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## TLS e UAS 3D data integration for the knowledge and representation of a mid-18th century architecture: the Teatro Massimo Bellini in Adrano (CT)

This study, conducted on the Teatro Massimo Bellini in Adrano (CT), is part of a wider research aimed at the knowledge, valorization, and fruition of the theatrical and cinematographic heritage of Catania and its municipalities, through digital surveying techniques. This architectural heritage represents a powerful bond to the past for the city and its inhabitants. However, its typological connotations are often neglected or changed. Therefore, understanding these architectures is an essential step in their protection.

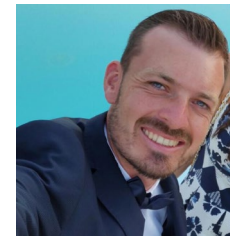
The Teatro Massimo Bellini is located within a historicized urban space near the historic municipal garden, behind the ancient axis of Garibaldi Street, where the Mother Church and the Norman castle stand.

Previous investigations conducted on the theater are purely historical-literary. No archival documents have currently been found to testify about its original stylistic formal and geometric

characteristics, especially of the spaces that have been rearranged over time.

Due to its typological and geometrical characteristics, we decided to proceed through an integrated survey, which could provide the necessary data for the graphic reconstruction of the building, ranging from an urban scale to a detailed scale.

The presented study aims to experiment and integrate LIDAR (TLS) and SfM techniques (UAS) to obtain a three-dimensional data model useful to document the entire spatiality of the opera and its urban context. Indeed, the integration between terrestrial laser scanning (TLS) and Unmanned Aerial Vehicle (UAV) digital photogrammetry techniques is tested and verified.



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Keywords:  
UAS, TLS, Digital Survey, Aerial Photogrammetry, Theatre Architecture

## 1. INTRODUCTION

The research presented here, conducted on the Teatro Massimo Bellini in Adrano (CT), is part of a wider research aimed at the knowledge, valorisation, and fruition of the theatrical and cinematographic heritage of Catania and its municipalities (XIX sec. - XX sec), through digital surveying techniques (D'Agostino & Galizia 2022). This architectural heritage represents a powerful bond to the past for the city and its inhabitants. However, its typological connotations are often neglected or changed. Therefore, understanding these architectures is an essential step in their protection.

The Adrano theatre is located within a historicized urban space near the historic municipal garden, behind the ancient axis of Garibaldi Street, where the Mother Church and the Norman castle stand (Fig. 1). The urban context where the theatre is located was transformed several times over the years. Today its façade, which serves as a perspective background to the Duca di Misterbianco street, rises among buildings without any significant architectural connotations. The first planimetric layout, which occupied the ancient ruins of the Church St. Vitus, dates to 1742 under Don Francesco Pipi. The current floor plan, by designer Vincenzo Costa (1846), is based on the "Italian-style" theatre typology and responds to the functional requirements for various types of performances.

The current interior layout and decorative apparatus result from many restorations, preservation, and adaptations carried out nearly three hundred years since its construction. Previous investigations conducted on the theatre are purely historical-literary (Ronsisvalle 1995, Santangelo 1994). Graphic documents from the construction period don't exist to testify about its original stylistic formal and geometric characteristics, especially of the spaces that have been rearranged over time.

Besides World War II damages, the building underwent a significant restoration in 2004, which redesigned the wooden truss roof and the large

vault covering the hall.

The entrance vestibule was also redesigned by incorporating marble wall coverings. The Adrano theatre would take the name Teatro Vincenzo Bellini in 1914 and was one of the first Italian indoor theatres built in Sicily, about 50 years before the Teatro Massimo in Catania and the Politeama in Palermo.

Due to its typological and geometrical characteristics, we decided to proceed through an integrated survey, which could provide the necessary data for the graphic reconstruction of the building, ranging from an urban scale to a detailed scale.

The presented study aims to experiment and integrate LIDAR (TLS) and SfM techniques (UAS) to obtain a three-dimensional data model useful to document the genesis of the elegant architecture, built in the small ancient centre of Adrano, the spatiality of the opera and its urban context. Indeed, the integration between terrestrial laser scanning (TLS) and Unmanned Aerial Vehicle (UAV)

digital photogrammetry techniques is tested and verified (Becherini & De Marco 2016, Parrinello et al. 2017, Galizia et al. 2020, Garozzo & Santagati, 2022). The final model is, therefore, the result of the integration of detailed metric information, data from laser scanner survey, and SfM techniques, which refine the material/chromatic data of the exteriors. The experimentation made it possible to identify a protocol for integrating data of different nature and resolution to obtain a complete three-dimensional reconstruction of the theatre's interior and exterior environments, valid for the ongoing research.

Fig. 1 - Adrano historic centre. Urban context and identification of interest areas.



## 2. METHODOLOGY APPLIED

The knowledge and study process of theatre architectures aims to provide interpretative keys from the architectural scale (as concerns their geometric and design genesis) to the urban scale (as concerns their location inside the city). The application of digital techniques of metric acquisition and graphic restitution has been a consolidated and evolving working methodology for decades, especially about the available equipment. In this case, such application has a threefold purpose:

- Analysis of the monument's capacity to dialogue with the adjacent urban context;
- Three-dimensional metric acquisition of the entire monument, testing the integration of two different digital survey techniques;
- Updating and enrichment of the two-dimensional graphic documentation of the project behind the architecture, through a diachronic reading of the historical phases.

The research activity here presented is part of a broader research aimed at the digital documentation of the theatrical heritage of the city of Catania and its municipalities, through the transition from the urban scale to the architectural scale down to the detail of the decorative apparatus. A general working methodology was defined for each of these architectures, choosing the most suitable surveying instrumentation (laser scanner or cameras) on a case-by-case basis.

The first phase of the research focused on the survey of the interior and exterior of the theatre architecture through the experimentation of integrated digital survey campaigns, using terrestrial Laser Scanner, mobile Laser Scanner and photogrammetric survey techniques from the ground or from a drone.

The choice of surveying techniques and instruments is mainly aimed at the accurate restitution of the roofing systems' articulations and the sculptural and decorative apparatus that characterises the monumental façades and internal halls of these architectures and, above all, at the production of point clouds thanks to which it is possible to obtain

highly detailed two-dimensional representations and three-dimensional models useful for the use and virtual dissemination of these assets and for future investigations and studies on the surveyed architectures. The second phase of the research involved verifying the integration of data from different survey campaigns. The last phase focused on data processing in the production of 2D drawings.

For the Adrano theatre, the methodology is structured as follows:

Digital survey:

1. Digital survey through TLS;
2. Digital survey through UAV.
  - Integration and post-processing of TLS and UAS survey;
  - 3D and 2D representation.

### 3. THE THEATRICAL HERITAGE IN SICILY IN THE LATE 18TH AND EARLY 20TH CENTURIES: CATANIA AND ITS MUNICIPALITIES

The census of theatre structures, promoted in 1868 by the Ministry of the Interior of the Italian Reign, counts seventy theatres in Sicily, which increased more than twofold in the early years of the 20th century. This testifies to the "cultural ferment" that the city has always displayed by using numerous private spaces for theatrical performances until the early 19th century.

By the 17th century, there were three active theatres in Catania, located at the Casa Comunale, the University, and the Jesuits place, in compliance with a provision, dating back to 1796 in force until the 19th century, prohibiting the construction of theatres without royal authorisation (Mazzamuto 1988). From 1812 onwards, following the law prohibiting its private use, the theatre assumed an autonomous, and therefore public, status. Theatres were built according to a well-defined typology, the so-called 'sala all'italiana,' which became widespread in the 18th-19th centuries; actually, the earliest examples date back to the 17th century, when drama by music became more popular and musical performance moved from a

private to an increasingly public form (Zerlenga 2020).

The design elements are: a hall with a planimetric profile mostly in the shape of a 'horseshoe', equipped with several tiers of boxes ranging from three to five; an arch-stage that separates the hall from the volume of the scenic tower, i.e. the performance venue (Ceniccola 2011).

After the Unification of Italy, every urban centre, even the smallest, required its own theatre as a symbol of local identity. Thus in Sicily a widespread diffusion of theatres began, exactly reproducing the major national 18th century theatres in their façades, architecture and internal distribution. "It was a process of emulation between cities, which well reflected the density of Italian urban geography, that led to this proliferation of theatres in the pre-unification territory" (Sorba 2001).

In Sicily by 1860, baronial and state-owned cities started to acquire theatres representative of local culture and society. Many cities commissioned local and national designers to plan a new typology, which required great technical and design experience. In this phase, the theatre was connected to the dominant classes of the society: the aristocracy and the emerging rich middle class.

The new theatres in the large centres such as Palermo, Catania, Messina and Noto were strongly desired by the local aristocracy, searching for a representative place to lead its social and cultural life. Even the towns along the coast - Termini, Mazzara, Patti, Syracuse, Gela, Barcellona - were equipped with refined theatres, thanks to the ambitions of the rich merchant bourgeoisie in search of courtly settings where they could entertain social relations, confirming their status symbol. In the inner part of Sicily, the baronial cities - Adrano, Sambuca, Ragusa, Modica, Piazza Armerina, Lentini, Troina, Paternò, Capizzi and Comiso - are no less important, being represented by the agrarian bourgeoisie (Lo Sardo 2011), which imposes its status through economic power, often financing the construction of theatres.



Actually, the theatre becomes the place where the community represents itself, staging its traditions, its links with other cultural environments, its aspirations.

Until the early 19th century, the theatre was understood as an introverted space, closed to the outside world, where priority was given to scenographic and stagecraft aspects. In the 19th century, the theatre assumed a new significance, as a place of aggregation for the community, extroverted and representative, whose construction would often be the cause of lively debates between the social classes of the time.

One of these is the Teatro Massimo Bellini in Adrano, a large centre with baronial origin in the area of Catania, where the dominant social class consists of the agrarian bourgeoisie, which, freed from feudalism, was proactive and collaborative in financing the construction work. Like many others, the theatre in Adrano, of eighteenth-century origins, was developed from the adaptation of a pre-existing site, the Church of San Vito, and subsequently enlarged in the mid-nineteenth century with the construction of the large 'horseshoe' shaped hall with boxes arranged on three tiers, the foyer and the meeting rooms (Inzerilli, 2017). The theatre was completed only in 1909, with the design of the façade by the engineer from Palermo Gaspare Silvestri Amari, who gave a new significance to the façade, intended as a boundary between interior and exterior space. This design transformed the theatre from an introverted to a façade architecture; thanks to this, the building dialogues with the city and the new street axis of Via Duca degli Abruzzi, laid out in the early 20th century, is directed towards it. The extension of the building's time span will bring some divergences between structural layout, façade and decoration. In fact, the 19th-century layout is overlaid with a modernist façade that, in its courtliness and the rigour of its geometric rule, gives the theatre and the site the role of a pole of attraction for social life, expressing the culture linked to the traditions and identity of the place.

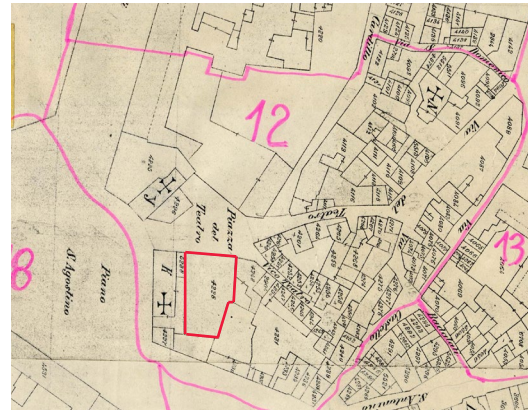


Fig. 2 - Cadastral planimetry of the early 20th century. In red, the lot occupied by the Adrano theatre and the adjacent Church of St. Vito.

### *The Teatro Massimo Bellini in Adrano*

The history behind the construction of the Teatro Massimo Bellini in Adrano (CT) covered a wide time span, involving several professionals who expressed their most distinctive qualities in this work. The steps in the construction of the theatre reveal the political and social dynamics of the historical period and the ambitions of the aristocracy and the newly emerging agrarian middle class, who saw their participation in cultural events as a way to manifest their status symbol. Under the rectorate of Don Nicolò Ciancio Pisano, the necessity of a large space where both religious and nonreligious events could be represented led to the choice of a site other than the Church of Santa Maria Catena, where sacred events were held until that date (Inzerilli 2017). For this purpose, the site of the ancient Church of St. Vitus, located in the eastern part of the town, was identified in the first half of the 18th century (Fig. 2-3). The old building was transformed into a theatre by erecting a wooden structure with a stage, assigned boxes and a semi-circular tier of seats for the upper class. The first planimetric distribution of the structure can be inferred from

Don Francesco Palermo's notarial deed of August 24 1742 .

In 1779 the Viceroy imposed some interventions to renovate the building, thus by the end of the eighteenth century the theatre was typologically modified from its original plan. Theatrical activity was carried out until 1824 and then for twelve years it was kept closed, until being declared unfit for use in 1836.

The boxes, trapezoidal compartments with a one-sided open space protected by a parapet, are separated from each other by a partition radial to the back wall and converging to an ideal focus located on the stage.

In 1839 Mayor Pietro Sidoti commissioned municipal architect Vincenzo Costa to restore the building. Restoration work started by master Francesco Paolo Gennaro, which was completed in 1846. The project present a total renovation of the building, proposing the 'Italian-style' typology, with the hall in the shape of a horseshoe, the enlargement of the stage, and the design of a third tier of boxes reached by stairs and side corridors (Inzerilli 2017).

Fig. 3 - Historical photo from the early 20th century. Facade of the Adrano theatre and the adjacent Church of St. Vito, which no longer exists.



The interior was decorated by the artists from Catania Giuseppe Di Stefano and Giuseppe Rapisardi (Fig. 4). The former one enriched the stage and boxes with friezes and arabesques and painted the vault of the hall; the second one painted the curtain, which is currently stored, after the restoration by the artist Angelo Cristaudo of Acireale, in the hall of the former convent of S.Domenico.

In 1892 the theatre underwent restoration works, including the operations commissioned to the architects Antonino Grasso and the Milanese Carlo Sada who in those years was in Catania involved in the design of the Teatro Massimo Bellini.

The restoration of the paintings was conducted by brothers Cesare and Alessandro Cappellani, who renewed the gilded stuccoes and the renovation of the stage apparatus.

These were the heyday years for the theatre, which hosted numerous famous theatre companies. In 1909 Mayor Melchiorre Battiatì entrusted the completion work on the facade to the engineer from Palermo Gaspare Silvestri Amari, a disciple

of Ernesto Basile, who realised a layout composed of a double order with three entrances giving access to the atrium from which the entire floor plan develops. The work was carried out by the masonry contractor Giovanni Viaggio and Sons, while the decorations were assigned to the artist from Catania Carmelo Florio.

A sculptural group by artist Mario Moschetti was placed on the top of the façade. It symbolised Tragedy, Music, and Comedy. It would be necessary to wait until 1928 to carry out further restoration activities inside the theatre. The direction of the project was given to Engineer Pastanella, who completed the work during 1933. In 1943 the theatre suffered severe damage due to wartime actions by the Allied Forces, remaining unusable for about three years.

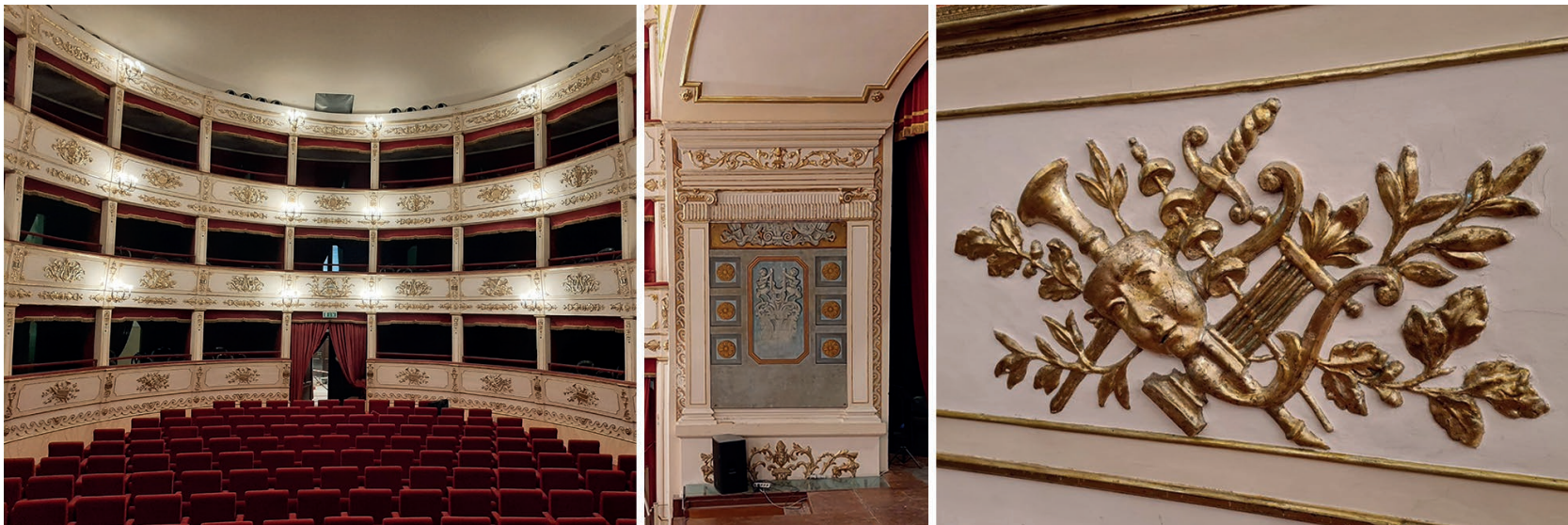
During 1946, the Genio Civile of Catania, made several steps to rebuild the main walls and the roof. Although in a precarious condition, the theatre continued to function, even turning into a dance hall. On December 30, 1980, the Teatro Bellini passed into the ownership of the

Municipality of Adrano. In the days that followed, it became necessary to provide for the care and maintenance of the Cine-Theatre's facilities and equipment.

In 1978, the architect Brancato of Palermo was commissioned with a project for the restoration of the theatre, but due to the lack of funds necessary to carry out the work in its entirety, it was decided not to go ahead with the work on the stage and the enlargement of the orchestra pit. During 1983, the project passed into the hands of architects Giuseppe Hervatin and Giuttari.

Shortly afterwards, the work was stopped due to lack of funds. It was only in 1996 that restoration work began and was completed in 2004, with the re-roofing.

Fig. 4 - Interior spaces of the Teatro Massimo Bellini in Adrano.





#### 4. AN INTEGRATED APPROACH THROUGH TLS AND UAV TECHNOLOGIES FOR 3D ARCHITECTURAL DOCUMENTATION

Theatre architectures hold the history of an era, not only cultural, but also political, economic, and social, which deserves to be known and conveyed. They represent a cultural and economic resource in the territory that should be preserved, valorised, and enjoyed. The analysis and three-dimensional acquisition of the architectural configuration of the Adrano theatre, using 3D digital surveying technologies, allows for a precise and detailed graphic documentation aimed at the knowledge and comprehension of the different construction phases of the heritage. By relating the construction design projects, it allows, at the same time, an understanding and dissemination of the high cultural value of the building and its connection to the urban context in which it is located.

Fig. 5 - The interior of the Teatro Vincenzo Bellini in Adrano.



<http://disegnarecon.univaq.it>

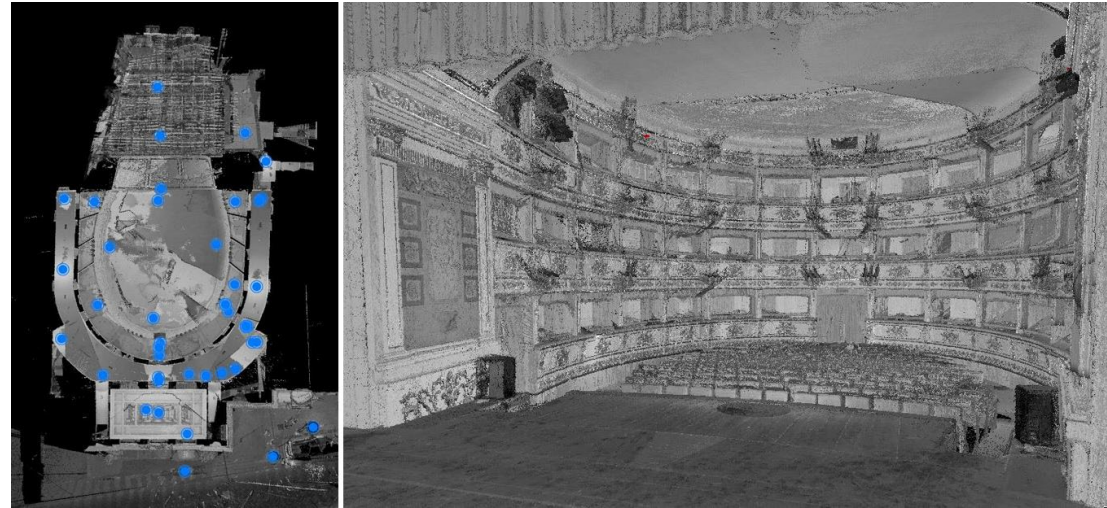


Fig. 6 - The point cloud obtained through TLS survey. On the left, the 43 station points.

The theatre is located on a lot flanked on two sides by buildings that existed prior to its construction, and with the two facades - main (west) and secondary (east) - facing Piazza Duca degli Abruzzi and Piazza Sant'Agostino respectively. Given the configuration of the site, the three-dimensional metric acquisition project was based on the integrated use and testing of two different digital survey techniques, the application of which was highly dependent on the spatial context:

- TLS survey technique was used for the three-dimensionality of the theatre's interior spaces (the entrance, the main hall, the foyer, the connecting staircases of the three tiers, and the related ambulatories);
- UAV photogrammetric survey technique was used for the reconstruction of the exterior, the roofs, and the entire non-accessible envelope, as included in the neighbouring buildings.

The articulation of interior and exterior spaces and the need to document the entire architectural heritage at a detailed scale influenced the choice

of an integrated metric acquisition strategy. The laser scanner chosen is the Leica BLK360 Imaging Laser Scanner (scan rate: 360.000 pts/sec, accuracy: 6mm at 10m / 8mm at 20m, ranges: up to 60 m, size: H 165mm, D 100mm, weight: 1 kg) and, thanks to the high manoeuvrability and accuracy of the data in indoor environments, it made it possible to obtain a highly detailed numerical model of the hall's decorative apparatus and its geometry, of the three tiers of the boxes system, of the side corridors, of the two curved ramps that allow access to the floors, of the foyer on the second tier and of the large entrance hall. 43 station points were set up to obtain a numerical model as complete as possible. Of these, three were positioned outside the theatre to allow for better integration of the data acquired from both survey techniques and to verify their reliability. The obtained numerical model is almost 1,700 billion points (Figg. 5-6).

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Fig. 6 - Top view of Teatro Bellini in Adrano taken by drone.

The drone used for the photogrammetric survey is the DJI mini2. Three different, manually controlled flight planes were programmed to reconstruct the exterior spaces, with shooting angles ranging from 0° to 45°, plus a nadiral flight to capture images of the roof and capture structural and decorative elements hidden by the overhangs. The distance between the drone and the scanned area was kept between 10 and 20 metres, to obtain a more accurate point cloud. From the photogrammetric survey (no. photographs: 560, image size: 4000x3000 pixels) a point cloud of approximately 26 million points was obtained (Fig. 7-8), which includes the theatre and adjacent buildings.

##### 5. INTEGRATION AND POST-PROCESSING OF TLS AND UAS SURVEY DATA FOR 3D AND 2D DOCUMENTATION

The survey of a theatre could be particularly challenging, precisely because of its morphological characteristics. Rows of boxes, a maze of stairs and corridor, numerous service rooms are just some of the elements that make this type of survey complex. Even the survey of the hall could be challenging, since it is a high ceiling space, often frescoed or stuccoed. Speaking about the exterior, since these are often particularly large structures,

integrating a terrestrial survey with an aerial one is crucial, to obtain metrical information about all those parts that are impossible to properly acquire from below. For example, the decorative apparatus and roofing, as well as the shaded areas due to overhangs.

In the case of Teatro Massimo di Adrano, the integration of surveys (TLS and UAV) was performed on the façade, for the dual aim of acquiring accurate metrical information on the decorative apparatus of the elevation and allowing the analysis of the roof relating to both the building itself and the urban context.

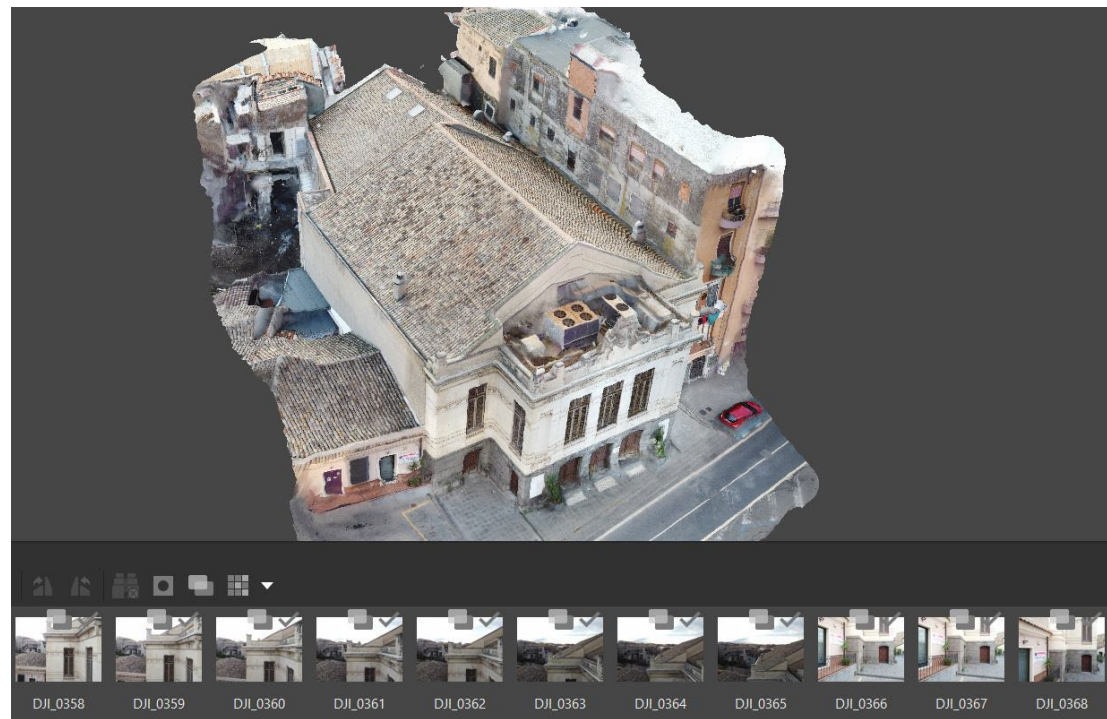
At a fine-detailed scale, considering the outputs of both the surveys for the restitution of the

decorative apparatus, the point cloud from drone is more detailed, speaking about the number of points and the colorimetric aspect; regarding this last consideration, the higher accuracy is due to the use of high-quality photos, as specified in the previous paragraphs.

At the same time, the use of aerial photogrammetry combined with terrestrial photogrammetry enabled the acquisition of geometric information of the exterior, which presents precisely in this case a level of complexity in survey operations due to the included lot that the theatre occupies.

The integration of laser scanner and drone-based survey campaigns allow, therefore, an accurate and complete restitution of the architectural

Fig. 7 - The point cloud obtained through UAV survey.





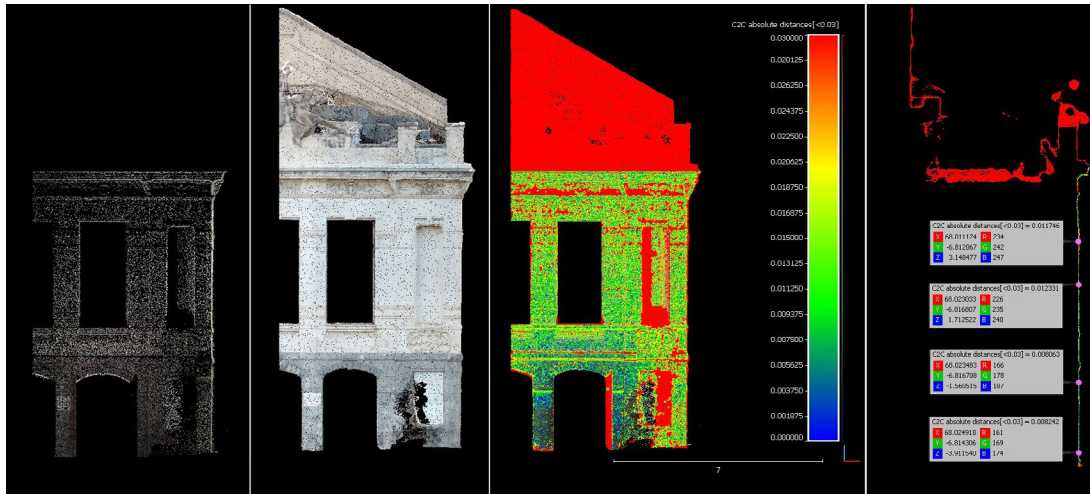


Fig. 9 - C2C analysis between UAV and BLK360 point clouds. From the left: the point cloud obtained through LIDAR; the point cloud obtained through aerial photogrammetry; C2C analysis; C2C analyses of a vertical slice.

object under investigation. Two point clouds were obtained: one from the terrestrial laser scanner and the other one through drone photogrammetry. To evaluate the accuracy and the reliability of the TLS and UAV models obtained, some metric and visual analyses are proposed. The comparison was performed using the open-source software CloudCompare, taking advantage of the Cloud-to-Cloud algorithm (C2C). This tool makes it possible to analyse both qualitatively, by means of a gradient, and quantitatively, by measuring in metres, the deviation between different clouds. After being aligned, the two clouds have been unified to make them comparable to obtain a reliable analysis. In doing this, a portion of the building in which the two clouds overlapped as much as possible was chosen. Once this portion was identified, we proceeded to segment the clouds and reduce the number of points. Indeed, it is important in these analyses that the two clouds be comparable in terms of the number of points. To achieve this, the point cloud from photogrammetry, which was very dense, was

reduced by more than 70 percent. Doors and windows were also eliminated in the analysis, as they are not accurate as a reference. The BLK360 point cloud was chosen as the reference cloud because it is characterised by higher accuracy. The comparison was performed by analysing the global accuracy of the entire point cloud. The global comparison shows that most deviations range from 0 mm to 2 cm (blue and green points). Larger deviations (red points) occur where the drone point cloud is missing, especially at overhangs, doorways and roofing. [Fig. 9]. Once the accuracy of the survey was tested, it was possible to extract portions of the cloud in the form of slices. Such elaborations allow the two-dimensional restitution of the geometry of the theatre, making it possible to read the spatial articulation of it. In addition, through these elaborations, it is possible to deduce some dimensions that without the integrated survey would be impossible to obtain, such as the size of some floors or the thickness of those walls not surveyable by direct method.

## 6. RESULTS

The methodological workflow adopted for the case study presented here demonstrates the validity and the utility of an integrated approach of metric acquisition to obtain a complete three-dimensional model, suitable for geometric, morphological, and material analyses and, generically, preparatory to future projects on the built environment.

If, on the one hand, the photogrammetric survey makes it possible to obtain, quickly and at low cost, point clouds that complete and integrate the data missing from the single use of a terrestrial laser scanner, especially if the photographic acquisition is made from a drone, on the other hand, the TLS point cloud is more accurate, although it requires higher acquisition and post-processing times. Figures 10-11-12 show the comparison between the two-dimensional digital data, i.e. between the orthophotos obtained from the TLS point cloud and the final point cloud resulting from the integration of the two survey fields.

Fig. 10 - Orthophoto of the main façade of the Teatro Massimo Bellini in Adrano. On the left, UAV point cloud, on the right, TLS point cloud.





Both the façade and the two sections, cross-sectional and longitudinal, show how the integration of the two proposed surveying methods completes the metric data acquired and relates the theatre's internal articulation with the system of roofs and buildings bordering the monument. A visual analysis of the two orthophotos of the main façade (Fig. 10), obtained from the drone and laser scanner point clouds respectively, shows the need for an integrated approach. The drone survey is functional for the completeness of the elevation survey, in architectures with overhanging volumes, such as the façade of the theatre in Adrano. For example, the gable between the two pitches of the roof is totally absent in the laser scanner survey and, instead, surveyed fully, thanks to the drone photographic acquisition, as is the case for the roofing system, as can be seen from the metric and visual analyses presented above. The critical interpretation of the acquired data was finally oriented to the two-dimensional drawing (plans, elevations, sections) of the current state of the site (Fig. 13), for updating and enriching the current two-dimensional graphic documentation.

## 1. CONCLUSIONS AND FUTURE DEVELOPMENTS

The goal achieved by this research is the spatial and formal knowledge of a theatre built in Sicily in the early 19th century, according to the 'Italian model,' which testifies to the vibrant artistic and cultural environment of the island. The methodology of investigation, based on the integrated inspection of the few documentary sources retrieved and the data acquired through the integrated survey, allowed the diachronic reconstruction of the theatre and the acquisition of a 3D model that becomes, through drawing, a critical tool to deepen and disseminate knowledge. The integration of the data acquired through LS3D and UAV allowed the merging of the internal and external environment such that in the future, through an interdisciplinary comparison, the restoration interventions that have taken place

over the years can be related. In addition, the graphic restitution of the planimetric layout obtained from the LS3D survey constitutes material on which to conduct future studies on the geometric tracing of the stalls. The results obtained will be compared with some coeval theatres designed in the Island, the survey of which has already been carried out. The comparison of the surveyed theatre architectures will be useful for understanding the figures of the designers working in the field, the innovative techniques used and the comparison of the design choices implemented with the rules dictated by the manuals of the time.

Fig. 11 - Longitudinal section. Above, TLS point cloud, below, final point cloud obtained from the integration of TLS and UAV point clouds.



### NOTE

[1] The documents kept in the historical archives of the Regional Archaeological Museum of Adrano show in detail the map, in which the boxes are assigned to the most important families of Adernò [Bibl. Vincenza Rosa Inzerilli, Il Teatro Vincenzo Bellini di Adrano, Tipolitografia Ricca, Adrano 2017]

### AUTHOR CONTRIBUTIONS AND ACKNOWLEDGEMENTS

The editorial responsibility of this essay is as follows:  
paragraphs 1, 3 to M.G.;  
paragraphs 2, 4, 6 and 7 to G.D.;

paragraph 5 to R.G.

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The activity in situ of photogrammetric survey with the DJI mini2 drone was performed with the technical contribution of Arch. M. Bertolone.

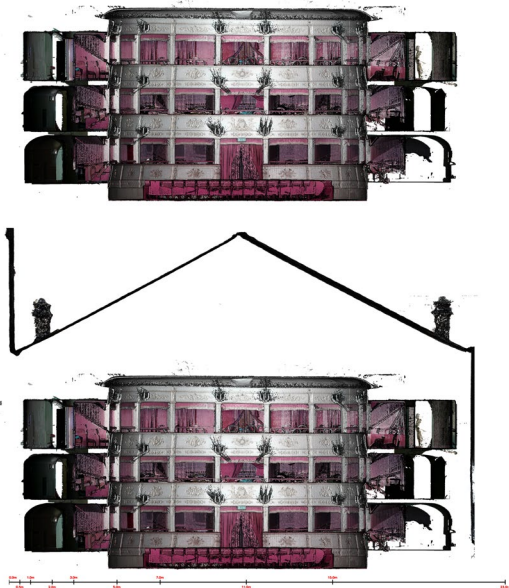


Fig. 12 - Cross-section. Above, TLS point cloud, below, final point cloud obtained from the integration of TLS and UAV point clouds.

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Fig. 13 - 2D representation of the main façade of the Teatro Massimo Bellini in Adrano, obtained from the integrated digital survey (2022)

