



Sandro Parrinello*, Francesca Picchio, Silvia La Placa*****

From Model to Model. The narrative between drawing and digital reproduction of Donatello's Pulpit

Reading, interpretation and form in defining a dialogue between drawing and model

“It is impossible not to communicate” as Bateson [1], [2] and the Palo Alto group remind us¹, and in communication, networks of relationships that connect and interconnect are formed. This communication is not only active, referring back to the systemic paradigm between individuals, but concerns the continuous flow of inputs that connects people to things. In this sense, architecture, environments, spaces and, even more so, artworks, are participants in this dialogue and this process of interaction. It is through this dialogue with place [3] that the paradigm of living is defined, and forms of connection and cultural dialogue are made possible². In the age of the digital revolution, the question is how forms, images, data and meta-data, of a multimedia nature, move the cultural dialogue

and change its constituent syntaxes and paradigms³. From these questions, a dialogue is established and uses the digital to elaborate a critical thought that actualizes signs and forms. The problem of the cultural interpretation of languages is addressed from another perspective [4].

If the drawing is about an artwork, a higher level of entropy is introduced, and it increases the uniqueness of the message⁴.

The drawing, which is intended to describe a certain complexity, becomes a critically simplified copy of the artwork, capable of communicating specific relationships of the artwork itself. In the drafting of signs, traits and language that explicates some of the work's meanings, a process of memorisation is then made explicit. It is therefore a question of defining languages so that communication processes are activated and memorisation actions are qual-

* ORCID: 0000-0002-3698-7885. Department of Civil Engineering and Architecture, University of Pavia, Italy.

** ORCID 0000-0002-8072-584X. Department of Civil Engineering and Architecture, University of Pavia, Italy.

*** ORCID: 0000-0001-9792-9323. Department of Civil Engineering and Architecture, University of Pavia, Italy, e-mail: silvia.laplaca@unipv.it

¹ This is the first of the five axioms formulated by Gregory Bateson and other distinguished exponents of the Palo Alto school relating to the study of communication, its pragmatic function, and verbal and non-verbal experience in the structuring of messages.

² *Space talks, and it talks even when we don't want to hear it* Umberto Eco argued in his introduction to E.T. Hall's book [3], foreshadowing the importance of the dialogue between the individual and space. On the other hand, in the history of living, building types are nothing more than the material transfiguration of how man has thought about the relationship between physical and social space, how he has shaped it and how he continually establishes bi-univocal communicative messages between man and space and space-man.

³ Digital neural connections contaminate spaces by animating dialogues between things (internet of things) and change, through algorithms, the way humans talk to each other, altering the timing of interpersonal communication.

⁴ Each artworks contains different messages and communicates in different ways to the user of the message. First and foremost, it is the author of the work who designs and realises shapes, sounds, or whatever is necessary to achieve a certain effect. From the sign and gesture of the author, the work then finds its own identity that surpasses the author's message in the multiple readings of the designated audience, the one for whom the work was created. Then there is the accidental audience, who in reading the work may misunderstand it, who may not have all the cultural tools necessary to be able to understand the message and who, for that reason, reinterpret the artwork. This message deviates even more if the audience lives in different time periods from those in which the author lived, inevitably modifying any grammar with respect to the paradigms of their own time. There is then a further message derived from the digital translation of the work, which corresponds to a synthesis of all previous levels of interpretation, (which is in any case limited by the level of interpretation and knowledge of the drawer who transforms it into digital), and which then dialogues with the digital audience, which has different models and speeds of comparison to establish it.

ified. This takes place through a dual synergy: the drawing as an experience, and thus as memory, and the drawing as a document, which constitutes memory about a narrative.

Reproducing an artwork requires establishing a multitude of dialogues, with the work, with the author of the work, with the space in which the work is experienced, and with the user of the work. Drawing a work, then, goes beyond the simple concept of reproduction, of copying. Drawing, by its own definition, allows for an interpretation, simplification of forms, or even transformation of meanings to create, from a work, something “other”.

This contribution aims to describe some drawing activities conducted on an extremely refined artwork explaining, in addition to the methodological components that defined the actions and activities conducted, the relationship between the artwork, its copy and its digital copy.

This is a path of knowledge based on drawing, in which an approach to material and physical knowledge of the artwork is developed through an analysis of forms and through processes of measurement [5].

It is therefore a comparative process, more cultural than strictly dimensional, of recognizing morphometric qualities in relation to measurement units.

The drawing reproduction does not seek to be a sterile copy, coming from a communication between the drawer and the artwork. The drawer seeks to weave a dialogue with the work to elaborate a sign.

The drawing intends to humbly contribute to a specific analysis, enhancing the forms that characterise the figures and the decorations drawn. Drawing sets graphic limits that segmented the continuous nature of the reality.

If a digital drawing represents an artwork, it is relevant to take into account two aspects for a methodological interpretation. It is necessary to evaluate the more complete cultural and historical framework in which the drawing is formed, considering also the goals and the purpose of the digital activities, and also the nature of the digital drawing, that could be considered as a database⁵ [6].

It is evident that a documentation procedure can only establish and constitute databases of different natures that dialogue themselves. Based on comparative and analytical activities, the process is aimed at reproducing forms, proportions and models in a digital language, creating files that can be interconnected through several softwares [7].

This is why the process of creating a cognitive database on Cultural Heritage is a fundamental step to the definition of a memorisation of the built heritage [8].

Comparative practices between digital and real are rarely defined through linear continuity. A recursive logical-temporal development constitutes the dialogue. This is composed by recall, re-proposition, remembrance or reflection, rapid analogy, etc. [9].

The communication meaning is mixed with the meanings of knowledge and data archiving. This meaning con-

cerns how a certain form of knowledge and archiving could or should be represented. In digital methods and tools there are limits concerning the representation. These limitations of a representation, that being symbolic, also bring limits to the fundamental notion of meaning.

Through the architectural digital surveying it is possible to obtain reliable models, in terms of metric data, that duplicate the environment under investigation. From these duplicates it becomes possible to develop multiple studies and analyses, digital simulation to control the development of the place predicting activities of design, monitoring, restoration or enhancement [10].

Often instrumental reliability is made to coincide with metrical accuracy to simplified reproduction of shapes from real measures. This topic, which does not work in the science of architectural representation, could be applied to have a simplistic qualification of digital models.

Every instant of the modelling process is characterised by a tension that concerns the approximation of the form, the definition of the limit. This tension originates a paradox that is established in the relationship between the precision of the data, which contemplates the presence of an error, the definition of a numerical value that qualifies a shape and the adherence between the digital and the real model.

Discretisation, selection and systematisation of the amount of digital data acquired are procedures aimed at simplification of the digital model [11]. This simplification of forms gives the digital model a simplicity to the advantage of its interconnectivity that makes it an aid to have precise knowledge because, in some way, it is incomplete. The notion of completeness concerns the infinitesimal limit of imperfection that therefore qualifies the digital model.

The production of technical models, digital and physical products, is the focus of this research that emphasizes the practical and applied aspects of digital documentation of Cultural Heritage. In particular, the focus concerns communication, memorisation, comparison, and knowledge of digital products, through a series of references and recurrences based on the nature of the different models obtained.

The allegorical model, “the invention and the Sacra Cintola narration”

Donatello’s pulpit in Prato constitutes an allegorical system in relation with Santo Stefano’s Cathedral. It communicates the events connected to the city and its relic, the *Sacra Cintola* (or Sacred Belt), placed by the apostles around the Virgin’s waist before her assumption into heaven. The Belt arrived in Prato in 1141, thanks to Michele Dagomari, a noble from Prato who went to Jerusalem on the occasion of the First Crusade (1096–1099). Dagomari left the relic as a gift to the *Pieve di Santo Stefano*. The Pieve became an important religious site for devotees because of the preservation of the Belt [12]. In the early 1300s the church was enlarged and, in 1428, the pulpit was built at the intersection of the south and west elevations of the Cathedral, in a position that ensures its full visibility from the two squares. Donatello’s pulpit represents the last stage of the Ostension ritual and from

⁵ A 2D or 3D drawing, a critical interpretation of the complexity of reality, contains a series of coded information in the form of spatial coordinates or alphanumeric codes that, appropriately selected and organised, enrich the descriptive potential of the real object, amplifying its communicative message.

this, five times a year, the bishop shows the *Sacra Cintola* to the devotees⁶ (Fig. 1).

The pulpit consists of a structure with a radius of 175 cm, placed more than 300 cm above the ground. The parapet is sheltered by an umbrella cover system, above which there is a statue of Santo Stefano, the patron saint of the city of Prato.

The circular marble parapet is supported by corbels and decorative rings and is divided into 7 panels. These are separated by pairs of fluted pilasters with Corinthian capitals, giving the structure the appearance of a small circular temple. The tiles host a festive sprites motif, assuming a variety of poses, in a composition characterised by rhythm and harmony.

Donatello was inspired by the figure of the *putto*, who in ancient times was believed to inhabit the paradise of Dionysus. The sculpted sprites in the pulpit represent both an icon of the Christian imagination (as they are associated with the Christian concept of "salvation") and the symbol of a stylistic and formal revival of classical art desired by the artist himself.

The five sprites within each tile are articulated on different levels of depth in the joyful dances for the Ostension of the Belt. This three-dimensional and dynamic effect is made possible by the "stacciato", a sculptural technique with which a relief effect can be achieved with minimal changes in elevation from the background. This technique was masterfully used by Donatello to scan the different planes. A background mosaic amplifies the sense of movement thanks to the light effects vibrations, by accompanying the Dionysian dances of the festive sprites.

The angular architectural solution has exposed the pulpit to deterioration over time, including the erosion of portions of the parapet and the cover system. For these reasons, the pulpit underwent numerous restorations starting from 1776. In 1972, it was replaced by a copy made of resin and marble dust, which is today visible on façades of the Cathedral [13]. The original parapet, together with the bronze capital below⁷, is now preserved in the *Museo dell'Opera del Duomo* (Fig. 2).

To constitute a digital memory of Donatello's pulpit, a digital duplicate has been developed to increase knowledge and communication through a dialogue between physical and digital models. For this reason, a research project has been developed to document the original pulpit and its outdoor copy [14].

To define a new dialogue between the artwork and its reproductions, different methodologies and tools have been tested.

The fast technological evolution applied to Cultural Heritage increased the accuracy of measuring instruments updating the databases obtained by digital survey.

The current databases are characterised by a multiplicity of information that, appropriately discretised, entails a constant renewal of the narrative and communication of the work's values [15].

From such three-dimensional digital products, the drawer is able to read in detail the texture and imperfections of the material, its colorimetric component as well as its manufacturing process. A processes of analysis, discretisation, and segmentation of the data obtained must be activated in relation to the drawing's communicative purposes.

From a discretised database, numerous interpretative models of the original artwork can be produced. Thanks to these models and through the digital, a dialogue between the work and its duplicates can be enriched, as well as the relationship between the values of the original work and the new meanings of its reproductions [16].

The graphic model, "the digital form and the symbolic reinterpretation"

The integrated survey project for the documentation of Donatello's Pulpit have been generated, as well as reliable databases of the external pulpit and the sculptural parapet in the *Museo dell'Opera del Duomo*. From these databases, it is possible to develop graphic models and interpretations able to narrate Donatello's artwork at different levels of knowledge.

The acquisition campaign on the external pulpit has been conducted by structuring an integrated acquisition methodology with laser scanning and photogrammetric techniques⁸. This process made it possible to obtain a complete digital database of the metric and material information of the artwork. The amount of data collected and integrated with each other constitutes a real digital duplicate of the pulpit, visualised in its 3D spatial component and in its relationship to the Cathedral façade and south elevation (Fig. 3).

This database, if properly integrated in the data and implemented in the information, allows the structural mechanics of the pulpit's operation to be made explicit in relation to the building for critical interpretations of the pulpit. Drawings, elaborated from the databases, help to make the image of the artwork explicit in its context, both at general and detailed scale. Two-dimensional representations of the façades were elaborated to allow comprehension of the metric-dimensional and material-qualitative relationships between the pulpit, the cathedral, and the urban space. These drawings also help to highlight aspects that are not immediately visible in the artwork: the irregularity of certain mouldings, the non-constant step of the corbels supporting the parapet, the variations (even if

⁶ The Ostension ritual from Donatello's pulpit takes place five times a year: on 8 September, for the celebration of the Nativity of the Virgin, during the Easter period, on 1 May, on 15 August on the occasion of the Assumption of Mary, and on 25 December.

⁷ The bronze capital is the artwork of Michelozzo and probably Donatello himself. Together with a second capital that was never realised, it was intended to form the base of the circular crown of the pulpit.

⁸ The TLS Faro CAM2 S150 Terrestrial Laser Scanner, the 3D telescopic rod-EYE, two types of drones, both from DJI Enterprise, the MAVIC 2 PRO and the MAVIC MINI, and the Canon EOS 77D camera have been used for the documentation of the external pulpit. The individual databases that can be obtained from these tools have different but compatible specific characteristics, and can therefore be integrated with each other. This methodological choice responds to the need to obtain digital models that are as complete and similar to the original.

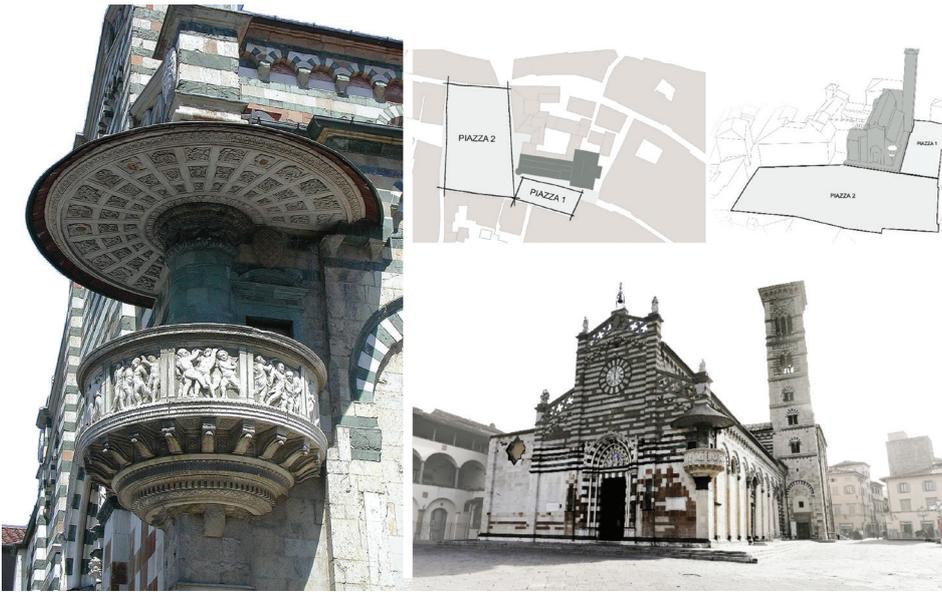


Fig. 1. Donatello's Pulpit in Santo Stefano Cathedral in Prato (left). The two squares on which the pulpit overlooks (above right), Cathedral west façade with the Donatello's Pulpit (below right) (photo by C. Rivellino)

Il. 1. Ambona Donatella w katedrze Santo Stefano w Prato (po lewej). Dwa place, na które wychodzi ambona (u góry po prawej), fasada zachodnia katedry z Amboną Donatella (na dole po prawej) (fot. C. Rivellino)



Fig. 2. The parapet of Donatello's original pulpit, exposed in the Museo dell'Opera del Duomo, next to the Santo Stefano Cathedral in Prato, general view (above), details (below) (photo by S. La Placa)

Il. 2. Oryginalna balustrada kosza ambony Donatella, eksponowana w Museo dell'Opera del Duomo, obok katedry Santo Stefano w Prato, widok ogólny (u góry), szczegóły (na dole) (fot. S. La Placa)

minimal) of the elements of the decorative apparatus (differences between the decorations on the capitals, between the pilasters, etc.) (Fig. 4).

The analysis of the drawings and the 3D models produced by reverse engineering process support considerations on the state of preservation. In particular, thanks to the analysis of the model, we can appreciate the morphometric variations due to building's developments and

restoration processes compared to the ideal representation of the pulpit. Comparisons between the ideal model, the real model, the copy and the digital model are possible through dimensional measurement, offering a broader view of the artwork [17].

The original pulpit parapet is located in the Museum, placed on a basement 150 cm above the ground. For its survey, image-based and range-based instruments have

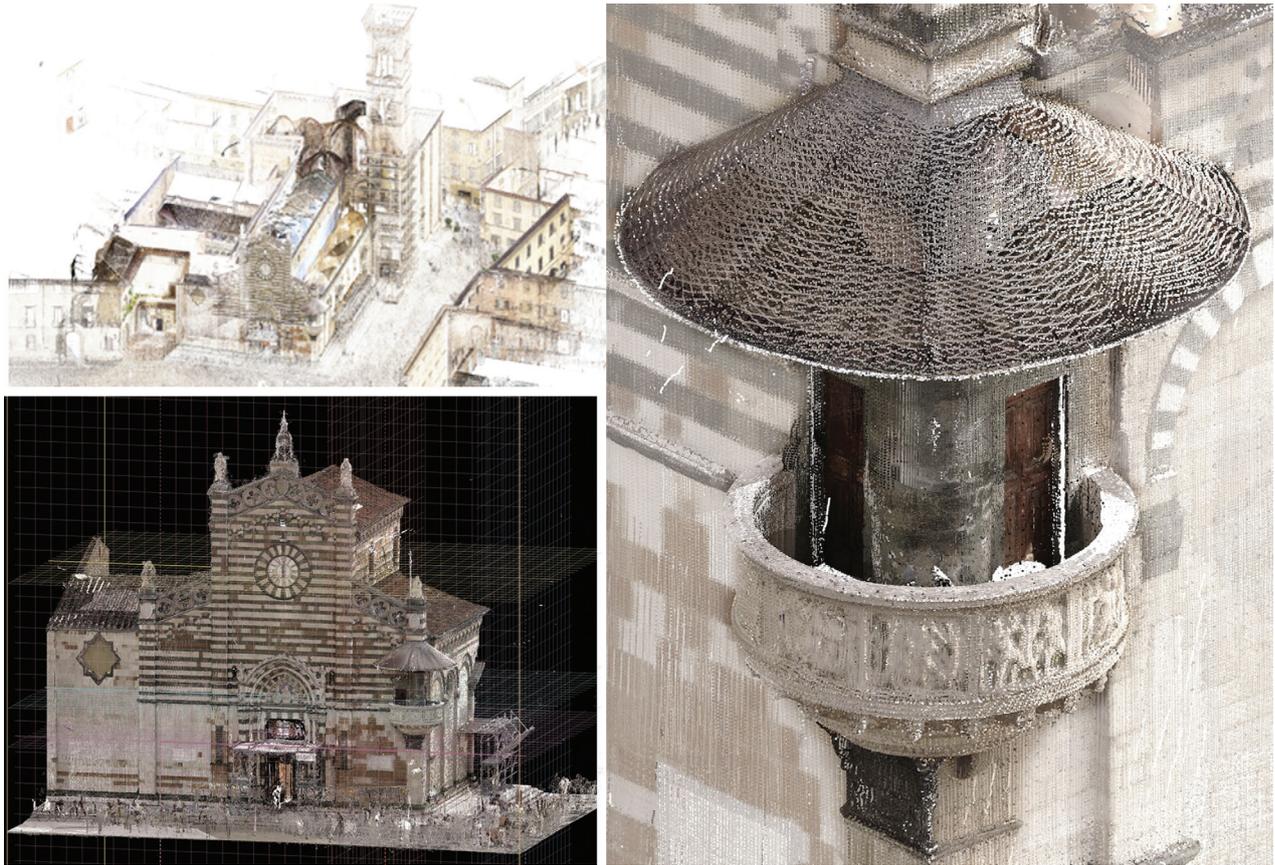


Fig. 3. The 3D laser scanner point cloud database. The images show the pulpit in its relation to the context of the square and the cathedral, as well as the processes of partitioning the cloud for the definition of the representation planes of the pulpit (elaborated by S. La Placa)

Il. 3. Skan laserowy 3D na podstawie chmury punktów. Widoki przedstawiają ambonę w jej relacji do kontekstu placu i katedry, a także proces podziału punktów z chmury dla określenia płaszczyzn reprezentacyjnych amfony (oprac. S. La Placa)

been used, performing at close distances to the surface to be acquired⁹.

Detailed digital duplicates were developed for each of the parapet tiles. The model obtained has a millimetric-range reliability on the surface rendering of the bas-relief. The integration of the different acquisitions generated models capable of describing the geometry of the elements and the texture of the material (Fig. 5).

The objective of this survey, designed with graphic restitution on a scale of 1:1, was to obtain a highly descriptive database of both the chromatic and geometric components of the sculptural apparatus. In particular, thanks to the use of image-based tools, it was possible to obtain a photogrammetric model of the entire parapet, with a colorimetrically realistic appearance to the original pulpit. A specific photographic set was set up to capture the colour differences and lighting effects of the tonal variety of the mosaic and sculpted surfaces. The set was equipped with stands, cameras with calibrated lenses and a 24-co-

lours colourchecker board for colour adjustment. The SfM photogrammetric model was appropriately scaled to the point cloud obtained by a laser scanner. It has been possible using homologous points, target and physical, in common between the two databases. The metric reliability between the two database alignments has been calculated and verified on the common points. Then, an orthometric development was carried out on a plane of the pulpit, obtaining the representation of all elements in “true size” viewing [18] (Fig. 6).

This aspect of the research was particularly useful for the design of the museum room in which the pulpit is located. On the occasion of the temporary exhibition “Donatello, The Renaissance”, panels III and IV of the original parapet were removed for display in other international museums¹⁰. The orthomosaic obtained, printed on a scale of 1:1, replaced the void left by the two tiles, providing a visual continuity of the entire parapet (Fig. 7).

In parallel, a detailed 3D model of the entire pulpit was produced using range-based tools. Tiles III and IV were

⁹ The Artec Eva was used to further refine the level of metric accuracy and textural detail, in addition to the TLS Faro CAM2 S150 Terrestrial Laser Scanner, and the Canon EOS 77D camera. The Artec Eva is a precision scanner that, working in structured light, allows creating metrically accurate and already textured 3D models of medium and small objects.

¹⁰ The museum institutions that will host the two tiles until June 2023 are Palazzo Strozzi and Museo del Bargello in Florence, the State Museums in Berlin and the Victoria and Albert Museum in London.



Fig. 4. 2D drawing processing obtained from the integration of range-based and image-based databases. The drawing shows the richness and complexity of the decorative apparatus (details) of the pulpit, trying to highlight the peculiarities of the artwork (elaborated by C. Rivellino)

Il. 4. Przetworzony rysunek 2D, w wyniku uzyskano integrację baz danych zasięgowych i obrazowych. Rysunek ukazuje bogactwo i złożoność detali dekoracyjnych ambony, starając się podkreślić osobliwości dzieła sztuki (oprac. C. Rivellino)

selected, optimised and prepared for 3D prototyping. This process addresses the communicative choice aimed at the enhancement of the three-dimensional component of Donatello's artwork.

The printed prototype as artwork signifier

Sometimes, digital duplicates or portions of them are created to find a tangible configuration of the artwork. Physical and tactile duplicates take the form of specific communicative supports of the artwork that are realised with a view to more inclusive fruition of the heritage (Fig. 8).

The technological innovations in the field of 3D scanning documentation of Cultural Heritage find further use when combined with the solid prototyping of acquired objects [19]. Producing three-dimensional prints of the

digital duplicate of artwork becomes possible from the processes of mathematical processing for the discretisation and modelling of data. Such printed reproductions, which can be quickly and cheaply obtained, represent the accurate physical copies of the investigated object. The reliability and correspondence of physical characteristics between the original, the digital duplicate, and the printed model are aspects that should be verified in relation to the purpose of use of the prints (visual, tactile, etc.). The preparation of the 3D model, the choice of printing material and the scale at which the object will be printed, are complex operations. Preliminary operations to prepare for printing take several times, require numerous print proofs and tests, and influence and qualify the relationship between the original work and the printed product. This dialogue between the artwork and its physical copy passes

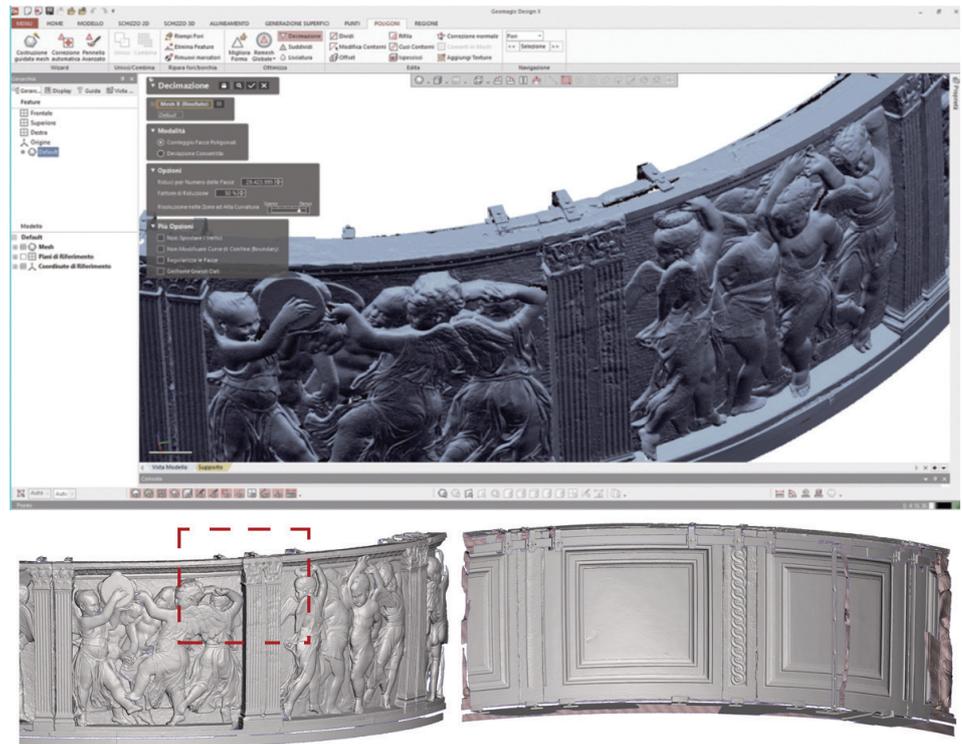


Fig. 5. Range-based data acquisition of the original interior pulpit by Artec Eva instrument. The use of tools capable of achieving a high level of detail made it possible to obtain a metrically and geometrically responsive 3D mesh duplicate of the entire pulpit parapet (elaborated by H. Fu)

Fig. 5. Akwizycja zasięgową danych oryginalnej balustrady ambony za pomocą instrumentu Artec Eva. Zastosowanie narzędzi zdolnych do osiągnięcia wysokiego poziomu szczegółowości pozwoliło uzyskać metrycznie i geometrycznie dokładną kopię siatki 3D całej balustrady ambony (oprac. H. Fu)



through the digital model prepared for printing, that represents a further synthesis and re-presentation of the real complexity in a specific heritage review. The tangible model of the work becomes the expression of a double discretisation: the first one, concerning the transition from the database to the digital model; the second one, concerning the transformation from the digital to the printed model. These processes are the result of specific technical and communicative choices, not necessarily in agreement with those expressed by the original work, but which contribute to giving a new meaning to the printed product.

In the field of Cultural Heritage, 3D printing finds its most specific application in museum collections. Sculptures, bas-reliefs, artefacts, mosaics, etc. become 3D tactile

reproductions and, by using this sensory organ, guide the user towards a new and deeper knowledge of the artistic and architectural heritage [20]. 3D-printed copies become objects to actively interact with, useful for understanding the exhibition route and the functioning of complex systems. Compared to the original works, they differ in appearance, colour, materiality and (sometimes) in scale, and can attract the visitor's attention throughout the museum.

The digital reconstruction process, developed from the use of a laser scanner and photogrammetric technologies, enables non-invasive heritage analysis. When it deals with prototyping and 3D printing, it offers to museum institutions and, in general, to scholars, the advantage of reliable, lightweight, manageable and reproducible copies. It is



Fig. 6. Orthometric development of the SfM model. Once scaled and oriented on the basis of the point cloud obtained from the terrestrial laser scanner (TLS), the cylindrical surface of the photogrammetric model was developed in the plane to obtain the true-size tiles (elaborated by F. Picchio)

Il. 6. Ortometryczne opracowanie modelu SfM. Po przeskalowaniu i zorientowaniu na podstawie chmury punktów z naziemnego skanera laserowego (TLS), cylindryczna powierzchnia modelu fotogrametrycznego została rozwinięta w płaszczyźnie w celu uzyskania płyt o rzeczywistych wymiarach (oprac. F. Picchio)



Fig. 7. Detail of the photographic image of the SfM model developed on the plane. This image was then printed on a scale of 1:1 on paper and placed on the basement of the original pulpit to replace the void left by tiles III and IV (elaborated by F. Picchio)

Il. 7. Detal obrazu fotograficznego modelu SfM opracowanego na płaszczyźnie. Obraz ten został wydrukowany w skali 1:1 na papierze i umieszczony w oryginalnej ambonie w miejsce pustki pozostawionej przez płyty III i IV (oprac. F. Picchio)



Fig. 8. 3D digital duplicates of the pulpit:

- 1) laser scanner point cloud of the external pulpit, 2) SfM model of the external pulpit,
- 3) SfM and textured model of III and IV tiles of the original pulpit,
- 4) detailed laser scanner model of III and IV tiles of the original pulpit,
- 5) optimized model of III and IV tiles of the original pulpit for the 3D printing
(elaborated by DAda-LAB research team)

II. 8. Cyfrowe kopie 3D płyt ambony:

- 1) chmura punktów oryginalnej ambony ze skanera laserowego, 2) model SfM balustrady kosza oryginalnej ambony,
- 3) model SfM i teksturowany III i IV płyty oryginalnej ambony,
- 4) szczegółowy model ze skanera laserowego III i IV płyty balustrady ambony oryginalnej,
- 5) zoptymalizowany model III i IV płyty balustrady ambony oryginalnej przygotowany do druku 3D (oprac. DAda-LAB research team)

possible to model and produce copies at different dimensional scales, maintaining correct proportions and textures of the material component.

The Donatello pulpit documentation project was an opportunity to experiment with the use of 3D printing in the study of the relationship between the original and the uniqueness of its duplicates.

Both III and IV pulpit tiles intended for museum loan were digitized and prototyped for 3D printing, enabling a new type of fruition, visual but also tactile, of the sculptural artwork.

3D printed models, with specific material roughness suitable for tactile experience, take on a communicative potential that is more physical than visual. In the case of the pulpit digitization project, two prints were obtained from the digital model of tiles III and IV: the first, light and manageable on a scale of 1:5, allows an overall view

of the design of the dance of the sprites and helps the understanding of the structural joints between the panels and the pilasters; the second, on a scale of 1:1, ensures the tactile reading by the blind and visually impaired (Fig. 9).

In both cases, the prints were made in white PLA filament, generating a monochrome product. On a visual level this communicative choice allows to emphasize the “stiacciato” technique. In fact, the homogeneity of the colour highlighting the shadows and therefore the depth of the bas-relief. From the point of view of tactile enjoyment, the monochrome colour of the PLA filament guarantees minimal differences in thickness to the touch, which could be altered by the application of a colour.

The flexibility of 3D-printed products makes them suitable for several educational purposes and attractive, interactive and inclusive forms of exhibitions. The copies obtained are configured as new representative models,



Fig. 9. Image of the two 3D printed tiles via solid prototyping process. The two tiles joined (above); the detail of the 3D printing achieved (below) (elaborated by DAda-LAB research team)

Il. 9. Obraz dwóch płyt w wydruku 3D w procesie prototypowania bryłowego. Dwie połączone płytki (powyżej); szczegół uzyskanego druku 3D (poniżej) (oprac. DAda-LAB research team)



Fig. 10. The exhibition in the hall of the Museo dell'Opera in which the original pulpit is presented stored. It is now possible to touch the printed panels and learn about the process that led from the survey to the 3D realization through information panels created for the purpose (photo by DAda-LAB research team)

Il. 10. Wystawa w sali Museo dell'Opera, na której prezentowana jest oryginalna ambona. Obecnie można dotknąć wydrukowanych płyt i zapoznać się z procesem, który prowadził od badań do realizacji 3D poprzez stworzone w tym celu tablice informacyjne (fot. DAda-LAB research team)

which interpret the original work and increase its accessibility and knowledge, structuring an innovative narrative and exhibition path (Fig. 10).

Conclusions

The considerations addressed in this contribution underline the importance of integrated digital survey and documentation for a dual purpose: to develop a database that can support the conservation of the artwork, and to create a product that can enrich the cognitive and communicative value of Cultural Heritage.

The models obtained from the different databases cannot give an exhaustive and complete overview of the original artwork. Each model represents a simplified version of the original but at the same time goes deeper into a specific descriptive aspect. From different products, a plurality of different narratives comes. These offer multiple points of view: each model is simplified from the original but related to the other models. This connection provides maximum personalization of the user's knowledge experience.

The models and the relationships between them also become "other" than the artwork itself. These new artworks enrich the historiographical and historicist debate on the original one.

The uniqueness and communicative capacity of each product allow us to consider digital duplicates also as "artworks in their own right".

The models express and intend to communicate the intrinsic and extrinsic values of the artwork, amplifying the graphic and infographic corpus, and, acquiring their own autonomy from the work itself, enrich it with informative content.

Drawing, together with the documentation processes that are based on it, makes it possible to organize not only the production of the model, but also the development of narrative sequences. These contribute to highlighting previously unexplored aspects and, consequently, to enhancing the heritage.

Acknowledgements

The documentation and graphic restitution activities described in this contribution are part of a research project scientifically coordinated by the University of Florence and the University of Pavia. The project, financed by the Fondazione Cassa di Risparmio di Prato and promoted by the Musei

The nature of different duplicates suggests multiple scenarios between the tangible and intangible. The rewriting of artworks in digital environments contributes to the updating of the communicative message. It is also possible to develop new narrative forms that support and dislocate the communicative message of the artwork for different types of users.

The provision of augmented and virtual reality applications enable the creation of settings in which the work transcends the physical limitations of matter.

The dances of the festive sprites can become dynamic actions and the architecture of the pulpit can explain the Mannerist anticipation that it intimately preserves in its forms.

Tactile prints oriented towards innovative ways of interaction with the visitor can be envisaged, diversifying the opportunities to know the artwork. The digital model supports the preservation of the memory of the physical model and, through its interconnectivity, tries to digitally preserve itself. In the digital transcription of languages, forms, and models, cultural repercussions are also produced in the specific territory.

The production of models supports the education in digital and digital languages. Education takes place by creating opportunities for comparison that give rise to interactions and temporal recurrences, in a duplication and replication of recursive experiences that are stratified over time.

Comparative processes are thus promoted to foster the development of knowledge and many forms of knowledge, giving rise to models of models.

As in an eternal shining garland, the dream of the pulpit and the message contained in the artwork, having acquired matter, are transformed into digital matter. Through the dream, the model is transformed into new models, which in their new physicality allow the messages of the past to be updated and actualized, setting the basis for the mechanics of the future.

Translated by

Sandro Parrinello, Francesca Picchio, Silvia La Placa

Diocesani di Prato, was conducted by researchers from the joint laboratory LS3D_Landscape, Survey and Design of the University of Florence and the University of Pavia and the DAda-LAB laboratory of the Department of Civil Engineering and Architecture of the University of Pavia.

References

- [1] Bateson G., *Mente e natura*, Adelphi, Milan 1984.
- [2] Bateson G., *Verso un'ecologia della mente*, Adelphi, Milan 1977.
- [3] Hall E.T., *La dimensione nascosta*, Bompiani, Milan 1968.
- [4] Ciastellardi M., *Le architetture liquide. Dalle reti del pensiero al pensiero in rete*, Edizioni Universitarie di Lettere Economia Diritto, Milan 2009.
- [5] Miceli A., Morandotti M., Parrinello S., *3D survey and semantic analysis for the documentation of built heritage. The case study of Palazzo Centrale of Pavia University*, "Vitruvio" 2020, Vol. 5, No. 1, 65–80, doi: 10.4995/vitruvio-ijats.2020.13634.
- [6] Galasso F., Parrinello S., Picchio F., *From excavation to drawing and from drawing to the model. The digital reconstruction of twenty-year-long excavations in the archaeological site of Bedriacum*, "Journal of Archaeological Science: Reports" 2021, Vol. 35, 102734, doi: 10.1016/j.jasrep.2020.102734.
- [7] Parrinello S., Picchio F., *Database and complexity. Remote use of data in the virtual space of reliable 3D models*, "Architecture and Engineering" 2017, 2(2), 27–36, doi: 10.23968/2500-0055-2017-2-2-27-36.
- [8] Parrinello S., Picchio F., Dell'Amico A., *When the future is the past. Database digitali per la virtualizzazione dei beni museali*, [in:]

- A. Luigini (ed.), #Earth2018. *Digital Environments for education arts and heritage*, Free University of Bolzen, Bolzen 2018, 212–222.
- [9] Hofstadter D.R., *Gödel, Escher, Bach. Un'eterna ghirlanda brillante*, Adelphi, Milan 1990.
- [10] Kowalski S., Samól P., Szczepański J., Dlubakowski W., *Teaching architectural history through virtual reality*, “World Transactions on Engineering and Technology Education” 2020, Vol. 18, No. 2, 197–202.
- [11] Acampa G., Grasso M., *Heritage evaluation: restoration plan through HBIM and MCDA*, “IOP Conference Series: Materials Science and Engineering” 2020, 949 012061, doi: 10.1088/1757-899X/949/1/012061.
- [12] Dello Russo M., *Storia della Sacra Cintola di Prato*, Stamperia Ferrante, Naples 1858.
- [13] Giusti A., Biliotti C., “... si belli e si mirabili”: *recuperi e limiti nel restauro dei rilievi donatelliani*, [in:] A. Giusti (ed.), *Donatello restaurato. I marmi del pulpito di Prato*, Maschietto Editore, Florence 2000, 61–72.
- [14] Rivellino C., Ricciarini M., *Testing the reliability of mini-UAVs acquisition campaign on detailed bas-reliefs. The case study of sculpturing elements of Donatello's Pulpit*, [in:] S. Barba, S. Parrinello, A. di Filippo, A. Dell'Amico (eds.), *D-SITE Drones – Systems of Information on cultural heritage*, Pavia University Press, Pavia 2022, 518–527.
- [15] Parrinello S., De Marco R., Galasso F., *Un protocollo di modellazione urbana mediante abachi e modulo tecnologici. Dal rilievo digitale al sistema informativo 3D per il centro storico di Betlemme*, [in:] T. Empler, A. Caldarone, A. Fusinetti (eds.), *3D MODELING & BIM. Data Modeling & Management for AECO Industry*, Sapienza Università di Roma, Tipografia Del Genio Civile, Roma 2020, 62–83.
- [16] Parrinello S., Dell'Amico A., *Experience of documentation for the accessibility of widespread cultural heritage*, “Heritage” 2019, 2(1), 1032–1044, doi: 10.3390/heritage2010067.
- [17] Bruzelius C., *Digital technologies and new evidence in architectural history*, “Journal of the Society of Architectural Historians” 2017, Vol. 76, No. 4, 436–439.
- [18] Pancani G., *Piazza dei Miracoli a Pisa: il Battistero. Metodologie di rappresentazione e documentazione digitale 3D*, EDIFIR, Florence 2016.
- [19] Jung T.H., tom Dieck M.C., *Augmented reality, virtual reality and 3D printing for the co-creation of value for the visitor experience at cultural heritage places*, “Journal of Place Management and Development” 2017, Vol. 10, Iss. 2, 140–151, doi: 10.1108/JPM-07-2016-0045.
- [20] Fu H., *Le stampe 3D per una fruizione tattile delle sepolture*, [in:] B. Bruno, E. Napione, F. Picchio (ed.), *I Mondiali di Italia '90 e la scoperta della necropoli romana. Un progetto espositivo per il trentennale della scoperta della necropoli di Porta Palio*, Pavia University Press, Pavia 2022, 99–105.

Abstract

From Model to Model.

The narrative between drawing and digital reproduction of Donatello's Pulpit

The paper aims to consider the narrative and interpretative contribution that digital models can make to heritage archiving date and enhancement, through an investigation conducted on Donatello's Pulpit in Prato. The pulpit is an architectural work of sophisticated decoration and constitutes a stage in the Ostension of the *Sacra Cintola* ceremony. The relic of the belt that encircled the clothes of the Virgin is preserved in the Cathedral of Santo Stefano. On the main façade of the church a copy of Donatello's work is placed. The original opera is kept in the Museum of the same Cathedral.

Today, the modalities of communication and transmission of cultural heritage acquire new features with the use and implementation of digital technology. Reality-based 3D models become increasingly accurate digital copies that duplicate the space and character of architectural works, constituting not only copies but serving as critical reinterpretations that express a formal synthesis of object complexity.

The documentation activities carried out have made it possible to generate three-dimensional databases of the two pulpits, the original one and the copy. From digital databases 3D models and printed models have been developed to dialogue in the museum exhibition with the Renaissance opera and its history.

Key words: 3D survey, digital twin, 3D printing, Donatello's Pulpit

Streszczenie

Od modelu do modelu.

Narracja między rysunkiem a cyfrową reprodukcją ambony Donatella

Celem autorów artykułu było zbadanie narracyjnego i interpretacyjnego wkładu, jaki modele cyfrowe mogą wnieść do archiwizacji dziedzictwa kulturowego. Przedmiotem badań była ambona Donatella w Prato. Ambona ta jest dziełem architektonicznym o wyrafinowanej dekoracji i stanowi miejsce publicznego wystawienia *Sacra Cintola* (pasa NMP). W katedrze Santo Stefano zachowała się relikwia pasa, który okalał ubranie Dziewicy Maryi. Na głównej fasadzie kościoła umieszczona jest obecnie kopia dzieła Donatella. Oryginalna balustrada przechowywana jest w Muzeum Katedralnym.

Obecnie sposoby prezentacji i rozpowszechniania dziedzictwa kulturowego nabierają nowych właściwości wraz z wykorzystaniem i wdrożeniem technologii cyfrowej. Modele 3D oparte na rzeczywistości stają się coraz bardziej dokładnymi kopiami cyfrowymi, które powielają przestrzeń i cechy dzieł architektonicznych, stanowiąc nie tylko kopie, ale także krytyczne reinterpretacje, wyrażające formalną syntezę złożoności obiektu.

Prowadzone działania dokumentacyjne pozwoliły na wygenerowanie trójwymiarowych baz danych obu ambon, oryginalnej i kopii. Z cyfrowych baz danych opracowano modele 3D oraz modele drukowane, które będą stanowiły dialog na ekspozycji muzealnej renesansowej ambony i jej historii.

Słowa kluczowe: badanie 3D, cyfrowa kopia, druk 3D, ambona Donatella