2007. Note in margine ad alcuni contributi al progetto Nuovi Uffizi, in *Cantiere Uffizi*, Cecchi, R., Paolucci, A. (Eds.), pp.283-293, Gangemi, Roma, Italy.

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Museological Value Discussion Promotes Sustainable Heritage

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Abstract

My paper introduces a tool for museum professionals to help facilitate and carry out value-based discussions involving matters of significant cultural value. The focus of my article is on collection care and collection development. Understanding and using the term *museological value discussion* helps professionals to see value-related issues that substantially affect everyday museum work. It indicates the need for museum professionals to actively practice and engage themselves in value-based discussions, in order to be able to prioritize and make sound decisions when dealing with matters leading to sustainable heritage. I will present two examples used in Finnish museums that could be described as methods of best practice. Eventually, the benefits of this kind of value-based discussions are to be seen in the more coherent decisions regarding collection care and development.

Keywords: Museological Value Discussion; Significance; Key Objects; Sustainable Heritage; Impact.

1. Introduction

Value-based evaluation within any institution is an ongoing process. Especially in academia, value-based discussions in the field of research ethics are important (Behm, 2008; Mustajoki and Mustajoki, 2017). As part of professional conduct, every new generation needs to situate itself within the context of these discussions. In my article, the term "value" is understood as cultural and moral guidelines, under which museum professionals conduct their preservation work in museums (E.C.C.O. 2003; ICOM Strategic Plan 2016-2022). These guidelines have their origin in such disciplines as history and philosophy, but in order to function as tools, the practical side of the theoretical framework also needs to be looked at. Prior research has shown that a coherent understanding of the value network behind any given actions is essential (Scott, 2013; Holden, 2006; Robbins, 2016; Robbins, 2017; Robbins, 2019). This means making the values that guide our work visible and reveal the impact factor of such work. In my article I introduce methods as to how value-based discussions have been given practical applications and how these applications offer building blocks for sustainable heritage.

2. Analyzing significance and key objects as elements of comprehensive understanding

Our world values various phenomena from various perspectives: philosophical, aesthetic, morally bound, ethical and economic. In recent decades, economic pressures have challenged museums to focus on their message and significance and after the turn of the millennium, there has been a growing interest in studying non-profit organizations (Holden, 2006; Scott, 2013; Museums, 2020). This is especially regarding the meaningfulness of museums, but also as a way to map out the various audiences to whom museums might matter (Weil, 2002; Knell, 2004; Anderson, 2004; Simon, 2010). All this indicates that museums can be policy makers in the field of cultural heritage. In this work, one cannot find relevant outcomes without value discussions, where values are seen more from a practical point of view than through more philosophical interpretations (Porter, Kramer, 2011; Piekkola et al., 2013; Ehdotus museopoliittiseksi ohjelmaksi, 2017). The philosophical legacy offers the needed background for this work, and functions as the foundation on which to build any professional applications (Danto, 1964; Dickie, 1971; Dickie, 1974; Dickie, 2001; Wollheim, 1980; Haapala, 2010). In general, contemporary professional writings introduce methods of making museum work relevant to current audiences, placing the emphasis on the meaningfulness of both our own time and of current visitor experiences. Such terms as "audience engagement" and "co-creation" are used to describe current trends in museological writing. Furthermore, more extreme themes such as "Do museums still need objects?" (Conn, 2010) or "Reinventing the museum" (Anderson, 2004) have been introduced. There have been suggestions to use the collections more effectively and to act like "les enfants terribles" (Museums, 2020: 19-20).

In addition to the more extreme views, there are statements, surveys and collection-oriented writings that recognize objects' cumulative meaningfulness and their interpretative potential. In contemporary museological literature these efforts are often referred to with terms such as "making museums matter" (Weil, 2002), "analyzing significance" and "writing of significance statements" (Russell, Winkworth, 2009; Assessing, 2014; Häyhä et al., 2015), "pointing out cultural biographies" (Mensch (van) and Meijer-van Mensch, 2011) or "selecting the key objects" (Lehto-Vahtera, 2018). All of these endeavors are useful tools for museums in defining legitimacy in the field of cultural heritage, at a time when financial resources are increasingly being scrutinized. This is why it is essential to look at our field from a more comprehensive perspective and combine these methods in order to make them practical, everyday tools, where the process of signification has its roots embedded in history. As Development Director Leena Paaskoski from the Lusto Forestry Museum states: «Objects become museum objects and cultural phenomena become cultural heritage only after the process of signification» (Paaskoski, 2015: 1).

To reach a comprehensive understanding is also important because analyzing significance and selecting key objects are often about single items that belong to museum collections. In these cases, meaningfulness is rarely seen from the more comprehensive collection care and development perspective, or as a potentially long-term and accumulative feature (Artefacta, 2016). Eventually, the core effort is to produce dynamic and significant collections and collection care, where collection items undergo constant re-evaluations and interpretation (Paaskoski, 2015). This work requires collaboration and partnerships with various stakeholders in order to reach all the way to the core layers of information. Museum professionals in this

process function as facilitators, interpreters and mediators.

The Finnish significance evaluation, *Analyzing Significance* (2015) is a progressive tool in the museum field, designed for use with museum collections to determine the level of collection objects' significance and museum value. It is based on its international counterparts, such as the Australian *Significance 2.0* (2009) or the Dutch *Assessing Museum Collections in Six Steps* (2014). The method is designed to work together with other means of documentation and value assessment used in museums, with the intent of producing a significance statement as a result. It is a method designed to enrich the information contained in museum collections. It uses prior research, community collaboration and the gathering of information as ways to enrich the knowledge base of an object. The most important assessment criteria are as follows: representativeness, authenticity, historical and cultural significance, experiential significance, communal significance, ideal state and usability (Häyhä et al., 2015: 14-15). This method enriches the information surrounding collection objects and can eventually ensure their legitimacy, by contributing to the collective memory of a community.

Fig. 1. Lyyli's Wooden Box (Lyylin puuloota)(Photo: Maria Utti, Lusto Forestry Museum, Punkaharju).
Fig. 2. Skeleton of a cat (Photo: Jari Nieminen, Aboa Vetus & Ars Nova Museum, Turku).

In addition, it can also work as an evaluation method for those objects that are entering museum collections or that may still be in private possession, merely commemorating something such as family history. This is, for example, the case in the significance analysis of *Lyyli's Wooden Box* (Lyylin puuloota) done by Leena Paaskoski in 2015. This small box was assumedly used as a sewing kit by a family member and was passed on to its current owner, who wanted to know more about its background. Analyzing the significance of the box using the above-mentioned seven criteria brought family history alive and enriched the commemorative value of the object. The small product of an anonymous handcrafter was no longer just a nicely done old box on the shelf, but became a transmitter of family history and childhood memories. These have to be seen as elements that contribute to the concept of immeasurable value, and should the object ever be placed into a museum collection, it would possess the highest level of museum value due to its information laden character (Mensch, 1992).

The idea of analyzing significance and bringing an object alive through stories is not a new phenomenon. In old collections, the recognition of significance or an object's status as a key object have had time to accumulate throughout the history of the museum, and such objects are very recognizable. Investigating the possibility for a museum object to gain key status in the eyes of contemporary visitors is, however, important. This can be done by investigating current trends using methods of contemporary interviews or even marketing material surveys, as was done in the *Key Objects of Collections* survey published in 2018 by the Aboa Vetus & Ars Nova Museum in Turku (Lehto-Vahtera, 2018). Aboa Vetus & Ars Nova museum is a historical and contemporary art museum located in the center of Turku. The museum was established in 1995 and it is governed by the Matti Koivurinta Foundation. The Latin name refers to "Old Turku & New Art" according to an early 18th century dissertation, *Aboa Vetus et Nova* (Juslenius, 1929). The underground section of the museum houses their archaeological collection and presents the results of extensive excavations done in the area from 1992 to 1995 and after 2005. The objects found are dated from the 14th to 19th centuries and consist mainly of coins, pieces of everyday objects, bone fragments, various tools and decorative items. Contemporary art exhibitions are held in the

museum building. The contemporary collection is based on the collecting work of the Turku-based entrepreneur Matti Koivurinta (1931-). The museum and its contemporary visitors offer a fruitful survey ground for studying the relation between the visitor experience and the exhibition layout, i.e. how visitors relate to objects displayed in the museum.

The underground archaeological section of the museum is made accessible by glass pathways, and the original ruins are left untouched. The atmosphere along the pathways is quite serene and archaic, with lighting in the space being dimmed. This, in turn, is an aid in creating an understanding of something ancient and valuable, even though the surrounding area itself consists of rather plain stone ruins and found fragments of objects. All of these aspects are part of a storytelling mechanism, one that allows museum visitors to engage themselves with the era in a more profound way (Rönkkö, 2009; Petterson, 2010; Anderson, 2004).

3. Museological value discussion leading to a long-term approach

The above-mentioned methods are examples of how meaning can be constructed. Along with the researched historical facts they offer building blocks for constructing museum identity. In this process museums are using power in choosing what kinds of stories they decide to tell (Duncan, 1995). Both analyzing significance and selecting contemporary key objects are useful tools when legitimizing contemporary signification. In addition to the contemporary endeavors, dynamic collection work should also be seen from a more comprehensive viewpoint, having its roots in history. When dealing with museum collections, it is not only a question of single objects or their key value and significance as part of contemporary museum activities. We should include a historical perspective in the equation. When determining the value network affecting a museum object, we need to consider the accumulation of value, century after century. This includes, for example, elements that contribute to the concept of immeasurable value. When using this concept, one should point out that the term “immeasurable” does not necessarily refer to things and objects that have a high monetary value.

Value accumulation is without question more than a museological issue; it involves a much wider area of our cultural heritage but should nevertheless be one of the core research areas of various memory organizations. Eventually, it is all about the process in which one museum item needs to be seen as part of a greater heritological reserve. It is important to see all collections that we have as part of this reserve, regardless under whose ownership they might be at any given time in history, and to see museums pointing out signification in this reserve. It is not only museums, rather the whole heritage sector that should be involved in this process. In order to participate, value discussion is needed, and this work ends up having an impact.

In general, the concept of an impact factor has been chosen as a key one when studying meaningfulness in society, either from the tangible or intangible points of view (Weil 2002; Holden 2006, Scott 2008; 2013; Conn 2010; Davies, 2011). The core question for any contemporary audience is as follows: What do people consider meaningful in their own environment, and why? One method used in the heritage sector to measure such meaningfulness is to look at the impact factor of meaningful objects in society, as was done in the two previously mentioned examples, Lyyli’s Wooden Box and Hiski the historical cat skeleton. Museum collections and the network of values embedded within them are things that not many other institutions in society possess. This reality should not be disregarded in time and place, where one’s own impact is a factor. It is important to understand that there have been institutional structures showing interest in meaningful objects, century after century. The fact that there are societies in the world that consider museum collections important is a straightforward indicator that an impact factor is indeed present. The continued care and existence of museum objects throughout the centuries is very strong evidence of this.

To use the concept *museological value discussion* takes a comprehensive approach to the key factors of significance, matters of meaningfulness and eventually collection development. In this way, the value perspective of the discussion is wider than just one object and its current value accumulation. It means seeing values accumulating century after century.

The need for a museological value discussion becomes evident when studying the field further, especially in the process of evaluating a museum’s own identity. When determining any long-term decisions affecting a museum’s collection or identity, museological value discussion comprehensively takes into account the entire span of everyday museum practices and addresses the need to consider both philosophical and practical-value approaches. It functions, for example, as a bridge between philosophical issues such as good vs. bad collection

items and more pragmatic issues, such as the monetary-oriented or condition-based values of collections. However, it is not enough for such a discussion to be based only on philosophical grounds, monetary issues and/or the public's current experiences and expectations; the more comprehensive viewpoint discussed above needs to also be taken into account.

Museological value discussion results in a value network, which consists of selected values specific to a given museum or heritage organization. This network is not based only on our current idea of values or identity, but also on those that have accumulated century after century. This is seen, for example, in the existence, caretaking and research of collections throughout history, and is seen in the obvious key objects of our culture. By studying these networks and groups of key objects, specific to each museum, it is possible to obtain information about the mutual values among museums and reach a common voice. This common voice is needed in order to see heritologically meaningful aspects of society as more than only possessing market- or profit-oriented values for our current consumption.

This understanding does not restrict itself only to museums as institutions or their collections, but also leads to a wider perspective and encompasses all museologically meaningful phenomena in society (Hudson 1993; Šola 2004; Mensch (van), Meijer-van Mensch, 2011). This aspect helps us to understand historically significant objects comprehensively, where museums as institutions are one part of the whole. Museums and their collections do not exist in an isolated past, nor do they bear meaning only in our current society but carry meaning and understanding from the past to the present and into the future. When museum professionals see their role as mediators, they function as important links and carry on the work of past generations. The professor of museology at University of Jyväskylä sees the situation as follows: «Professionalism related to research and preservation work of the current museum generation will greatly determine what kind of past we will have in the future» (Vilkuna, 2003: 10).

Using the methods described in the above-mentioned two examples as part of the museological value discussion, museums can build their accumulating value portfolios, statements of significance and key object reserves, and also leave this knowledge for future evaluators. Furthermore, through an active value discussion museum professionals will be better equipped to respond to any short-term fluctuations in their everyday work and be better prepared to help mediate important issues in the heritage field for future decision makers. In this process, it is important that museum professionals understand and see their working role as mediators, and not merely as contemporary consumers. When museum professionals are knowledgeable in value-based debates, this eventually promotes a more coherent and focused view, especially regarding museological values among and between various parties, be they museum professionals, politicians, students or museums visitors. It also puts more emphasis on non-profit aspects of values. One can ultimately address this issue through the following question: To what extent has the entire museum succeeded in its work as a mediator? Concentrating on how theory produces best-practice applications for museum professionals helps to create sustainable heritage for all of society. This in turn has a long-lasting impact.

References

Anderson, G., (Ed.). 2004. *Reinventing the Museum – Historical and Contemporary Perspectives on the Paradigm Shift*. Altamira Press, Lanham, USA.

Artefacta. 2016. *Konkreettinen esinetutkimus harvinaista*, Available at: http://www.artefacta.fi/uutiset/konkreettinen_esinetutkimus_harvinaista.552.news (accessed on 20.12.2018).

Assessing 2014. *Assessing Museum Collections – Collection valuation in six steps. 2014*, Cultural Heritage Agency, Amersfoort, available at: http://www.cultureelerfgoed.nl/sites/default/files/publications/assessing-museum-collections.pdf (accessed on 2.3.2019).

Behm, J., 2008. *Tutkimusetiikka ja tutkimusympäristön normit*, Helsingin yliopisto, Helsinki, Sweden.

Conn, S., 2010. *Do Museums Still Need Objects?*, University of Pennsylvania Press, Philadelphia, USA.

Danto, A., 1964. The Artworld, in *Journal of Philosophy* 61, pp.571-584, Journal of Philosophy, Inc., New York ,USA.

Davies, P., (Ed.), 2011. *Museums and the Disposal Debate. A Collection of Essays*, Museums Etc., Edinburgh, Scotland, UK.

Dickie, G., 1971. *Aesthetics: An Introduction*, Pegasus, Indianapolis, USA.

Dickie, G., 1974. *Art and Aesthetics: An Institutional Analysis*, Cornell University Press, New York, USA.

Dickie, G., 2001. *Art and Value*, Blackwell, Oxford, UK.

Duncan, C., 1995. *Civilizing Rituals – Inside Public Art Museums*, Routledge, New York, USA.

E.C.C.O. Professional Guidelines, 2003. *Code of Ethics 2003*, Available at:

http://www.ecco-eu.org/fileadmin/user_upload/ECCO_professional_guidelines_II.pdf (accessed on 20.2.2020).

Ehdotus museopoliittiseksi ohjelmaksi. 2017. *Opetus- ja kulttuuriministeriön julkaisuja* 9/2017. Available at: http://urn.fi/URN:ISBN:978-952-263-455-9 (accessed 2.3.2019).

Haapala, A., 2010. Arvot, arvostukset ja taidekokoelmien kartuttaminen, in *Kokoelmalla on tekijänsä, Jyrkkiö*, T., Liukkonen, E., (Eds.). pp.65-79, Valtion taidemuseo KEHYS, Helsinki, Sweden.

Holden, J., 2006. *Cultural Value and the Crisis of Legitimacy*, DEMOS, London. Available at: https://www.demos.co.uk/files/Culturalvalueweb.pdf (accessed on 2.3.2019).

Hudson, K., 1993. The Great European Museum, in *Nordisk Museologi* 2, pp.51-60.

Häyhä, H., Jantunen, S., Paaskoski, L., 2015. *Analysing Significance. Suomen Museoliitto, Helsinki*, Available at: https://www.museoliitto.fi/doc/verkkojulkaisut/AnalysingSignificance.pdf (accessed on 20.2.2020).

ICOM Strategic Plan 2016-2022. Available at: https://icom.museum/wp-content/uploads/2018/06/ICOM_STRATEGIC_PLAN_2016-2022_ENG.pdf (accessed on 8.7.2019).

Juslenius, D., 1929. *Vanha ja uusi Turku*, WSOY, Helsinki, Sweden.

Knell, S., (Ed.), 2004. *Museums and the Future of Collecting*, Ashgate, Burlington, USA.

Lehto-Vahtera, J., (Ed.). 2018. Kokoelmien avaimet – Museokokoelmien tunnisteobjekteja. Aboa Vetus & Ars Nova, Turku.

Mensch (van), P., 1992. *Towards a Methodology of Museology. University of Zagreb, Zagreb*, Available at: http://emuzeum.cz/admin/files/Peter-van-Mensch-disertace.pdf (accessed on 20.2.2020).

Mensch (van), P., Meijer-van Mensch, L., 2011. *New Trends in Museology*, Museum of Recent History Celje, Celje, Slovenia.

Museums 2020 Discussion Paper 2012. *The Museums Association*, Available at: http://www.museumsassociation.org/museums2020 (accessed on 20.2.2020).

Mustajoki, H., Mustajoki, A., 2017. *A New Approach to Research Ethics – Using Guided Dialogue to Strengthen Research Communities*, Routledge, London, UK.

Paaskoski, L., 2015. *Lyylin puuloota: merkitysanalyysi esineen tulkinnassa. Artefacta*, Helsinki, Available at: http://www.artefacta.fi/tutkimus/artefactum/6 (accessed on 20.2.2020).

Pettersson, S., 2010. Kokoelmatutkimus kontekstin luojana, in *Kokoelmalla on tekijäns*ä, *Museologia* 4, Jyrkkiö, T., Liukkonen, E. (Eds.), pp. 174-187, Valtion taidemuseo KEHYS, Helsinki, Sweden.

Piekkola, H., Suojanen, O., Vaino, A., 2013. Museoiden taloudellinen vaikuttavuus. Vaasan yliopisto Levón-instituutti, Vaasa.

Porter, M., Kramer, M., 2011. *Creating Shared Value. Harvard Business Review*, Available at: https://hbr.org/2011/01/the-big-idea-creating-shared-value (accessed on 2.3.2019).

Robbins, N., 2016. Poisto museokokoelmasta – Museologinen arvokeskustelu kokoelmanhallinnan määrittäjänä, *Jyväskylä Studies in Humanities* 283, Available at: http://urn.fi/URN:ISBN:978-951-39-6581-5 (accessed on 15.9.2017).

Robbins, N., 2017. Museum Collection Disposal – The role of museological value discussion in collection management, in *The Museums Review* 2, 1. Available at: http://articles.themuseumreview.org/vol2no1robbins (accessed on 20.12.2018).

Robbins, N., 2019. *Promoting Value Practice in Museums Creates Impact. Curator: The Museum Journal*, Available at: https://onlinelibrary.wiley.com/doi/abs/10.1111/cura.12350 (accessed on 20.2.2020).

Russell, R., Winkworth, K., 2009. *Significance 2.0: A Guide to Assessing the Significance of Collections. Heritage Publications*, Available at: www.environment.gov.au/heritage/publications/significance2-0/part-1/index.html (accessed on 2.3.2019).

Rönkkö, M., 2009. Museo mediana, in *Museologia tänään. Suomen museoliiton julkaisuja* 57, Kinanen, P. (Ed.), pp. 246-278,Gummerus Kirjapaino Oy, Saarijärvi, Finland.

Scott, C., 2008. Using Values to Position and Promote Museums, in *International Journal of Arts Management* 11, pp. 28-41, HEC - Montréal - Chair of Arts Management, Canada.

Scott, C., (Ed.). 2013. *Museums and Public Value*, Ashgate, Burlington, USA.

Simon, N., 2010. *The Participatory Museum*, Museum 2.0, Santa Cruz.

Šola, T., 2004. Redefining Collecting, in *Museums and the Future of Collecting*, Knell, S., (Ed.), pp. 250-260, Ashgate, Burlington, USA.

Vilkuna, J., 2003. *Täytetyn tiikerin äärellä. Museologia, mitä se on?*, Available at: http://www.tieteessatapahtuu.fi/037/vilkuna.pdf (accessed on 2.3.2019).

Weil, S., 2002. *Making Museums Matter*, Smithsonian Books, Washington, USA.

Wollheim, R., 1980. *Art and Its Objects*, Cambridge University Press, Cambridge, UK.

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A Museum in between: Troy; Past, Present, Future

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Abstract

In the era of digital transformation, built environment is still as a static base for experiments. It has been freshly under several researches related to both learning-teaching and various industry-based acts. By hosting a wide range of topics from historical to contemporary, art to sciences and technology, museums have been evidences of the past whatever their form is. Various encounters are truly only possible through the museums what capture the attention during the visit at the museums and how the breaking points are clearly learnt from the presented topics. However, the new questions have already arose 'how do we understand, remember and teach the past today and how do we transfer it to future?' Having a strong relation with the role and techniques of museums, juxtapositions of digital technology and the idea of museum have led to rise of new advancements by witnessing considerable time shift. Especially, in the matter of historical landscapes and archaeology, such fields needing serious amount of time to occur as a science and overlapping layers with both physically and non-physically, the role of digital technologies and digital world which can show themselves as attached, added or in the state of going hand in hand in with a museum which is already an innovation in the accumulation of the knowledge. In this study 'Troy Museum' which located in Çanakkale, Turkey as a multi-layered museum taking its name from a village was built around 3000 BC, in the bay where Scamender (Karamenderes) and Simoeis (Dumrek) Rivers flowed into Aegean Sea. Even though the original name is unknown, later it is called as 'Troy'. Thanks to the geographical location of the settlement, it has been continuously settled for 3500 years. A total of seven settlement layers with more than fifty buildings phases have been attested from the Early Bronze Age, to the Early Iron Age (ca 3000 – 1000 BC) (Troy Museum Archive, 2019). On top of them remains of ancient Greek and Roman settlements which were covered by a small Byzantine settlement located as parts (Troy Museum Archive, 2019). Besides its well-deserved architectural design as a museum and curation of the exhibitions, it is also a significant example of the employment of digital elements among the Troy Museum with its development in the frame of digital heritage and the subject of the ancient city. It is investigated to document through the study both the elements of digital exhibition and the lessons learnt through digital advancements. Its effect on collective and individual memory by using an ancient history-based museum as a case in the middle of the blended past among different civilizations. This idea is supported by question and answers through a visitor to addresses the experiences in a certain amount of time after the visit and what is remaining in his mind related to both conventional museum experience and the digital experience. It is aimed to reach remarks related to future of the museums and innovative forms of learning by experiencing in the museums and the exhibition practices.

Keywords: Digital Heritage, Museum, Memory, Mediterranean

1. Introduction

In this article, the museum, which takes an ancient city as a focus point that has been stratified historically and spread over different geographies, has been examined through digital display techniques. While Troy is an ancient city that carries the trail of a different civilization in multiple layers, it will be examined how the digital display methods contributed to understanding, learning, and remembering such a settlement in the Troy museum designed with a contemporary interpretation (Sweeney, 2018). The research points out that many up-to-date interventions related to architecture and urban sense in this era we argue can no longer be considered regardless of the digital layer (Arslan and Verdiani, 2019). In this context, the research seeks to answer the question through user experience (UE): Does digital layer exists and works purposefully in the context of Troy as an archaeologically sited multi-layered history museum?

2. Brief Story of Troy

The unique fame of Troy comes from its myth – the myth of the Trojan War. It is a story best known from Homer's epic poem, the Iliad, (Eagles, 1990) composed in Ancient Greek in the eighth century BCE. The poem explores love and anger, duty, and heroism, setting these against the dramatic backdrop of a bloody and ongoing war. This war was the decade-long conflict between the massed armies of the Achaean Greeks on one side and the Trojans and their allies on the other, resulting in the eventual defeat and destruction of Troy. Throughout history, the name of Troy has been synonymous with this myth of the Trojan War, and the story of Troy has always been bound up with the story of this conflict. Behind the myth lay a real city of bricks and stone, inhabited by real people (Figure 1) (Sweeney, 2018). Troy is also a scenario of destruction, the last layer of the town, with all the buildings destroyed and abandoned, leaving a mix of ruins. Most of the visitors would find difficult to interpret this remains by themselves, while it is the value of each stone to establish the possibility of an interpretation. Even the findings, in such a situation, would hardly rebuild their relationship to the contests if not supported by accurate knowledge. The interpretation of the stratigraphy and phases of the whole settlement is still subject to new theories and hypothesis (Easton and Weninger, 2018) and the strength of the myth links the communication of the place to well defined values. In this, digital solutions in the "exhibition machine" may greatly contribute to creating a direct communication and "contact" between the visitors, the remains, and the reconstruction of that past.

Fig. 1. Location of Troas Archaic Period Settlements (C. Aslan, 2014).

Troy as a city was a fully functioning community from the start of the Bronze Age until the seventh century CE, a period of about four millennia. During this time, its fortunes waxed and waned. There were times when the city flourished, its population expanded, and its wealth multiplied. The Late Bronze Age (2920-2550 BC), the Hellenistic period, and the Imperial Roman period were such moments. But there were other times when the city's fortunes plummeted, and the number of its occupants dwindled. Such times included the Early Iron Age and the Byzantine period. Each phase created a layer overlapping, reusing, and integrating the previous, with a gradual expansion of the city boundary, in any case, no matter the good or bad fortune, the buildings keep on exploiting the same settlement, sometimes following past remains and often defining a completely new urban asset. Today, the archaeological site of Troy is defined by nine main chronological phases, Troy I–IX (Figure 2) to distinguish the remains from these different periods. The nine cities of Troy represent, in effect, the nine lives of a real community (Sweeney, 2018).

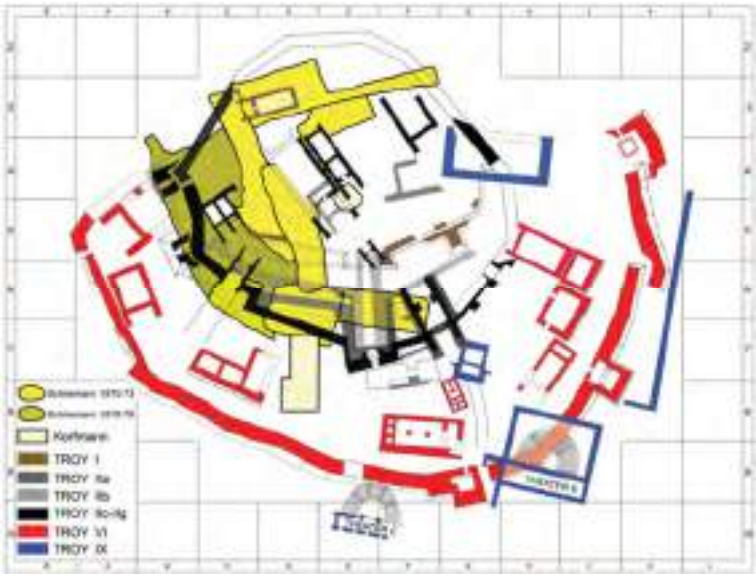


Fig. 2. Plan of Ancient Troy and its main stratigraphy (Easton and Weninger, 2018).

The excavations in the site have revealed nine main cities with various ruins of city walls, typical house-foundations, a temple, a theatre and recently an underground watercourse (also mentioned by Homer), a defensive ditch and several elements which may indicate the presence of a lower town. The same story of the discovery and excavation defined an epic event for archaeologists and cultural heritage scholars, the attention and importance given to the Epic from Homer was so bold over any previous tentative about the localization of the place of the mythical events that the intervention of Heinrich Schliemann, who brought back to light the ruins of the city in 1873, was the centre of a great attention and resonance (Sweeney, 2018). In its way the discovery created a new myth around the figure of Schliemann, no matter how controversial his behaviours may be (Easton, 1998) and out of any doubts this event gave a brilliant and persistent moment to the whole story of archaeology. Giving a real and consistent evidence to the myth. The intervention following the first discovery went in depth investigating the whole area, digging out a vast patrimony of artifacts (Tolstikov and Treister, 1996), parts of buildings and urban sectors. The incredible weight of the Homer's Epic and the complex adventure of all the mythical characters involved in the ancient events, keep on a strong presence in the popular imagination, even with a the large debate ongoing between scholars about the balance between myth and real evidences, the first one maintained his capability in capturing attention on the area and attracting visitors and curious, even those with a scholastic of very generic knowledge about At the present time, nine cities were unearthed, those have been subdivided into 46 strata. From the technical point of view, the "nine cities" or "nine layers" of Troy have been classified as follow: (URL 4).

Table 1. Nine chronological phases of Troy (Sweeney, 2018).

Troy I	Early Bronze Age I: The spread of bronze working across the Near East; the beginnings of seafaring
Troy II	Early Bronze Age II: Urbanization, increased connectivity, and trade around the Near East
Troy III Troy IV	Early Bronze Age III: Growth of central Anatolian communities
Troy V	Middle Bronze Age: Old Assyrian Empire; increased trade across Near East; written records appear for Anatolia
Troy VI	Late Bronze Age: Complex states and empires; sophisticated networks of trade and diplomacy across Mediterranean and Near East; 'Age of Heroes'
Troy VII	Early Iron Age: Greater fluidity and instability in political structures; emergence of Phoenician and Greek trade networks across the Mediterranean
Troy VIII (Geometric-Archaic-Classical-Hellenistic)	The Greek World: Emergence of Homeric poetry; spread of Greek settlement across the Mediterranean; rise of aristocratic culture; Persian Wars; Athenian Empire and Peloponnesian War; campaigns of Alexander of Macedon; Hellenistic kingdoms
Troy IX (Roman)	The Roman World: Roman Republic and Julius Caesar; Augustus and the establishment of the Principate; continued spread of the Roman Empire; relocation of the imperial capital to Byzantium; split into the Eastern and Western Empires

Fig. 3. Aerial view of the Troy area in its present asset (Yalin Architecture Archive, 2020).

The ancient city represents influence in a large cultural and economic field, since the ancient times. The urban centre is described as a strong and a holy (*hieros*) citadel, surrounded by walls and high towers, within which are palaces and temples. Importantly, Troy is described as concerned with how physically imposing it is. Definition includes "well-built" (*eudmetos*), "well-walled" (*euteichos*), "well-towered" (*eupyrgos*), and "the great city" (*asty mega*). The city also represents the ideals of society and community in addition to the ideals of urban physicality (Sweeney, 2018).

3. The Museum of Troy

The contest for a project aimed to the design and realization of the new Museum of Troy was opened by the Ministry of Culture and Tourism of the Republic of Turkey in 2011, proposing an intervention on a place with an area of ten hectares. The museum is expected on a place near the archaeological site in Çanakkale, next to Tevfikiye Village. The museum itself is supposed to preserve the artifacts found during the archaeological excavations and to exhibit them. In addition to the conservation and restoration laboratories in the museum, there is a 2000 square meter warehouse area, temporary and permanent exhibition areas, activity areas, and sales areas for access to the natural environment. As a result of the competition which includes 132 projects participation, Ömer Selçuk Baz and the Yalin Architecture team won the first prize. The studio, on its website presents it as "Trojan Museum National Architecture Competition in Troy, one of the world's most famous archaeological sites, on the UNESCO World Heritage list. With its 5000 years of history and its importance in the development of the history of European Civilization, Troy represents a profound influence due to both historical and the development of the communities towards today's civilized structures" (URL 1).

Fig. 4. Entrance of the Museum (Yalin Architecture Archive, 2020).

The cube-shaped museum was opened in October 2018 after five-years construction period, it rises visually strikingly from the rural area around the village of Tevfikiye, where the ruins of Troy are, it hosts an exhibition system aimed to display the nine different settlement periods, starting with the first defensive wall built in 3000 BC (Figure 4).

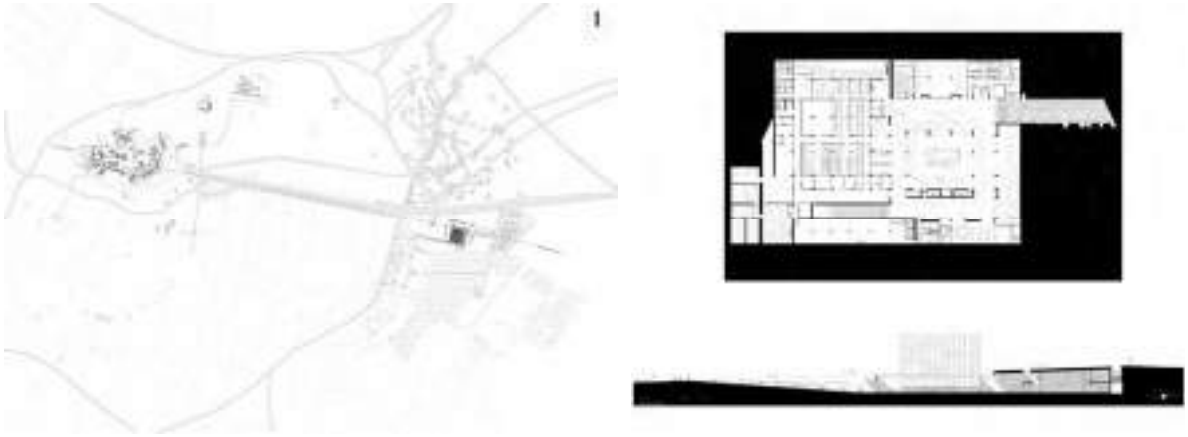


Fig. 5. Site plan, floor plan and section (Yalin Architecture Archive, 2020).

The cultural coordinator of the permanent exhibition of the museum, which aims to be more accessible by displaying the stories of the findings with interactive display techniques, is a cultural anthropologist from the University of Victoria. As Deniz Ünsal mentioned, “Troy is not like Ephesus, where there are enough preserved remains to help visitors visualize the ancient city. It can be difficult to understand many layers without a guide". (URL 2). “We tried to make the museum experience more experimental; It is important for people to interact with it rather than just look at the material”. The works exhibited in the 3000 square meter exhibition hall range from a small bronze seal that helps establish a connection between the inhabitants of Troy and the Bronze Age Hittites in North-central Anatolia, to a massive ancient Greek sarcophagus, which was moved to the museum by crane before the construction of the building was completed.

The museum hosts also findings from Alexandria Troas and the Apollo Smintheus found in the nearby, and other archaeological artefacts from the region's heritage. The open terrace at the top of the museum offers a wide panoramic view of the archaeological site, and its panels point to places of historical importance. “The museum is a three-dimensional guide that will help you understand the ruins”. “When you first go to the museum and then encounter the ancient settlement, by that time you stand under a fig tree, that will be the moment you truly understand the city” (URL 2).

Fig. 6. Interior sketches and views (Yalin Architecture Archive, 2020).

4. Understanding the Digital Layers of Troy Museum Through Visitor Experiences

Digital Layer is a design subject influencing the project of places, giving new options to define choices, it allows to expand the perception of architecture and the way it can be communicated to visitors and users.

The digital layer starts from a first phase, the one of the system of tools that allow the gathering of information and then define the design proposal where the operators create and work on a “digital twin” of the real place; then, it evolves in digital solutions allowing to get onsite specific information about what is in front of the users/visitors, later it is integrated by online digital system that in sparse or coherent and connected ways define the amount of information available in place about the subject (Arslan and Verdiani, 2019).

While digital layer is a phenomenon that can be encountered in any intervention both in architectural and urban scale, it is also matter of the museums in micro scale.

The context of digital layer can be integrated to an existing building or it can be created by the set-up of the exhibition elements within the purpose of the museum. Here, the main theme is archeologically constructed ancient city and history around it as well as several myths. So, it is directly issue of digital layer’s range of interest.

Digital approach in this museum is aimed to contribute visitors’ long and short memory and suggesting a structure pushing learning through several interactive experiences harmonically in between past and future among the realities and myths parallel to each other.

4.1. Digitally Augmented Contents

Digital exhibition sections of the museum are specifically selected to indicate their contribution to help understanding complexity of Troy. They are projected by following different figures wandering around the museum (Figure 7). Digital exhibition is approached by the contribution to the memory and learning process. In Figure 8 shows a depiction of Tumulus, following the dead of a noble, royal family member or important personage, a mound is built by piling earth on top of his/her tomb so that it can be seen from all directions. The Tumulus of Achilles in the Troad was built as a monumental tomb although it does not host an actual burial. In the museum, Dedetepe Tumulus (Figure 8). one of many in the Granicus Plain, can be dated to the early fifth century BC when the Persians controlled the region.

Fig. 7 Interactive display presenting the coins from the Troad (Troy Museum Photograph Archive, 2019)

This tumulus is located near the village of Çeşmealtı and the burial chamber within it was built with marble blocks joined by lead clamps. The chamber housed two marble *klinal* (banqueting couches) with painted decoration.

Fig. 8. Dedetepe Tumulus (Troy Museum Photograph Archive, 2019).

However, four skulls found inside the tomb indicate that it was used for several generations. The tomb was robbed at least twice, the first was in the Hellenistic period. The Dedetepe Tumulus was excavated by the Çanakkale Archaeological Museum Directorate in 1994 (Troy Museum Archive). The mound of Hisarlık where Troy is located has been continuously settled for 3500 years thanks to its favourable geographic location. Buildings and fortifications were constructed with stones and mud bricks. When those buildings were destroyed, they were used as the foundations for new structures built above them, thereby creating intertwined settlement layer (Troy Museum Archive). At the mound of Hisarlık, a total of seven settlement layer (Troy I – VII) with more than fifty building phases have been attested from the Early Bronze Age to the Early Iron Age (c.a. 3000 – 1000 BC) (Figure 10). On them there are the remains of ancient Greek (VIII) and Roman Troy (IX) settlements, parts of which were covered by a small byzantine settlement (Troy X). Thus, the cultural deposits of the mound reach a height of 15 metres (Troy Museum Archive). In the section of the layers of Troy, layers are presented one by one by juxta positioning on top of each other. While visitors can follow the arrangements of specific period through the screen, they can be aware of plans and section at the same time. This makes much easier to understand developments and incursions in parallel to it.

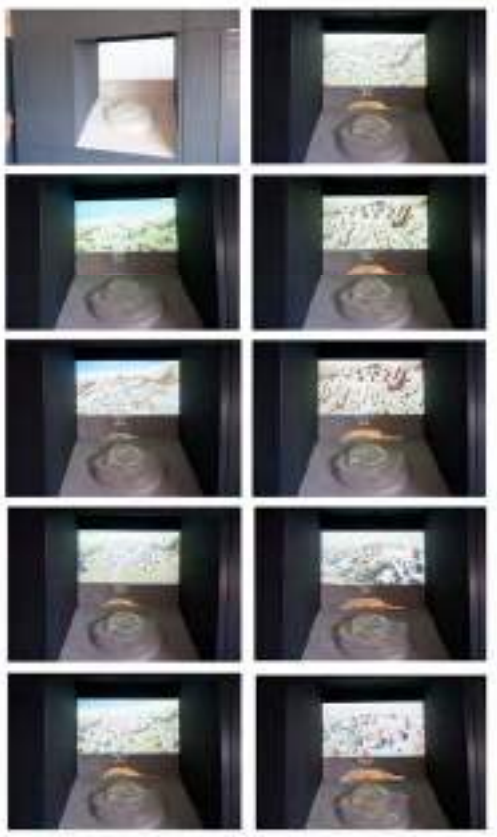


Fig. 9. Interactive overlapping system for the presentation of the layers of Troy (Troy Museum Photograph Archive, 2019).

Fig. 10. Section dedicated to the Early Bronze Age Trade Routes (Troy Museum Photograph Archive, 2019).

One of the display element choice is an inclined surface to visualize Early Bronze Age Trade Routes (Figure 10). The surface houses are symbols, figures, colours, and dots while showing the real-time objects at the same time behind the surface through the wholes. Music and lights are accompanying the different routes' visibility. Dioramas are one of the visitor attractors parts of the museum to display life in Troy. In this method, the houses and lifestyles are modelled and presented completely including the inhabitants. Digital exhibition elements make Troy Museum more attractive by different age brackets. Children are more likely to spend time in front of a screen with a virtual interactive representation than with real objects (Figure 11).

Fig. 11. Daily life in Troy City visualization (Troy Museum Photograph Archive, 2019).

Fig. 12 Parallel timing videos explaining the material culture of the time (Troy Museum Photograph Archive, 2019).

Fig. 13. Live screen shows the characters like Helen and Achille (Troy Museum Photograph Archive, 2019).

Fig. 14. Digital epitaph panels (Troy Museum Photograph Archive, 2019).

Fig. 15 Dioramas created through virtual screen (Troy Museum Photograph Archive, 2019).

Some of exhibition elements has short videos, audios with accompanying sound. Thanks to the nice audio system, sounds are not mixing to each other. In Figure 15, characters from Troy are telling parts from the book. Hearing and seeing Helen at the same time is already very interesting for these children on the photo. The design of the displays is arranged to allow an easy access to adults and younger visitors, with a proper ergonomics that helps in extending the access to the information to people using a wheelchair as well. Some specific elements, like seats and the size/positioning of the panels are organized in the logic of the "access for all" (Christ, 2009), with the same practical solutions for any kind of visitor.

Fig. 16. Touch screen optimized display for interactive content browsing (Troy Museum Photograph Archive, 2019).

Fig. 17. A circular room with a screen showing a ritual (Troy Museum Photograph Archive, 2019).

Fig. 18. Visitors can interact with the architecture of the ancient city (Troy Museum Photograph Archive, 2019).

Elements inviting to explore with curiosity introduce the element of the game/surprise along the visit, augmenting the possibility to fix very specific concept and giving to other a more robust impression. Like in a

cultural kaleidoscope, the visitor is then invited to directly discover the contents “hidden” in the museum machine, getting a reward of knowledge and getting back a special fascination.

Fig. 19. Small objects create experiences through audio (Troy Museum Photograph Archive, 2019).

4.2. User Experience of Learning Through Digital Layer

To better understood the efficiency of the museum as a “exhibition and learning machine”, it was defined a set of questions to be directed to visitors with the aim of having a quality feedback about learning contribution from the museum. To experiment the way the questionnaire works a first test was applied to a visitor who spent three hours and has seen the whole museum. The visitor is a new university graduate from the engineering field, a young professional with an interest on history. In this research, one of the parameters of Troy Museum analyzed is the “historical reminderness” (Korkmaz, Savasci and Aydin, 2019). The research from Korkmaz, Savaşçı and Aydin (2019) is well addressed and focused on this topic, a research that pushes forward several results, some of them emphasize the importance of the digital exhibition layer used in the museum. Participants were asked how the exhibitions could be animated in visitor minds, especially about the settlement and how lifestyle of Trojan people can be understood. Participants who experienced the Troy Ancient City and Troy Museum with the integration of simulations and holograms, brought back a very interesting feedback, in line with the question, one participant said: “Visitors visit this place not only by seeing the animations of the architectural structures, but also how the interior of a megaron structure is. By seeing the animations, I think they will feel as if they were there with Troy in history. Because I had these feelings when I visited the museum. Troy's lifestyle, how they live, how I could understand how their appearance was”.

In addition, another participant said: “There were holograms. By watching it, we can see what kind of lifestyle people are, their daily lives. We can better understand how Trojan women do business or how men work”. Another question is that what was done in the museum to make the legend and characters of Troy be revived. The 14 legends and characters of the Trojan legend in the guise of the artists' characters are animated. It is stated that their digital appearance in the museum is remarkable. However, a comment was like: “Trojan mythology can be understood a bit more with interactive elements. Inside, when you enter, there is a floor reserved for mythology where all the myth is told. There is something with a sensor that is transferred with drawings and this shows the people Paris, Helen, Akhileus, Hektor in the form of a box. When you go and stand in front of them, the sensor perceives you and that character starts talking to you, introducing himself”. Other is stated that the characters are not included enough and there are shortcomings. In the observations it was stated that there were simulations and boards of Trojan mythology. Troy including the techno-columns of the characters is thought to be effective in obtaining information about the characters.

Following that, a series of alternating questions is directed to a figure within this research as stated below:

1. After your visit of Troy Museum, which digital installations have you used, and you remember? How could you define them?
2. Which digital exhibition technology do you find most interesting in Troy Museum, and why?

3. Compared to the other history museums that you have visited, could you define which are the special differences between the Troy Museum and the others?
4. Do you think there are digital installations with an important function in giving a better vision of the history and permanent information to enhance the following visit, how do you make this connection?
5. Having envisioned the future of the historical museums, what do you think should be considered more in terms of exhibition techniques in parallel with digital culture and orientation?

The answers from the subject are:

1. As far as I have remembered, interactive exhibition elements were the ones that I spent most of my time during my visit. The first one I remember was speaking Helen, she was repeating a section from the Iliad, Homeros. In addition to that, some of them was working with QR code which enables you to be one of character from Troy either prince or princess. I also enjoyed table games such as trade routes or naval routes.
2. The most interesting one was layers of Troy. Even though I like and read the history, it supposed to be complicated to visualize how the city has changed its borders and how it has been developed on on top of other. Within the exhibition, it was quite slow and easy to follow each layer by using 3 objects at the same time. Plans, sections, and images.
3. Minimal cubic form of the museum and its accessibility. It was easy to visit, to control each part. I can say that I did not miss any of the exhibition. This was important because a lot of museum makes me very tired. I am losing my interest in the middle of the exhibition a lot of times. Especially in such complex history, content should be more important than architectural presentability which I think Troy Museum was exactly providing.
4. I think it is very important in terms of memory. I see them as a kind of game. As much you play, that much you learn. It makes you feel like you are living in that term for a while, and you can have that feeling.
5. As a person who is very interested in computer science, I would be very happy to see more advance technology here such as virtual reality or augmented reality. This makes the time which should be spent in the museum one or two hours more but at the same time, they are very powerful technologies in terms of learning and remembering. They can be also used as a solution to preserve the heritage. For example, you can play with the digital twins and ruin everything. Then, years later can be shown in a dystopia. This is very effective way in my opinion especially if children start to play with this more interactively.

A very effective way to check the results from a museum setup is gathering a feedback from the visitors and the users. In the present time, the whole process, from getting aware about what the museum offers, checking it online, preparing the visit and then entering the place with a small or extended knowledge about the contents is really worth of attention, the museums should be considered like "complex learning machines", but the exploration of their potentiality and the extended number of possible variables to their enhancements are yet to be explored in the system of museum design. The feedback of the users/visitors about the effects of simple (the basic displaying of findings or artworks) or mixed setup (combining real or copies of items/objects to one or more multimedia components) is strategic for obtaining a complete read of the value of a museum and then plan appropriate re-design (Packer, Bond, 2010) or acquire those point of strength to be replicated in other contexts (Hein, 1995). Formulating a questionnaire is the fundamental point (Hooper-Greenhilll, 2007), it should be “in line” with the subject, not too far from a “generic” approach to the museum topics, then allowing parallels and matching between different cases, but at the same time personalized in capturing the real key elements of the specific venue. For the Troy museum the following questionnaire was designed with the aim to propose it to a series of subjects in form of interview. In the starting of the interviews, one interview is conducted with a university graduate by considering five questions distributed around five themes as remembrance (1), keeping attention (2), specificity and identification (3), digitalisation (4), curiosity and future orientation (5) In the next steps of this research, it is planned to gather a significant number of interviews from a range of users/visitors to define a range of feedback and then understanding in details the effects of the place, the architecture, the single setups/exhibitions on the perception between the museum communication and the “archaeological” uncertainty combined to the of immense historical value of the location. It is worth to underline that the questionnaire design is aimed to bring inputs of the digitally augmented exhibition context on the constructed memory through this museum.

5. Reflection and Conclusion

Since the earliest day of meeting with its visitors, Troy Museum has succeeded in making a great impact and this effect has been supported by awards and success both architecturally and socially. Although the Museum of Troy is not yet two years old, it received the Chamber of Architects National Architecture Award in the building branch at the 17th National Architecture Awards, it was awarded the most successful museum at the Attraction Star Awards and shortlisted for the European Museum of the Year Award 2020 (URL 3). One of the reasons why the museum resonates in this way is undoubtedly the fact that at a first degree, it fits in the context very well by adopting a calm, minimal approach without hindering the layers. Looking closer, the success of the plan schemes and interior design, which is called the second level of analysis of the museum, can be clearly seen by establishing a close bond with the visitors. The focus of this article is on the relationship between exhibition objects and visitors, which is third-level analysis. The originality lays on the question of how much the emphasis given to digital installations and exhibition techniques can contribute to the memory that can be created in an archaeology and history museum. Despite the short time that has passed over its completion, importance of the story and its role on the public memory is already evident in the visitor impressions, the time they spent inside by interacting with the displays and the details they gave while describing the complete experience. In this sense, Troy museum addressing a historically difficult context shows that digital display objects progress in harmony with the interior design and building form both. They affect whole museum positively and contribute to the memorization, comprehensibility and the pleasure gained during the visit. Digital orientation helps to overcome "digital threshold" in museums related to history and archaeology by preserving the traditional nature of the field.

References

Arslan, P., Verdiani, G., 2019. A special poetic of iron and stone: reflections about the design of the Montemartini Museum in Rome, in Scarpanti, E. (ed.), *Mantua Humanistic Studies* N.5, pp.101-132, Universitas Studiorum, Mantova, Italy.

Aslan, C., 2014. Troya: Protogeometrik, Geometrik, ve Arkaik Dönemler (Troy: Protogeometric, Geometric and Archaic Periods), in *OLBA* 22, pp.81-116, Mersin University Publications of the Research Center of Cilician Archaeology, Mersin, Turkey.

Christ, W., 2009. Access for All, Approaches to the Built Environment, De Gruyter, Incorporated, Germany.

Easton, D., Weninger, B. (2018). A possible new Bronze Age period at Troy, in Anatolian Studies 68 (2018): 33–73, British Institute at Ankara, Cambridge University Press, UK.

Easton, D.F., 1998. Heinrich Schliemann: Hero or Fraud? In *The Classical World, n.*91 (5) pp.335–343, doi:10.2307/4352102, The Johns Hopkins University Press, USA.

Hein, G.E., 1995. Evaluating Teaching and Learning in Museums, in *Museum: Media: Message*, Hooper-Greenhill E. (ed.), Available online at http://george-hein.com/downloads/evalTeachLeicesterHein.pdf (accessed May 2020), Routledge, United Kingdom

Hooper-Greenhill, E., 2007. *Museums and Education: Purpose, Pedagogy, Performance,* Routledge, United Kingdom.

Korkmaz, H., Savasci, U., Aydin, B., 2019. An Evaluation of Museum Promotional Activities and Visitor Experiences: The Museum of Troy Case, in *Journal of Tourism and Gastronomy Studies* 7/4, pp. 3165-3166, Gazi University, Ankara, Turkey.

Packer, J., Bond, N., 2010. Museums as Restorative Environments, in *Curator: The Museum Journal*, Vol.53, Issue 4, Wiley Online Library, USA.

Eagles, R., 1990. *Homer, The Iliad, introduction and notes by Bernard Knox, Penguin Classic*, United Kingdom.

Sweeney, N.M, 2018. *Troy, Myth, City, Icon, Architectural Histories*, Bloomsbury Academic, United Kingdom.

Tolstikov, V., Treister, M., 1996. *The Gold of Troy. Searching for Homer's Fabled City*. Harry N. Abrams, USA.

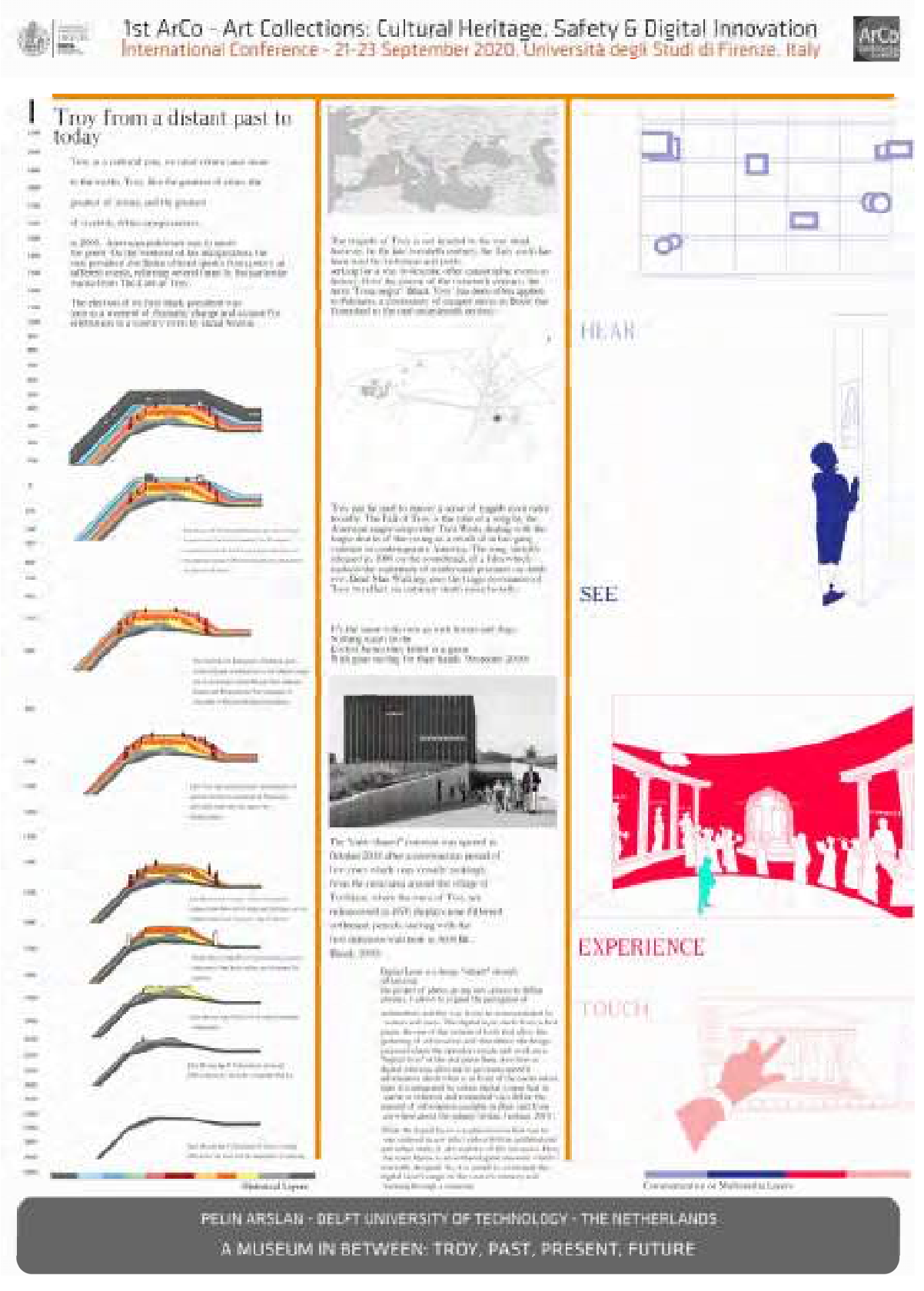
Troy Museum, Author Archive, 2019.

URL 1 Official website of the Yalin Mimarlik Studio http://www.yalin-mimarlik.com/projeler/troya-muzesi (accessed May 2020).

URL 2 Basak, E., 2019, Ziyaretçilerine Efsanevi Troya Deneyimini Yaşatan Müze, in *Arkeofili*, 27 July, https://arkeofili.com/ziyaretcilerine-efsanevi-troya-deneyimini-yasatan-muze/ (accessed May 2020).

URL 3 European Museum Forum Website, list of candidates for the European Museum of the Year Award 2020 https://europeanforum.museum/annual-conference/nominations-2020/ (accessed May 2020).

URL 4 The Greek Age of Bronze, Weapons and warfare in the late Helladic time 1600-1100 BC, By Salinbeni, A., http://www.salimbeti.com/micenei/history.htm (accessed May 2020).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The digitalisation of Cultural Heritage for the non-invasive study of Architecture

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Abstract

The current evolution of hardware and software systems allows the researcher to work with virtual products at high level of interactivity. Research on cultural and architectural heritage, when it presents itself as rest or ruin, has always gone through phases of visual study with the main aim of reaching the most scientifically correct hypothesis on the structure of the original form. Even the design, aimed at adapting for the re-evaluation and reuse of the architectural asset requires careful assessment of the scenarios in the project to ensure the ability to know in advance the relationship that the intervention will establish with the object and the historical memory represented and witnessed in it. In the past, through drawing, technical or artistic, the expert verified and synthesized his hypotheses, producing products aimed at the comparison with the scientific community and the dissemination of knowledge. In our time, we have reached an evolutionary level of digital technology that it is no longer useful to return the research through traditional techniques. Even if the techniques of representation, or direct drawing, always turn out to be the most immediate and flexible for the reorganization and the control of ideas and thoughts, it is only through the restitution with digital means that it is possible to reach common codifications, beneficial for the research and indispensable to be able to approach the global scientific discussion. Together with what has been said, also the research path, if assisted by the digital environment, can be more durable, not so much for its archiving and futurization (on this point we don't want to go into the matter here) but for the possibility of "fixing" intermediate processing steps, always traceable for further studies or new elaborations. Processes such as digital and photographic survey, the study of the data recorded by them (with the management of point clouds and digital photogrammetric reconstruction) and the various number of uses of the products obtained, with an exponential series of resulting outlets, they have today a surprising evolution in the timing of the process and the ease in obtaining a high-level result. In addition, the stabilization and diffusion of platforms for the creation, management and formation of parallel virtual realities (by now not only viewable but also interacting and flexible) show the need for the rooting of digital technology in the basic system of research. There is no more room for anachronistic skepticism about computerization, nor for ignorance of the basic rules that govern it. There is a need for an openness towards these new means that guarantee the use of the architectural heritage to a wider audience, not forgetting their strategic importance, the possibility, therefore, of storing data and recreating virtual scenarios able to last in the near future and to be considered more long-lived than the architectural element itself. With this contribution we want to present some research results, obtained in recent years, in order to show the potential and, above all, highlighting the optimization

Keywords: Digital Heritage; software; reconstruction; photogrammetry; virtual reality.

found on the operation of software (and the evolution on the accessibility of hardware). Hoping to provide a positive contribution to knowledge and help the rooting of digital technology in the scientific community (national). We want to support the inclusion and contribution of the thought of young scholars and young researchers, evolving their contribution from the position of manual operator only.

1. Introduction - digital is the future but that future is almost gone

This text aims to bring to the reader our interpretation of the current state of the panorama of research and design on cultural and architectural heritage. Our focus is on the relationship between intervention, or research, and the digital world. The text will alternate hints for thought on methodologies used in research projects and general descriptions on the current possibilities offered by dedicated software and devices. As mentioned, both the scope of research projects and projects applied to assets of high historical importance will be considered, interpreting them as products for obtaining intellectual or territorial growth. With this text we do not want to highlight a specific method, applied to a specific case but to give light to our historical moment and try to highlight details and structures with the aim of encouraging an evolution, useful for the growth of our scientific community.

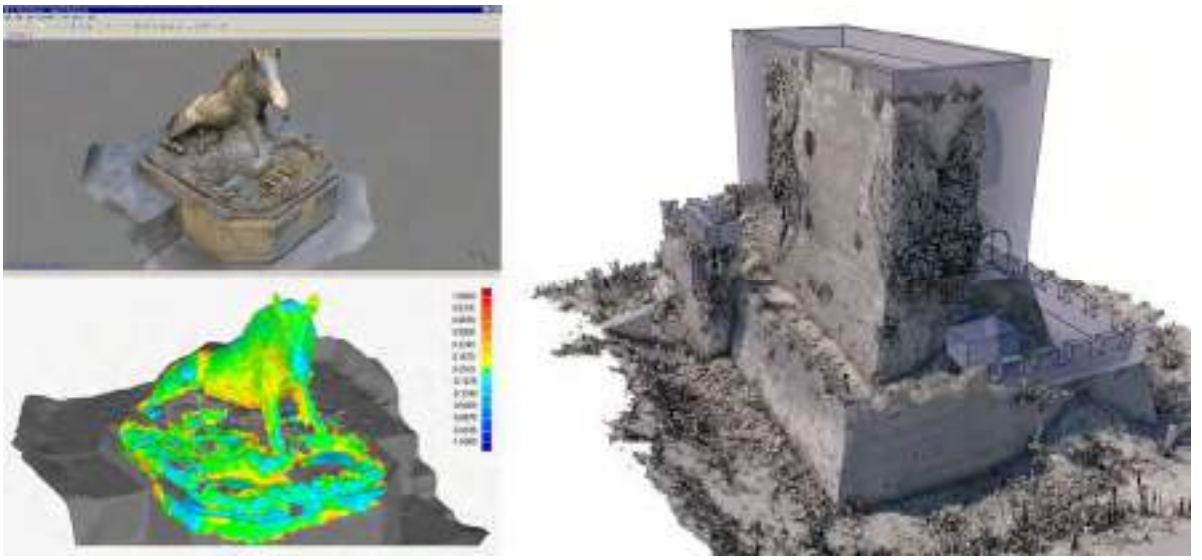

Fig. 1. Examples of analysis and digital works – Agisoft Metashape (Photoscan), 3D Systems Geomagic Qualify and Maxon Cinema 4D.

2. Cultural heritage and historicized architecture

2.1. Analysis for study and operation

When we relate to a cultural, artistic, or architectural asset, we can find two possible scenarios: one relating to a positive condition of the object, or of the place, and the second, opposite, of criticality. The cultural asset is always strategic, through its use it will always be possible to obtain an increase in the value of the territory, or of the place, which hosts it. The use of it may be dedicated to its exploitation or safeguard but, in both cases, the conservation conditions will be created. This last observation should now be taken for granted, the numerous examples of the national and global territory highlight and confirm the positivity of the actions applied to assets, where companies or individuals have activated an economic process, focused on the asset itself, there was a growth in the location and changes were made to the property itself. From this, it is identified that the project, invasive and inclusive, always proves to be an activator of the cultural good system. By making changes, the project will again include the object in the dynamics of the socio-economic territory, thus promoting its

activation and conservation. What has been said is true only in the first of the two scenarios mentioned at the beginning of the chapter; the second, on the other hand, contains most cultural assets, that is, those in a state of neglect or immobility. These are in a state of emergency, with a condition of precarious conservation if not in the process of degradation or disappearance. On them it will be necessary to facilitate the activation, by the administration or the superintendent public authority, of a design process that outlines a transformation or inclusion program and, as said, through the use it favours the maintenance and consequent conservation. For the presentation of the project, however, the canonical practices of relationship with the asset of cultural relevance will have to be taken into consideration, that is, moments of documentation and analysis useful to understand the identity of the asset and its place in order to plan coherent and positive interventions and reasoned.

2.2. The conservation through utilization projects

The architectural heritage itself identifies objects of significant historical value (Ceschin, 2015). These will be single or serial witnesses of the compositional, building, and artistic characteristics of their contemporary and, for the current conservation theory, they will have to keep these original peculiarities well distinguishable from current intervention actions (Cecchi, 2015). The same actions must be reasoned and weighted to align with the essence, the identity of the work but declaring a recognizable character. This arrangement must not be taken as binding, or simply with prejudice. The indication and control over the conception of interventions related at protecting the asset must be interpreted as the added value of the project being conceived, not as a limit or a brake on the possibilities implemented by intervention strategies. A project conceived on (and for) an architectural asset will always have to aim to create an economic movement that will naturally provide a starting point for growth for the place. Already the activation of the project, followed by its operation, will attract social attention to the good, creating usage dynamics on it which, in our opinion, are today the strongest conservation action. By specifying, when an asset provides growth to its territory, identity or economic, this growth will involve the territory itself in its dynamics; for which the property will be spontaneously defended and, consequently, preserved by the local society. Thus, outlining an exchange relationship. We want to leverage on the desire to cancel those project actions aimed at the black conservation of the property. Examples of a remote past that have created glass bells to crystallize prominent architectures, creating landscape furnishings, beautiful to the eye but useless or not sufficiently included in the place's development programs. Staring at the image but losing everything else, denaturing the work and degrading it to ornaments. Conservation should be the goal, the goal, and not the strategy. In addition, the historical nature of the asset should be the input to activate a transformation process rather than, as still too often happens, the filter for proposed actions; that is, the defence of the important asset must not be conservative but progressive, trying to evaluate the proposed projects under development, giving them the opportunity to act and outline a functioning capacity and bring results.

3. The architectural digital survey

3.1. The necessary basis before acting

The architectural survey is an operation aimed at understanding the work in its entirety, so you must first of all understand what you have in front of you, understand all its values from dimensional to constructive, from formal to cultural ones (Docci and Maestri, 2002). Once you understand what kind of information we want to obtain through the survey, we will choose which methodology to carry it out with. The digital survey presents itself as a necessary basis capable of guaranteeing maximum reliability before being able to continue towards that indispensable process for the future development of the asset, characterized by a path made of traceable procedural steps that allow the various elaborate products to be followed and efficiently managed (Mancuso and Pasquali, 2015). Wanting today to update and complete the documentation of the built heritage, we must undertake strictly digital operations, the opportunities, and advantages in terms of time spent, possibility of data processing, quality of the level of detail acquired make the digital survey solution superior to any technique adopted in the past. The available instrumentation (Pucci, 2013) allows to obtain qualitatively superior results to those that could be obtained with traditional survey techniques, not only with regard to the

survey campaign itself but also with regards to the elaborates that were produced, certainly carrying a percentage of error greater than that which can be found today with the tools we use, such as laser scanners, drones, or digital cameras (Guidi, 2014). The greater precision obtained through the return with digital means allows us to obtain more truthful results and common codes useful for research and indispensable to be able to approach the global scientific discussion (Mancuso and Pasquali, 2016). The perception, if not also the understanding, of how an approach based on survey and digital restitution allows absolute precision, greater in the modalities and procedures of all the operating parts on the issues of the built heritage and in general of Cultural Heritage (Addison, 2000). coverage, extreme speed, and greater safety in operations. However, to date (in 2020) what many call new tools are customary and contemporary tools, commonly used by all "young" scholars and researchers.

Fig. 2. Texture model processed in RealityCapture - UAV drone photogrammetry.

In addition to this, it is necessary to extend the reasoning to documentation and search for sources. This component that completes the geometric relief and provides more precise frameworks for understanding the cultural asset, in some cases turns out to be the necessary basis, because it is safer, to justify the proposed interventions, whether they are reconstructive or consolidation. Even in this phase, the use of digital techniques is now the only way forward. First, by consulting paper material in historical archives, any researcher or professional found himself in difficulty with cataloguing or collocation problems. This, as systems used in recently reorganized libraries or archives demonstrate, can be improved through software systems and devices. Returning, however, to dynamics close to the good and the individual project, it becomes necessary after finding the appropriate documentation to digitize it, first of all to make it easier to analyse and make it "insertable" in those presentation documents mentioned above and secondly, to preserve it. This point is very important, first of all because the study operations (in progress of the project or in the future) could affect the integrity of the document itself and therefore making it a digital copy you can use, reproduce, and rework easily and directly. Secondly, but with a greater importance, the digitization of the sources turns out to be the first component suitable for the conservative action of the cultural asset, because the architecture and the work of historical interest is not composed only of its materiality but also of all this which has undergone and gone through and, paper documentation to the contemporary, must become part of the object, like its construction and decorative components. In conclusion, following the collection and digitization of documentary sources, only through software could we reproduce excerpts of them, highlighting or reworking them with non-invasive methodologies.

3.2. Software operations in laser-scanner survey and photographic survey for digital photogrammetry

Following the digital surveying operations, weighted, and designed with a survey program suitable for the asset and the project being conceived, two sets containing the recorded data will be composed. A first containing the individual scanning stations, linked to laser-scanner operations; the other the digital images obtained by shooting with cameras, terrestrial or equipped on an aerial-piloted drone. The next step is developed with software operations that make the survey data useful for the study and usable, both by the designer for understanding the work; that by the workers employed in the realization of the project; that can be archived for future research. The operations can be summarized with the laser-scanner data registration and the digital photogrammetry applied to the images (Guidi et al., 2010). However, this phase at the end of the digital automatisms will not be considered concluded, but the most appropriate return methodology must be considered. In fact, the two operations will produce two digital models of the property under study, these will have to be put in relationship to ensure that the different peculiarities complement each other, to create a unique of complete and in-depth understanding.

On this step it is necessary to mention the RealityCapture software programmed by Capturing Reality; digital photogrammetry application that automates the creation of a unique model between laser-scanner point cloud and digital photogrammetric model, producing a virtual environment where the virtualized object is completed by internal algorithms that relate the data of the two measurements, optimizing the result (Dellepiane et al., 2012).

Fig. 3. Photogrammetric process phases by Agisoft Metashape (Photoscan) – Medusa's Head sculpture.

Returning to the restitution phase, it must be the researcher and the designer who will summarize which works will be more appropriate to the current study or the weighting of the project, once identified these the 3D space must be rendered, returned, to canonical 2D processing, more immediate understanding and, even more rapidly, spreading.

Parallel to the return, however, the researcher will have the model in a 3D environment that will remain on file for the creation of new returns, in the near and remote future, useful for understanding and observing the state of the art of the cultural heritage at the time of the survey. In addition to this, the possibility of migrating this model into more complex but more easily usable digital and virtual environments, which today have evolved into means of understanding that must necessarily be integrated with traditional methods which are by now rooted, which are insufficient and highly limiting for the correct understanding of the assets.

4. VR and AR, shortly Extended Reality

When talking about virtual environments and typologies of reality, it should be better at least to try understanding what their characteristics are and what they differ in, which mainly is the depth of perception and the quality of immersion they are able to offer to the users.

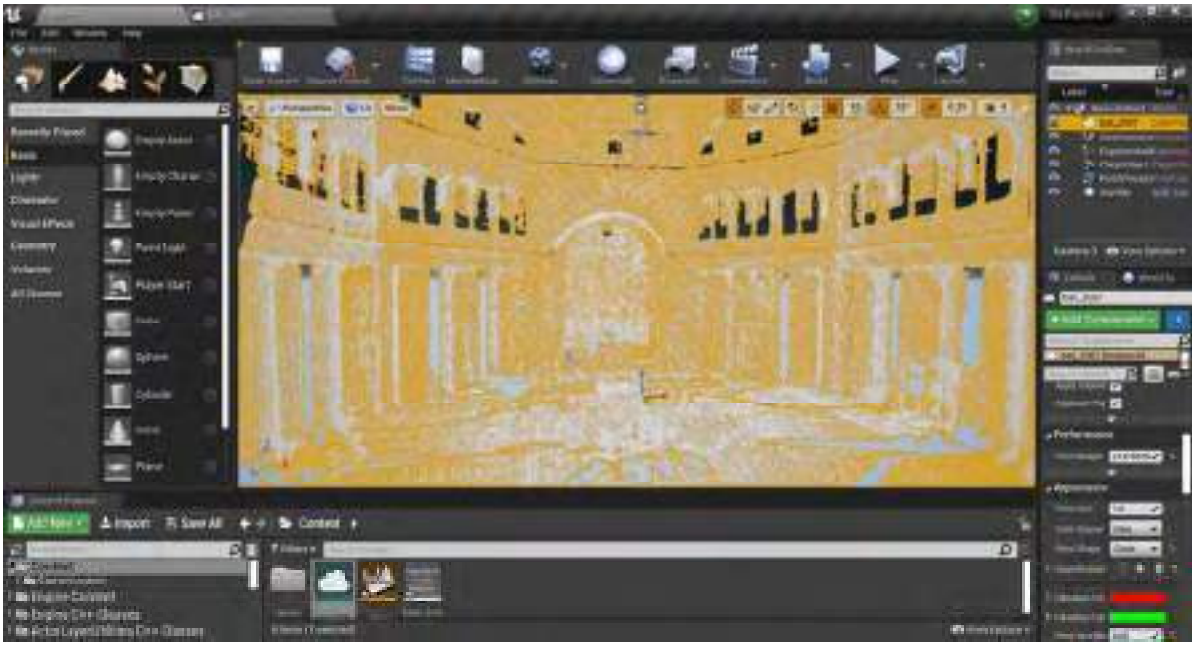

Fig. 4. Screenshot from Epic Games UnReal Engine software – *Battistero di San Giovanni*, Firenze.

Augmented Reality (AR) enhances the world we are living in by overlaying digital content, amplifying our current state of presence by adding something extra (Aukstakalnis, 2016). It allows us to provide information and add objects and information overlapping them on the reality around us through the creation of applications or other device that allow us to expand the real world with the addition of text, images, animations, and 3D models. The process that leads to the achievement of this reality overlay is facilitated by the technology of the latest mobile devices, able to scan reality through their cameras and identify some markers to connect to reproduce animations or three-dimensional models. Inside Virtual Reality (VR) the user is completely immersed in the new reality created, simulating an innovative digital environment that fully replaces the real world. The user who dives himself through the use of VR viewers, called Head mounted Display (HMD), is transported to this virtual environment and is able to interact with what has been reconstructed with 3D modelling software or real panoramas made with 360 cameras, and live a totally immersive experience.

Regarding Mixed Reality (MR), we find ourselves in front of a union of AR and VR, sometimes also referred to as hybrid reality, which merges real and virtual worlds to generate new environments and new display modes, in which physical and digital objects coexist and interact with the user in real time. Mixed Reality does not take place exclusively in the physical or virtual world but is a mix of reality (the world we see and perceive with our senses) and virtual reality (the world we experience through special devices).

This type of interaction is based on the possibility of anchoring virtual objects to the real world, allowing users to interact with them according to the environment itself. Extended reality, XR, is the term used to refer to all the immersive technologies, and not, mentioned above, which, as the term suggests, are extensions of the reality in which an architect usually works.

4.1. Intervention impact evaluations, virtual environments for simulation

Applied to an architectural project, XR allows a clearer overview, showing the users the new spaces right away and offering them an immersive virtual visit, or the possibility of obtaining information by viewing it directly from a mobile device (Verdiani, 2017). Applied to an existing architectural and cultural heritage preservation area, starting from a survey, then moving on to 3D modelling and subsequent restitution through dedicated technological tools, such as Oculus Rift S or HTC Vivepro, the digital reconstruction of the heritage

environment helps scholars and students to share and collect information and knowledge. The creation of a new digital resource from the investigation of a precious element of cultural heritage that was previously simply documented by basic images, is an innovation, a step forward in enhancing the possibilities of digital learning and sharing (Guidi and Angeleddu, 2016; Verdiani, 2010).

Fig. 5. Screenshot from Epic Games UnReal Engine software – Basilica Cisterna in Istanbul.

Not only is the impact of intervention on the asset eliminated, but the performance is maximized by the multiple applications that can emerge from a process of investigation based precisely on the digitization and discretization of the existing architectural heritage.

A case study is the Cistern Basilica of Istanbul, which we treated and developed in 2018 (Verdiani et al., 2018). The theme was interesting for the presence inside the building of two gorgon protomes, placed in support of two of the 336 columns that support the roof of the cistern. These two architectural elements, for reasons that we will not discuss here, had not yet been surveyed and digitized, despite their historical and architectural value. We have therefore carried out a photogrammetric survey campaign that allowed us, with zero impact on the sculptures, to obtain a three-dimensional mesh model on which we have carried out dimensional and stylistic studies that have supported all the historical and architectural research carried out in order to arrive at some reasonable hypotheses that would bring the architectural asset back to its original context. At the end of this analysis the virtualization of the ruin was proposed, allowing not only a digital classification of the property, but also a larger audience through interactive immersive visits within the virtually reconstructed environment.

The potential and, above all, the optimization found on the software operation (and the evolution on the accessibility of the hardware), are a key factor for the research and its speed of execution. Just thinking about one of our recent studies in which, thanks to the development of a plugin of one of the software used for the virtualization of the asset, we have the possibility to import directly in a semi virtual environment the point cloud obtained during the survey campaign with 3d laser scanner (Verdiani, 2012). Once the cloud has been processed, optimized, and exported in a format appropriate to the software in question (Unreal Engine), it is imported directly into the software, bypassing the entire process of creating three-dimensional meshes, making the process of virtualization of the asset or ruin or any architectural element under study even faster.

5. The scientific world, research and digital

5.1. A national panorama to be updated

Regarding Mixed Reality (MR), we find ourselves in front of a union of AR and VR, sometimes also referred to as hybrid reality, which merges real and virtual worlds to generate new environments and new display modes, in which physical and digital objects coexist and interact with the user in real time. Mixed Reality does not take place exclusively in the physical or virtual world but is a mix of reality (the world we see and perceive with our senses) and virtual reality (the world we experience through special devices). This type of interaction is based on the possibility of anchoring virtual objects to the real world, allowing users to interact with them according to the environment itself.

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6. Conclusions – there are no conclusions, but we would like a real start

The level of technology and the "innovative" possibilities that can be used today are now more than ever the attractors of the community's attention. The technological revolution, if in the past years has seen an incremental boom of considerable magnitude, today we can say we are in a phase of constant growth, and the time has come to embrace the possibilities that this has opened up for us. The text highlights the practices on the virtual world and on the most current digital technologies, showing how they can make a difference within a procedural process often forced by limits imposed by the inability of those who manage them to go beyond the traditional and outdated operational methodologies. These are means that in recent years have taken on the connotation of stable and verified instruments of mass fruition, capable of acting as an intermediary between the case study and the average user who wants to immerse himself, figuratively and virtually, in a scientific and cultural context rich in content and of great depth.

We wanted to present a tangible and safe operative panorama, in order to create a research product that is present and scientifically correct. In addition to this, some reflections were presented, born from our direct experiences, which gave us an even clearer and more precise picture of the direction that the scientific panorama should take. These last ones want to make use of the creation of a sort of newfound sensitivity for sedimented (fossilized) figures in academic and professional environments. One would like to see the perception of the skills acquired before the digital revolution evolve, to have the maturity to recognize one's own cultural limits and to lean on the new generations more conscious and aware of the digital world. When able to dialogue with them, find a common growth, but if insensitive to this gap, recognize themselves as no longer indispensable or useful to the growth itself.

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References

Aukstakalnis, S., 2016. *Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR,* Addison-Wesley Professional, Boston, USA.

Addison, A., C., 2000. *Emerging trends in virtual heritage*, IEEE Multimedia, Florida International University, USA.

Dellepiane, M., Marroquim, R., Callieri, M., Cignoni, P., Scopigno, R., 2012. Flow-based local optimization for image-to-geometry projection, in *Visualization and Computer Graphics, IEEE Transactions*, vol. 18, no. 3, pp. 463 – 474, Florida International University, USA.

Docci, M., Maestri, D., 2002. *Manuale di rilevamento architettonico e urbano*, Laterza, Roma-Bari, Italy.

Cecchi, R., 2015. *Abecedario. Come proteggere valorizzare il patrimonio culturale italiano*, Skira, Milano, Italy.

Ceschin, F., M., 2015. *Non è petrolio. Heritage culturale, dal Grand Tour ai selfie, per una nuova economia della bellezza*, Claudio Grenzi Editore, Foggia, Italy.

Guidi, G., Russo, M., Beraldin, J., A., 2010. *Acquisizione 3D e modellazione poligonale*, Mcgraw Hill, Milano, Italy.

Guidi, G., 2014. Terrestrial optical active sensors – Theory & applications, in *3D Recording and Modelling in Archaeology and Cultural Heritage-Theory and best practices*, Campana S. and Remondino F. (eds.), pp. 37–60, Archaeopress Publishers of British Archaeological, Oxford, UK.

Guidi, G., Angheleddu D., 2016. Displacement Mapping As a Metric Tool for Optimizing Mesh Models Originated by 3D Digitization, in *Journal on Computing and Cultural Heritage*, 9, 2. 9:1–9:23, ACM, Digital Library, New York, USA.

Mancuso, A., Pasquali A., 2015. Different ways lead to different results? Experiences on modern photogrammetric surveying on cultural heritage subjects, in *Proceedings of the CHNT Conference 2014*, Museen der Stadt Wien – Stadtarchäologie, Vienna, Austria.

Mancuso, A., Pasquali A., 2016. Digital Micro-Photogrammetry: new ways to dialogue with future researchers in *Proceeding of 20th Conference on Cultural Heritage and New Technologies*, Vienna, Austria.

Pucci, M., 2013. Prima che appaia il "divieto di fotorilievo": considerazioni sulla fotomodellazione, in *Disegnare Con La Fotografia Digitale, Disegnarecon*, September, Bologna University Press, Italy.

Settis, S., 2017. *Architettura e democrazia*, Giulio Einaudi Editore, Torino, Italy.

Verdiani, G., 2010. *Il ritorno all'immagine, nuove procedure image based per il Cultural Heritage*, lulu.com. USA.

Verdiani, G., 2012. Rilievo digitale 3D, le metodologie e le strumentazioni per il rilievo laser scanner. In: Tipologie delle strumentazioni per il rilievo digitale, in *Manuale di rilievo architettonico e urbano*, Bertocci S. and Bini M. (eds.), Cittàstudi Edizioni, De Agostini, Novara, Italy.

Verdiani, G., 2017. *Retroprogettazione, Metodologie ed esperienze di ricostruzione 3D digitale per il Patrimonio Costruito*, Didapress, Firenze, Italy.

Verdiani, G., Ricci, Y., Pasquali A., 2018. Collection of 3d models about the Medusa's heads in Istanbul. www.sketchfab.com (accessed: May 2020)


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International Conference - 21-23 September 2020. Università degli Studi di Firenze, Italy
ArCo
THERE IS NO MORE ROOM FOR ANACHRONISTIC SKEPTICISM ABOUT COMPUTERISATION, NOR FOR IGNORANCE OF THE BASIC RULES THAT GOVERN IT.
ANDREA PASQUALI - YLENIA RICCI
UNIVERSITÀ DEGLI STUDI DI FIRENZE - DIPARTIMENTO DI ARCHITETTURA DIDA - ITALIA
THE DIGITALISATION OF CULTURAL HERITAGE FOR THE NON-INVASIVE STUDY OF ARCHITECTURE

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Cultural Heritage, Safety and Innovation

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Physical Architectural Models Heritage and AR/VR Technologies: studies and perspectives.

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Abstract

Urban and Architectural physical models, in their many scales and codifications, as many authors tried to explain, can be considered properly a common Cultural Heritage to expand on. Virtual Reality and Augmented Reality research in the architecture and archeological field has led to a variety of possible uses of systems to accompany cultural tourists or students in their learning processes. The following research proposal is to raise awareness of the importance of physical models, taking a look at some case studies to see how this heritage has been managed by some Cultural Institutions inside and outside Europe and trying to find new paths to reach this goal combining them with new technologies highly engaging people's attention. By its nature, the scaled physical model presents itself with immediate impact as a transitional object, from the real urban and architectural object (hard to be embraced in its entirety) to something which can be perceived at first glance and sometimes you can even touch.

As taken in their role of educational/learning tools or study/design tool, they can be part of an exhibition, a help for the disabled to embrace urban spaces and architectural volumes, or be the main subject of a whole museum. Conveniently evaluating how cultural tourists and common people engage urban and architectural physical models, during a visit to a museum or along a walk in the city, we can imagine how to interest them by AR and VR technologies applied to the model itself, adding a social value in this behavior as it aware their consciousness about being part of the architectural and urban environment.

AR and VR technologies, in fact, appear to be powerful propulsion of the cultural heritage at many levels, thanks to their easy accessibility just downloading and easy app on the mobile or tablet. Especially SAR (Smart Device AR) gives a chance to experiment on-site, by displaying. Some of the case studies taken into consideration are regarding techniques and processes which have been used to digitalize old models such as plan-reliefs, or VR and AR as a tool for architectural design purposes, as shown by the CDP (Collaborative Design Platform) prototype, where users can place foam mock-ups on an augmented table and in the meantime visualize 3D model while transforming through a tablet.

This field of interest appears to be useful to discover and highlight VR and AR devices' potential and limits when applied to devices' physical models and to eventually identify new paths of research in this direction. One of them could be applying responsive materials to mock-ups to improve the tactile experience in a virtual reality scenario.

Keywords: architectural physical models, cultural heritage, tangible augmented reality, interaction, exhibition, engagement

Nomenclature:

PhAM Physical Architectural Model
CH Cultural Heritage
IT Interaction Technologies
AR Augmented Reality
VR Virtual Reality
MxR Mixed Reality
SAR Smart Augmented Reality
CDP Collaborative Design Platform
TUI Tangible User Interface
TAR Tangible Augmented Reality

1. Introduction

The main reason for undertaking this study was to answer some questions about the role of APM in Cultural Heritage, questions which came to attention while appreciating how new AR, VR and MxR technologies are capable to link individuals to collective heritage in Museums and other Cultural Institution. This link, mainly operated by means of personal devices (mobile or tablet), allows interaction between visitors and works of art or archeological artifacts on display during their cultural experience. Thinking about all the objects displayed in Museums, all of us can say that barely in any of these we can see almost one architectural physical model on display, even if the exhibition is not strictly relating to architecture. PhAM is familiar and belongs to everyone's daily experience more than we could think, it has the power to attract and win over attention, maintains its modernity and its evocative and narrative power over time.

But how much and in which ways cultural tourists and common people are aware of the presence and the value of PhAM? How they interact with that? Is there an evolution in displaying APhM? Is there a human-computer interface suitable for PhAM? This study attempts to understand which is the state of art in the fruition methodologies of PhAM in the field of cultural heritage, giving importance to materiality and to the tactile aspects of the user experience, using new interactive technologies such as AR and VR.

This work is an acknowledgment of the role of the PhMA. In the paper we try to highlight that its peculiar trait, materiality, make PhAM still relevant today, with the advent of AR, VR and MR technologies. By means of this paper a quite investigated and to expand on field of interest is determined, which occurs at the intersection between different field of research and technologies: architectural physical model and virtual modeling, human-computer interfaces, tangible interaction, 3D printing and smart materials, AR, VR and MR, Cultural Heritage Management, tourism, User Experience design and engagement. This makes the study capable to offer many in-depth analysis possibilities, but also means a huge amount of data to manage. On this occasion, two fronts of investigation were identified and approached.

The first section of the paper intends to underline the importance of PhAM and to identify its use in the Cultural Heritage field so far, with a brief focus on its engagement evolution. The second section presents the research on Interaction Technologies applied to PhAM, which lead to the final taxonomy of the current systems capable to integrate PhAM or other physical models with AR and VR technologies.

The aim is to create a foundation of knowledge as a starting point to investigate potential uses of PhAM in Cultural Heritage dynamics, to bring PhAM to a new level in engaging scholars or cultural tourists as a learning tool, strongly captivating, current, easy and to encourage interest and participation in creating new PhAM's fruition modalities.

2. Physical architectural models heritage

2.1. Defining PhMA heritage

The PhAM shapes up to be an artifact capable to represent architecture in many appearances, depending on the purpose of the exhibition, the location, the need it is built to answer to. The variety of the uses it carries out reflects the multiplicity of the definitions that have been coined so far. Mindrup (2019), among the various have uses cited in his book, writes about model as sign of possess or as act of devotion as depicted in many renaissance paintings. Padan (2017) speaks about theme parks and national identity when she refers to miniatures connected to a specific landscape and political situation. Some models are conceived to become tactile models for the visually impaired, to be displayed in an urban context or among an exhibition itinerary. Constructed to study

cinema or theatre sets, also a set model representation becomes suitable for being put on a show, sometimes even as part of a performance, as Brejzek and Wallen (2019) say.

The common feature of all architectural model is that, as Barlozzini (2013) said, it is a vehicle for convening architectural thoughts. So, to clarify the subject of the dissertation, following the codification made by Moon (2005) PhAM is considered as divided in two broad headings: PhMA for study purposes, made for private function of design and exchange of ideas, and after the fact PhMA, made for the typically more public purposes of communication and presentation, not mutually exclusive. In the first heading could include also conceptual and highly expressive physical models, self-speaking objects at the crossroads of sculpture and architecture (Celant, 1987), mainly coming from Architectural design practice. The second heading consists of models coming from both architectural practice or education purposes, included alongside other forms of architectural representation, solely to help illustrate the current project, archeological site or built heritage.

Whether it has been conceived for public display from the very beginning of its construction or not, when the PhAM denotes certain communication qualities such as a historical, archeological, artistic, conceptual, and poetic value as an object, it becomes something worth to be shown. In this paper, PhMA heritage is the totality of every PhAM which takes part to an exhibition as an object displayed in various public cultural institutions, regardless of its scale of representation or purpose, from poetic concept models to analogical built heritage miniatures.

2.2. Collecting and exhibiting architectural models

As Brayer (2014) wrote, among centuries architectural models gave rise to more or less well-organized collections, reflecting the artistic and intellectual movements of their time. Today, the purpose of architecture collections remains to chronicle the history of architecture and it is a constantly changing practice. Digital technology has transformed architecture and the type of architecture collections, which now must face a new challenge: more contents coming from the field of architectural practice and built heritage to display and new technologies to make these contents available to a broad range of people.

Inspired by Silvestre (2012) and his "Lista Incompletìsima de Museos de Miniaturas", the list below presents a selection of museums that have been taken into consideration as examples for their modalities of displaying architectural models. It is not exhaustive and does not want to be a complete survey of Museums or Exhibitions displaying PhAM, but it can relevant to frame some PhAm displaying modalities and its engagement in museums, in order to sketch out a future taxonomy of exhibition and space configurations specifically dedicated to PhAM.

As Gunter (2015) supposes, the first PhAM exhibition organized on purpose was probably Furttenbach's Kunstkammer, on the second half of the sixteenth century, as a specific collection exhibited in his house in Ulm, Deutschland, where the fourth floor was entirely dedicated to an architecture museum, with a collection of architecture and engineering models and drawings, that were there to be touched and explored directly, to learn and discuss on the topics of architecture. And is whit this first sort of exhibition that we start the short overview based on the list.

Fig. 1. Screenshot of the 3D virtual tour of Soane Museum's Model Room, Soane Museum, UK.

Since the eighteenth century, the Grand Tour of cultural sites in Europe was the culmination of an architect's education. Sir John Soane owned one of the largest private collections of drawings, models and objects of antique monuments. Plaster casts, architectural details and models in his house stand as an example of didactical use, most important for architectural practice and education.

Still remaining in his original configuration, Soane's collection provides an insight into the display and use of models in pedagogical and design practices during the nineteenth century (Mindrup, 2019) and is a museum since 1837. Some models are enclosed in glass showcase but mostly the models are free, and the atmosphere is very warm and close to the tangible experience.

- DAM Deutsche Architekturmuseum, Frankfurt, Germany.

The Deutsches Architekturmuseum, or DAM, opened in 1984. Oswald Mathias Ungers was commissioned with the conversion of a mansion on the banks of the River Main into an architectural museum: his concept of a 'building within a building' has been possible by gutting the building and leaving only the outer walls intact. Since 1989 a collateral Collection of the DAM is established in Frankfurt, Hedderichstrasse, not far from the museum.

The permanent exhibition is hosted on the second floor of the museum and is currently Germany's most comprehensive collection of panoramic models on architectural history.

As seen from the website the models are displayed as a diorama, it is possible to interact just by walking on a corridor and watch the models

Fig. 2. Screenshot of the website of Deutsche Architekturmuseum, Frankfurt, Germany.

looking in a one- or two-sided shop window line. The DAM has organized a "Digital Model Collection" were images of models from the collection are stored and are available online.

- Museum of *Plan-Relief* Paris, France.

Presents a one-of-a-kind collection of historical models of fortified cities and campaigns carried out during the reigns of Louis XIV and Napoleon III. Plan-reliefs were used to plan military strategies, as they provided a detailed 3D insight into the cities, their buildings, fortifications and surrounding area. As it is possible to see by the interactive map of the museum and by the pictures on the website, models are displayed in glass boxes, to preserve from dust and accidents. The display is a traditional contemplative way to engage PhAM.

- Biennale Architettura in Venice, Italy

International Architecture Exhibition inaugurated in 1980, offers a direct and tactile experience of architecture, where scaled or 1:1 models enhanced by mixed media and various display typologies are arranged inside the spaces of Biennale Gardens and *Arsenale*.

The bodily experience is intense and highly engaging. The public is selected, and visitors are seeking for specific thematic contents, this means a respectful behavior towards the environment of the architectural exhibition so that models are exhibited mainly without glass protection.

- Museé de l'Armée Invalides, Paris, France.

The Dôme Church – Tomb of Napoleon I - The "Dôme des Invalides", reserved for solemn occasions, hosts two PhAM: one representing the hole Hôtel National des Invalides, the other is a precious wooden painted model of the Dome itself. It is possible to virtually visit the Dome thanks to an interactive 360° interactive view and see where the models are placed inside the space of the Dome. Higy suggestive to be inside the Built Heritage and embrace it entirely thanks to the model, it pushes to search for analogies between the two scale realities.

Fig. 3. The physical scaled model of the Dome, displayed inside the Dome-Museum.

- Archidepot

Opened in June 2016, specialized in exhibiting and storing architectural models as an endeavor to combine the aspects of "Museum" and "Preservation". Exhibits various works, changing the architectural models on exhibit with every exhibition period, ranging from studies to complete models by Japanese and foreign architects and architectural firms who are active both home and abroad. Visitors, who came to witness the architectural models/art works, can walk into two exhibition spaces which are open and flexible, capable to arrange the display of the models in an easy to change way.

- Model in model

Architectural Model Museum in Shangai, China. Inspired by Archidepot, the founder of Fengyuzhu Enterprise wanted a place where to display the architectural models of all the famous contemporary Chinese architects. Designed by Wutopia, the result, opened at the floor of Fengyuzhu's Shanghai headquarters in 2019, is a 1,000-square-meter interior design space that integrates models into different conceptual display areas, where the models are displayed without glass protection. The display areas create suggestive atmospheres, generating an immersion in evocative worlds set apart from reality or in some cases barely connected to it through thin windows.

1.1.*Observations on engagement with physical objects.*

Strictly connected to the study of the various PhAM display typologies, the topic of the engagement is briefly but necessarily encountered to better understand the starting point from where evaluate the technologies that can fit best in combination with this specific architectural representation media.

From a critical point of view, Brejzek and Wallen (2018) write about the shift from traditional displays of individual objects to scenographic approaches in the design of exhibitions, and they put emphasis on narrative and immersive formats as the expression of a wish to transform the actual communication between the object

and the visitor from contemplation to interaction, turning the viewer and the model into the active authors of an ephemeral and personal space. No doubt that interaction and participation are the main topics in current CH management too, and are the principles at the base of various new proposals as in the project "The Ara as it was" by Magnelli (2019) and many others as Mandolesi et al. (2020).

Studies and observations by Dudley (2012) focus on materiality and how people experience physical things in daily life and in Museums. The interpretations we give about something we experience thanks to our senses are influenced by many factors: cultural and personal experiences, pre-existing knowledge comes together in the construction of the experience of the material world. While focusing on meaning, values, context and representation of these objects, Dudley notes that the physical and sensory ways in which we engage whit material things have been often overlooked. But these interactions must obviously avoid the manipulation of original artifacts, due to the fragility of these objects that needs to be protected and preserved.

Interaction in AR is possible with a dematerialized object as seen well in Li et al. (2019) where digital copies of the artifacts in the exhibition are available in a multiuser virtual environment: users are able to interact with objects and engage each other, using a combination AR and VR devices configuration. Many studies put emphasis on how tactile experiences do strengthen memorability and enhance engagement. Especially due to the fact that AR and VR are so close to our daily experience, it is necessary to maintain the focus on the materiality of objects because these qualities are defining our sensory responses to them, not overestimating the visual feedback but counting on the use of touch in human computer interaction (HCI) in virtual environments. This fits with the proper features of PhAM.

The fascination for the craftsman's work is also strictly related to materiality and technique knowledge and it surely is one of the aspects that makes PhAM so interesting and valuable. In the age of digital models and 3D printings it's possible and currently it exists a new worthiness for the digital product. The aspect of reproducibility of the objects is an interesting option to take in consideration as a tool to engage visitors in tactile performances as show by Balletti and Ballarin (2019) and well surveyed in Scopigno et al. (2015). And to this specific topic of replicas, one interesting aspect is represented by smart materials capable to augment objects and connect them with information technology, up to create Smart Interactivity, as explained by Micocci and Spinelli (2019).

From another point of view, we have to consider what happens when our capacity of imagination is captured by the material representation of an architectural idea or the miniature of an ancient building: when we move close to the model, body interaction is activated and the viewer mentally plays with the scale switchover. Then we fantasize and we can generate a new world, like the model is the key to a parallel universe. This generation process is described as *cosmpoiesis* both in Brejzek, Wallen (2018) and Mindrup (2109) as a particular feature of PhAM.

Materiality, interactivity, participation: these three principles seem to be the current goals to achieve in current CH management to obtain the engagement of the visitors in museums.

3.New interactive technologies

3.1.PhAM and AR-VR-MxR in Cultural Heritage: state of the art

As soon as the PhAM has been described as an autonomous cultural heritage object, is it possible to create virtual environments and interaction interfaces as it is currently happening for other heritage objects?

The following overview tries to present some examples of PhAM augmented using AR and VR technologies and devices, prototypes or systems, intended to add contents to a displayed PhAM or creating qualitative contents to be activated through it.

The "trait d'union" between heritage objects and PhAM is represented by plan-reliefs heritage. These artifacts are the topic of many papers, such as Verdiani (2019), Tschirschitz et al. (2019), Laroche et al. (2011), Kersten et al. (2018). The model is the source to investigate on, first through a process of digitalization (laser-scanning or photogrammetry). The digital copy obtained is not only used for restoration purposes. The further step is the conservation and valorization of those data and the creation of new contents for the visitors to empower the knowledge of the material object. Laroche et al. (2011) describe the physical mock-up of Nantes harbor that is

nowadays at the "Château des Ducs" Museum in Nantes, France. The original mock-up stands in the exhibition space, shown behind glass panels. The object has been digitized and a 3D model has been reconstructed. The project “Nantes 1900" is now on display in the museum: a touchscreen lies in front of the huge model; it allows the visitors to interact with the digital version of the plan-relief and discover contents following personal learning dynamic. There is a tangible interaction, but it happens through a touch screen, the materiality aspect is available only by visualizing the original artifact and not by touching it or touching something similar. Tschirschitz et al. (2019) illustrate the conversion and the adaptation of an existing virtual 3D model for a VR application. The model is a historic 3D digital reconstruction of the city of Duisburg, Germany, based on the digital survey operated by laser-scanning a physical model dated 1566. The VR system used was HTC Vive which permits a real immersive experience to the user. The historic wooden model of Solomon’s Temple, by Kersten et al. (2018), follows the same workflow as the above-mentioned one used for the plan-relief of Duisburg. Verdiani and Soeters (2019) had to manage with the Maastricht plan-relief, consisting of 13 pieces and digitalized through a photogrammetry process that led to a digital twin of the ancient maquette. Photogrammetry is considered faster, time and costs saver and capable to guarantee high resolution outcomes results.

Nofal et al. (2016) examined how tangible interaction can be used to enable the communication of qualitative information about a built heritage. The study’s aim is to test three prototypes designed as an interactive installation, where each condition consisted of an interactive navigation input and a passive representation output. The input was given by a touch screen where a map is displayed as the main interaction method, either via a tangible interactive surface or via a tangible interactive surface activated by a 3D printed statue capable to move on a mockup depicting a landscape map. Each prototype achieves a different form of engagement. As Nofal underlines, tangible user interfaces (TUIs) afford objects which can also incorporate particular material attributes (e.g. size, shape, texture, color) conveying further information in addition to the digital representation.

In his PhD thesis, Nofal (2019) presents the original approach of “*Phygital Heritage*”, intending to disclose heritage information via simultaneous and integrated physical and digital means. The four studies conducted are substantially a taxonomy itself of the interaction technologies systems available nowadays to connect physical and digital experience: a tangible interactive museum prototype, an augmented reality experience, an in-situ interactive projection mapping , a tangible gamification installation.

Fig. 4. A screenshot captured during the video presentation of the model of the Neupfarrkirche Regensburg.

Arctron 3D, as an enterprise offering a wide range of services about 3D, was capable to realize projects for museums where 3D survey, digital modeling, 3D printings and AR/VR can combine perfectly to offer an engaging experience about a broad range of artifacts, from landscape to architectural models. They showed how to also integrate holograms in the display of a PhAM, in addition to tactile 3D printings with AR features activated through a mobile device or a tablet. The high quality of the 3D printings and the 3D digital models make the experience very intriguing and captivating. The realization captured in fig. 8 combined digital models with 3D prints. The scaled 3D models with state-of-the-art hologram technology were combined to create an extraordinary exhibition highlight.

During the 2016 Venice Biennale, Greg Lynn, Trimble, and Microsoft HoloLens team up to feature Lynn's work as part of the Architectural Imagination Exhibit. Greg Lynn was able to present his project titled 'The center for fulfillment, knowledge and innovation' in Detroit, USA, using Microsoft Hololens and Trimble technology, being able to experience his 3D models as holograms placed in the real world. This system utilizes mixed-reality technology to take 3D content off the screen and put it into the real world.

It is usually helpful and appreciated in the constructive field but in this case, Lynn used it to augment PhAM, bridging the gap between the digital and physical model and making the one depending on the other to have the entire visualization of the project. HoloLens was given to the visitors of the exhibition, as some images found online shows, but it was not possible to find any scientific report about this experience, to evaluate the engagement level and the real feel of the experience.

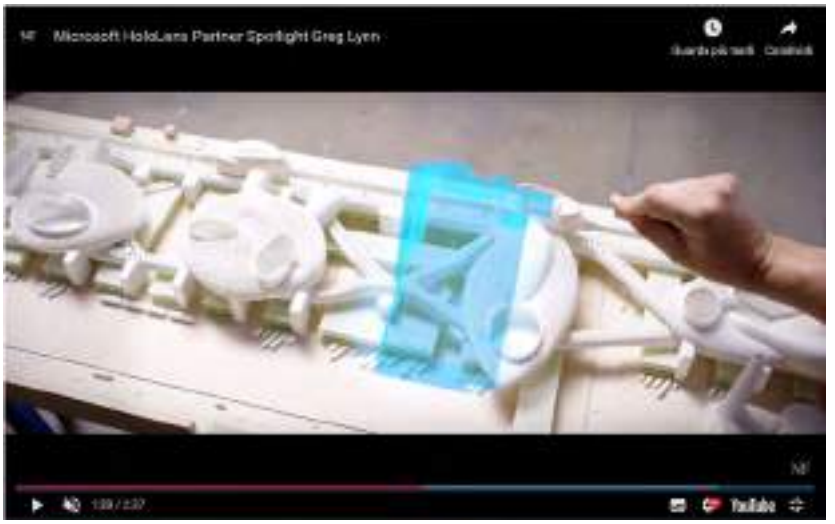

Fig. 5. A screenshot captured during the video presentation of Gregg Lynn's project during the 2016 Venice Biennale, using Microsoft HoloLens and Trimble.

3.2.Seeking some clues to the future of PhAM: AR, Mixed Reality applications from other fields of research

The contribution given from other fields of research interested in expanding physical model purpose in museums environment and in exhibition spaces, are mainly coming from the architectural design education or construction field, and others are coming from museums and cultural heritage development or geoscience field. Milanovic et al. (2017) undertake an interesting survey about AR and VR in architectural design and education. VR applications' utilizations in the architecture field are wide, from design to construction and project communication as well as collaborative decision making. AR systems for architecture support a real time immersive interaction between users and combine the real and the virtual, bringing out from its use collaboration and communication as main qualities, which could result utilizable in potential exhibition context interfaces. AR hybridization via SAR has been on experimentation since the nineties. AR hybridization through HDM or screens permits interaction with tangible objects created specifically for manipulation in a VE. In the end they

propose Coraulis, a platform which support immersive VR thanks to its 360° screen, providing visual and aural immersion as well as SAR used to map printed 2D plans or sections and mock-ups display on the tabletop.

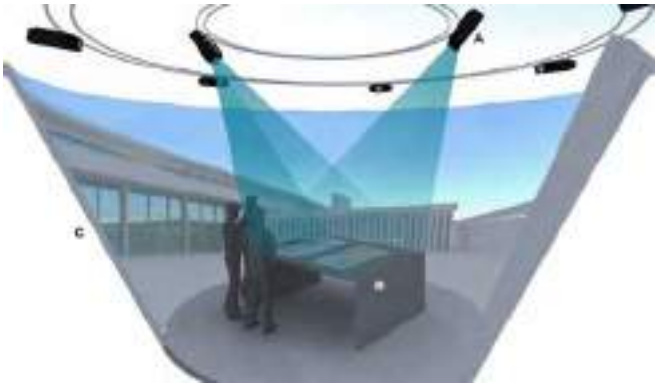

Fig. 6. Possible configuration for CORAULIS (A: beamers for SAR, only two are represented in the image, B: tabletop with augmented plans and mock-up, C: immersive screen); source Milanovic et al. (2109).

Benchwork System (Seichter, 2004) was designed as a collaborative urban planning station. It was integrated remote and local collaborative Immersive AR enabled desk and its tangible media aided working environment using an HMD.

One possible evolution of this system is treated in Schubert et al. (2014) as Collaborative Design Platform and later developed under the name of Tangible Mixed Reality, where the study and the prototypes led to a system directly coupling real and digital information using interactive augmented visualization. CDP (Collaborative Design Platform) combines a tangible tabletop system and a Smart Device AR application: users can place foam mock-ups on the augmented table and in the meantime visualize the whole 3D model urban area through a table.

Dalsgaard and Halskov (2012) combine tangible tabletop interaction and 3D projection in the Tangible 3D Tabletop that consists of a translucent table surface under which a projector and a camera are mounted while two projectors are mounted above the table. The projector beneath the table displays information on the table and the two projectors send images of the tangible objects while they fit in fiducial markers beneath their basis.

As it is described by Naranzani et al. (2019) regarding urban planning context. Their prototype explores the use of input gestures on 3D printed conductive objects in an AR environment. Conductive filament allows interactions through capacitive touch sensing. Gesture as tap, double tap and press-hold can be used to convey an exchange of information within the AR display such as selecting, adding, and deleting new buildings, etc… ARkit was used for the AR content. Project Augmented relief Models (PRAM) are used to display information about the landscape and have been through the years developed as a useful tool in public setting such as museums, proving the power of physical representation. The physical relief model prompt tangible interactions, observed Priestnall et al. (2012). More recently, new studies conducted by Mendes et al. (2019) and Priestnall and Cheverst (2019) confirm the high engagement obtained by offering a kinesthetic interaction that includes the ability of the viewer to move around the model helping him in the built of a spatial interrelationship between geographical features.

Mixed Reality (MxR): using a combination of HoloLens and Fologram, Jahn et al. (2019) demonstrate how mixed reality environments “enables designers to rapidly prototype mixed reality applications directly within industry-standard CAD tools, removing the requirement for programming and application development expertise and enabling improvisation of task specific applications for design and construction. This platform provides near real-time spatial and geometric information bidirectionally between the Microsoft HoloLens and McNeel Rhinoceros 3D and Grasshopper”. This technology could be used to improve model making, to construct the model while it is in a still three-dimensional holographic representation.

4.Conclusions and Perspectives

Some years ago, when reading about architectural models in the field of architecture or cultural heritage, it was easy to find statements complaining about a weak or absent awareness of the importance of this object, despite its renowned importance in architectural practice. In the light of all the observations made so far, it comes to evidence how the current position on the stage, among other representation media, has become relevant. It reveals how crucial this moment is for its development. The above-mentioned review of technologies related to the physical model in general, and to that of architecture, can be used as a basis from which to draw directions for new research paths. There are still many ways to go and many hypotheses to check. For its capability to merge with all the new technologies and new material so far, and for its boundary role between sculpture and architecture, the PhAM can find new expression when combined with AR/VR or MxR realities which can enhance its materiality through tangible interaction interfaces (TUI).

Among the hybrid systems analyzed, the most interesting are probably those prototypes elaborated for teaching architectural design. Indeed, AR and MxR meet the requirements of the design process: in addition to allowing interaction between users, they permit to remain in material and physical contact with the model through shared interactions. How these kinds of prototype systems can be transferred into the museum dynamics as tools for learning or just augmenting PhAM, is to be verified.

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References

Archidepot. https://archi-depot.com/en/about Soane Museum, UK. https://www.soane.org (accessed: May 2020).

Arctron 3D. https://www.arctron.de/references/; https://www.arctron.de/home/ (accessed: May 2020).

Barlozzini, P., 2013. Il Modello in Architettura: uno Strumento di Rappresentazione tanto Arcaico quanto Attuale, in *Formare 3*, Aracne (Ed.), Firenze, Italy.

Ballarin, M., Balletti, C., 2019. An application of integrated 3D technologies for Replicas in Cultural Heritage, in *ISPRS International Journal of Geoinformation*, 8.285, MDPI, Basel, Switzerland.

Ballarin, M., Balletti, C., Vernier, P., 2028. Replicas in cultural heritage: 3d printing and the museum experience, in *the International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, Volume XLII-2, 2018 ISPRS Towards Photogrammetry, Riva del Garda, Italy https://doi.org/10.5194/isprs-archives-XLII-2-55-2018, ISPRS.

Biennale Architettura in Venice, Italy. https://www.labiennale.org/en/history-biennale-architettura Brayer, M: A., Collecting and exhibiting architectural models, in *L'Architecture au jour d'lui*, 404, p. 44, Archipress & Associés, Paris, France.

Brejzek, T., Wallen, L., 2019. *The model as performance: staging space in theatre and architecture*. Bloomsbury Methuen Drama, London, UK.

Calixte, X., Leclercq, P., 2017. The interactive projection mapping as a Spatial Augmented Reality to help collaborative design: case Study in architectural design, in proceedings of the *14th international Conference on Cooperative Design, Visualization and Engineering*, University of Balearic Island, Spain. Springer, http://hdl.handle.net/2268/221286 http://dx.doi.org/10.1007/978-3-319-66805-5_18, Germany.

Casiez, G., Granier, X., Hachet, M., Lepetit, V., Moreau, G., Nannipieri, O., 2018. *Virtual Reality and Augmented Reality: Myths and Realities*, edited by Bruno Arnaldi, Pascal Guitton and Guillaume Moreau, ISTE Ltd and John Wiley & Sons, Inc., USA.

Celant, G., 1987. Il Progetto è un Oggetto. In *Rassegna 9*, 32, 76-88. C.I.P.I.A., Italy.

Robles De La Torre, G., 2006. The Importance of the Sense of Touch in Virtual and Real Environments, in *International Society for Haptics*, 13, 03, pp. 24-30, IEEE MultiMedia, USA.

DAM Deutsche Architekturmuseum, Frankfurt, Germany. https://dam-online.de/en/ (accessed: May 2020).

Dalsgaard, P., Halskov, K., 2012. Tangible 3D Tabletop: combining Tangible Tabletop Interaction and 3D Projection, in *Proceedings of NordiCHI 2012 conference,* Association for Computing Machinery, USA.

Hadjiri, K., 2006. Bridging the Gap between Physical and Digital Models in Architectural Design Studios, in *International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, Vol. XXXIV-5/W10, ISPRS..

Hornecker, E., Ciolfi, L., M. Carroll, J., 2019. Human-Computer Interactions in Museums in *Human-Computer Interactions in Museums*, Morgan & Claypool, USA.

Jahn, G., Newnham, C., van den Berg, N., Beanland, M., 2019. Making in Mixed Reality, in *Recalibration: On Imprecision and Infidelity*, Acadia Pub Co, Mexico City, Mexico.

Kersten, T. P., Tschirschwitz F., Lindstaedt, M., Deggim, S., 2018. The historic wooden model of Solomon's Temple: 3D recording, modelling and immersive virtual reality visualisation, in *Journal of Cultural Heritage Management and Sustainable Development*, https://doi.org/10.1108/JCHMSD-09-2017-0067, Emerald Publishing Limited, Bingley, UK.

Laroche, F., Servièrest, M., Lefèvre, D., Keruanton, J.L., 2011. Where Virtual Enhances Physical Mock-Up: A Way to Understand our Heritage, in *ISMAR - research, technology and application in Mixed and Augmented Reality*. Basel, Switzerland, Archives Ouvertes, hal-00671976f.

Laroche, F., Keruanton, J.L., 2010. Creating Interactivity of our Heritage stored in Museums: Experimentation with Chateaux des Ducs de Bretagne History Museum of Nantes, France, in *Scientifique VRIC, Pp2*, Archives Ouvertes, hal-00473007.

Li, Y., Ch'ng, E., Cai, S., See, S., 2018. *Multiuser Interaction with Hybrid VR and AR for Cultural Heritage Objects* 978-1-7281-0292-4/18, IEEE, USA.

Lynn, G., Trimble and Hololens. https://www.designboom.com/architecture/venice-architecture-biennale-greg-lynn-packard-plant-us-pavilion-microsoft-hololens-05-28-2016/ (accessed: May 2020).

Magnelli, A., 2017. A Multimedia Tale in which History and Technology come together to create a fully immersive and multi sensorial experience, in *Proceedings of the 22nd International Conference on Cultural Heritage and New Technologies 2017*, CHNT 22, http://www.chnt.at/proceedings-chnt-22/. ISBN 978-3-200-06160-6, Museen der Stadt Wien – Stadtarchäologie, Wien, Austria.

Mandolesi, S., et al., 2020. *Digit(al)isation in Museums: Civitas Project - AR, VR, Multisensorial and Nultiuser Experiences at the Urbino's Ducal Palace*, DOI: 10.4018/978-1-7998-1796-3.ch011, IGI Global, USA.

Mendes, M., Almeida, J., Mohamed, H., Giot, R., 2019. Projected Augmented Reality Intelligent Model of a Cute Area with Path Optimization, in *Algorithms*, 12, 140; DOI:10.3390/a12070140, MDPI, Basel, Switzerland.

Micocci, M., Spinelli, G., 2019. Pervasive, Intelligent Materiality for Smart Interactivity, in *Cuaderno 94*, Centro de Estudio en Diseño y Comunicación, Pp.121-134, ISSN 1668.0227, Universidad de Palermo, Argentina.

Milovanovic, J., Moreau, G., Siret, D., Miguet, F., 2017. Virtual and Augmented Reality in Architectural Design and Education: An Immersive Multimodal Platform to Support Architectural Pedagogy, in *17th International Conference, CAAD Futures 2017*, Gülen Çağdaş, Mine Özkar, Leman F. Gül and Ethem Gürer, Jul 2017, Istanbul, Turkey, Archives Ouvertes, hal-01586746.

Mindrup, M., 2019. *Histories of the Miniature and the Prototype, the Exemplar and the Muse*, MIT Press Ltd., USA.

Models in model. https://www.archdaily.com/926871/models-in-model-wutopia-lab (accessed: May 2020).

Moon, K., 2005. *Modeling Messages: the Architect and the Model*, The Monacelli Press, New York, USA.

Morris, M., 2006. *Architecture and the Miniature*, Wiley-Academy, Chichester, UK.

Museé de l'Armée Invalides, Paris, France. https://www.musee-armee.fr/en/your-visit/museum-spaces.html https://www.musee-armee.fr/en/your-visit/museum-spaces/dome-des-invalides-tomb-of-napoleon-i.html (accessed: May 2020).

Museum of Plan-Relief Paris, France. http://www.museedesplansreliefs.culture.fr (accessed: May 2020).

Naranzani, M., Eghtebas, C., Mulhaus, M., Jenney, S., 2019. Demo: Tangible Urban Model, two way Interaction through 3D Printed conductive Tangibles and AR fo Urban, in *Ubi/Comp/ISWC'19 Adjunct*, London, UK, https://doi.org/10.1145/3341162.3343810, ACM Digital Libray.

Nofal, E., Boschloos, V., Hameeuw, H., Vande Moere, A., 2016. The role of tangible interaction for communicating qualitative information of built heritage, in *Proceedings of the 8th International Congress on Archaeology, Computer Graphics, Cultural Heritage and Innovation 'ARQUEOLÓGICA 2.0'*, Valencia (Spain), p.441-444, Editorial Universitat Politècnica de València, Spain.

Nofal, E., 2019. Phygital Heritage Communicating Built Heritage Information through the Integration of Digital Technology into Physical Reality, Faculty of Engineering Science, Department of Architecture, by Eslam Nofal. Priestnall, UK.

G., Cheverst, K., 2019. *Understanding visitor interaction with a projection augmented relief model display: insights from an in-the-wild study in the English lake district*, Thesis, https://doi.org/10.1007/s00779-019-01320-2, KU Leuven, Belgium.

Priestnall, G., Smith, A.,Goulding, J., Arss, N., 2012. Exploring the Capabilities of Projection Augmented Relief Models, in *Geographical Information Science Research UK Conference 2017,* University of Nottingham, UK.

Raskar, R., Welch, Greg, Chen, C., 2000. Table -top Spatially-Augmented Reality: Bringing Physical Models to life with Projected Imagery, in *IWAR '99: Proceedings of the 2nd IEEE and ACM International Workshop on Augmented Reality*, October 1999, IEEE, USA.

Sardo, N., 2004. *La Figurazione Plastica dell'Architettura: Modelli e Rappresentazione*, Edizioni Kappa, Rome, Italy.

Schubert, G., Artinger, E., Petzold, F. and Klinker, G., 2011. Bridging the Gap: A (Collabora- tive) Design Platform for early design stages, in *Proceedings of eCAADe 2011*, T. Zupančič-Strojan, M. Juvančič, Š. Verovšek and A. Jutraž (eds.), Ljubljana, pp.187–193, ISBN 978-9-4912070-1-3, eCAADe (Education and Research in Computer Aided Architectural Design in Europe), Ljubljana, Slovenia.

Schubert, G., Strobel, B. and Petzold, F., 2016. Tangible Mixed Reality, in *Proceedings of the 21st International Conference on Computer-Aided Architectural Design Research in Asia*. Melbourne, Australia, 333– 342, The Association for Computer-Aided Architectural Design Research in Asia (CAADRIA), Hong Kong.

Scopigno, R., Cignoni, P., Pietroni, N., Callieri M., Dellepiane M., 2015. *Digital Fabrication Techniques for Cultural Heritage: A Survey Visual submitted to Computer Graphics Forum (11/2015) Computing Lab*, CNR-ISTI, Pisa, Italy.

Seichter, H., 2004. Benchworks Augmented Reality Urban Design, in *Proceedings of the 9th International Conference on Computer Aided Architectural Design Research in Asia*, Seoul; Korea, pp. 937–946, Yonsei University Press, Seoul.

Silvestre, Federico L., 2012. *Micrologias o Historia Breve de Artes Mínimas*. Abada Editores, Madrid, Spain.

Tschirschwitz F., Richerzhagen, C., Przybilla, H., Kersten, T. P., 2019. Duisburg 1566: Transferring a Historic 3D City Model from Google Earth into a Virtual Reality Application, in *Journal of Photogrammetry, Remote Sensing and Geoinformation Science*, ISSN 2512-2789, https://doi.org/10.1007/s41064-019-00065-0, Springer, Germany.

Verdiani, G., 2015. Bringing Impossible Places to the Public: Three Ideas for Rupestrian Churches in Goreme, Kapadokya Utilizing a Digital Survey, 3D Printing, and Augmented Reality, in *Open Archaeology* 1: 131–143 DOI 10.1515/opar-2015-0007, De Gruyter, Berlin, Germany.

Verdiani, G., Soeters, G., 2021. Maastrich, the City, The Maquette and the Collection at the Palais des Beaux-Arts in Lille, France, Museen der Stadt Wien, in *Proceedings of the 24th Cultural Heritage and New Technologies Conference, CHNT24*, Stadtarchäologie, Wien, Austria.

Wang, X., 2008. Augmented Reality in Architecture and Design: Potentials and Challenges for Application, in *International Journal of Architectural Computing*, 7, 2, pp. 309-326, https://doi.org/10.1260/147807709788921985, Sage Journals, New York, USA.

Yael, P., 2017. *Modelscapes of Nationalism Collective Memories and Future Visions*, Amsterdam University Press B.V., the Netherlands.

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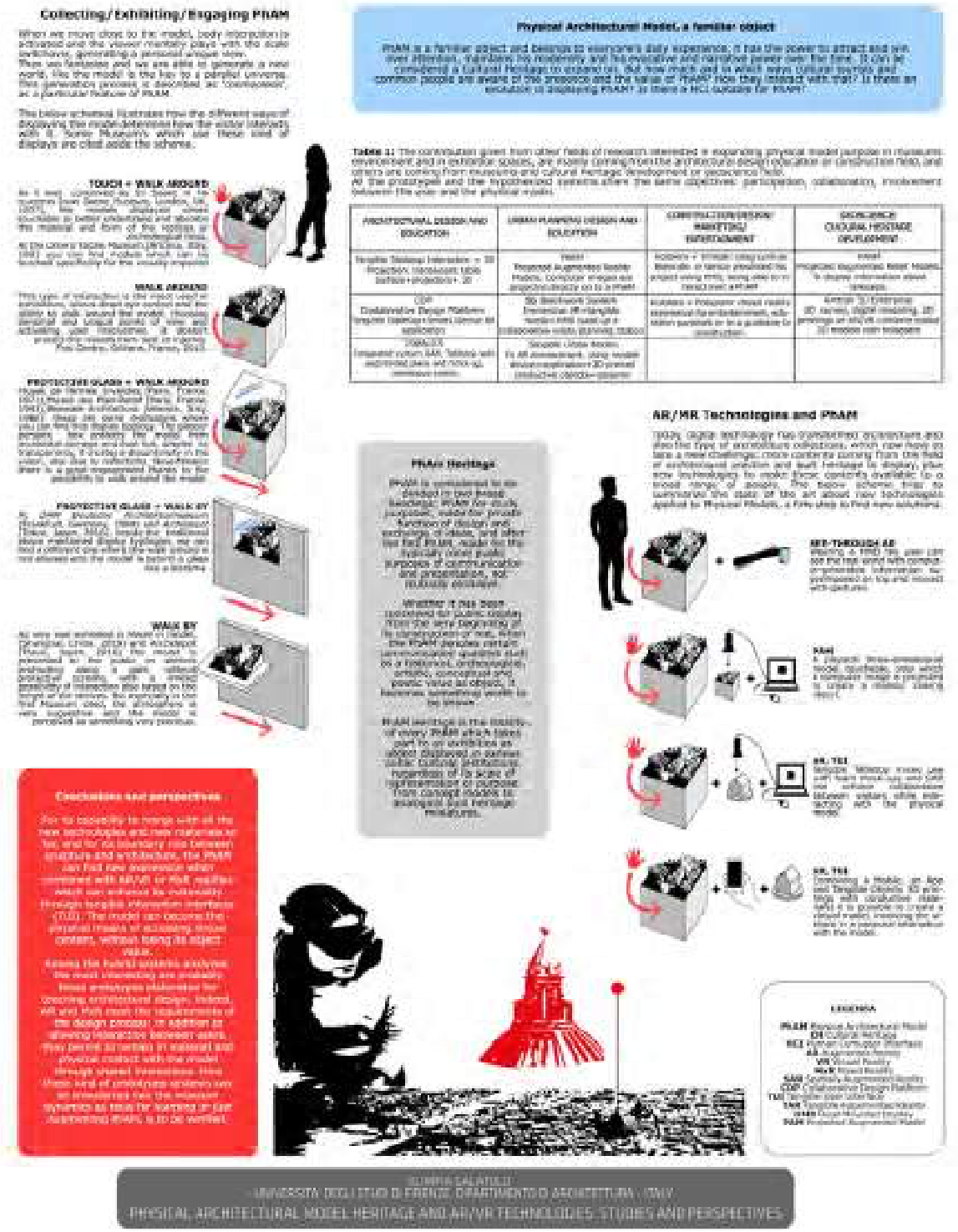

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