Ana Kontic
Ana Kontic, graduated from the University of Belgrade, Faculty of Architecture, is a PhD candidate employed as a Teaching Assistant in the same school. Ana's research interests are in the field of constructive protection of cultural heritage. She is a participant of several international and domestic workshops and conferences, and is the author of a few articles in the field of digital documentation of architectural heritage.
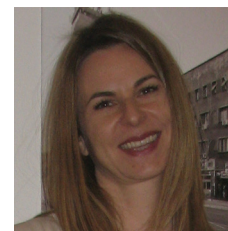
Renata Jadresin Milic
Renata Jadresin Milic is an architect and architectural historian, a Senior Lecturer at School of Architecture, Unitec Institute of Technology, New Zealand. She holds undergraduate and postgraduate architectural degrees, an MSc and a PhD. She is the author of research papers in international journals, chapters in monographs, and she presented at a number of conferences held in Europe, the US, Australia, and New Zealand.

Rade Mrljes
Rade Mrljes is an architect - conservator, PhD student and employed at the Cultural Heritage Preservation Institute of Belgrade. He focused his interest on the research on the protection of cultural heritage in the context of contemporary urban planning. He participated in many international workshops, seminars and conferences.

Defining the methodology of integrated research in the process of digital documentation of architectural heritage: case study Lizori, Italy

The aim of this paper is to define the methodology of integrated research in the process of digital documentation of architectural heritage. The thematic framework of this work was stimulated by participation in a professional workshop in Lizori, Italy, held in June 2018. The paper presents a result based on the integration of traditional and instrumental methods of heritage surveying. This specific method of integrated research uses a variety of tools, in the process of morphological specifications of different parts of a historic building. The specific nature of architectural heritage requires the integration of different methods in order to achieve a high level of accuracy. The Lizori digitisation project, on the one hand, aims to present an almost unknown historical heritage through multimedia valorisation, and on the other, to set up an information tool for restoration, maintenance and valorisation.

DISEGNARECON volume 12/ n. 23 - December 2019   EXPERIENTIAL DESIGN FOR HERITAGE AND ENVIRONMENTAL REPRESENTATION   KONTIC - JADRESIN MILIC - MRLJES   2.2

ISSN 1828-5961   Defining the methodology of integrated research in the process of digital documentation of architectural heritage: case study Lizori, Italy

INTRODUCTION

The use of digital technologies in heritage projects and academic research is becoming increasingly topical worldwide. This is confirmed in editions of the influential *Journal of the Society of Architectural Historians* (JSAH, November 2017 and the more recently in 2018 and 2019) with texts that raise this topic, and ask many questions about: Digital technologies as a New Evidence in Architectural History today?; and: How have Digital media altered what we consider evidence and the ways we employ it for scholarship (Morton, 2017). This demonstrates that highly regarded academic institutions now acknowledge the academic and practical value of these developments; that we have entered an age in which our discipline can be immeasurably assisted, enriched, and sometimes transformed by the advent of accessible, low-cost, and increasingly user-friendly technologies. These tools enable us to identify evidence that was not previously visible or accessible, synthesize and map geographically and chronologically referenced data points with precision, fuse databases to combine information from secondary sources that in turn generate a new type of data, and test hypothesis through 3D models and animations. The potential tools include the following: 3D laser scanning that can be used to produce exact recordings of the dimensions and materials of monuments; Photogrammetric 3D models of buildings, sites and objects that can be generated with ordinary cameras (including those on portable devices); and HBIM (historic building information modeling) software that can embed historical information within 3D scans and photogrammetric models (Bruzelius, 2017).

Although BIM has been applied widely for a number of years at an international level in new-build construction and with numerous relevant publications and online content, BIM for heritage assets (HBIM) is a relatively new field of academic research and appears less popular in terms of adoption by heritage professionals (Historic England). However, heritage projects typically rely on multi-disciplinary collaboration: a number of experts and specialists contribute, exchange and interpret complex information and data about a heritage asset to inform the understanding of its value and significance. This understanding is crucial for decisions on future interventions, conservation and management, so the quality of information for this multi-disciplinary knowledge base is crucial for heritage projects (Chiabrando et al., 2016; Beltramo et al., 2019). Poor information (inaccurate, incomplete or uncoordinated) often leads to errors, which can be detrimental to the historic asset, its value and significance.

The aim of this paper is to present the methodology of integrated research in the process of digital documentation of architectural heritage. A key focus is the integration of different research methods and their position in the process of digital documentation. The paper explains the methodology of integrated research through literature analysis and a case study of Lizori, Italy, assuming that the methodology and its application in the case study can be instructive and inspiring in further research and documentation of architectural heritage. The primary objective of the paper is to identify, explain and analyse the data collection methodology applied in the Lizori case study as an integral part of the digital documentation process of architectural heritage, through the systematisation and interpretation of the methods used. According to the stated goals of this research, the starting hypothesis is defined:

- Through its interdisciplinary platform for studying architectural heritage, the methodology of integrated research enables comprehensive and in-depth documentation of spatial, structural and design characteristics of historic buildings. Considering the specificity of architectural heritage, the methodology of integrated research also adapts to the different morphological characteristics of their individual elements by combining and integrating traditional and digital practices.

The following research tasks are further defined to allow systematic research, from literature analysis to understanding the data collected in the specific spatial framework of this case study:

- collection, analysis and systematization of data obtained from literature in the context of a previously defined methodology;
- analysis of previously obtained data through a case study;
- understanding of the methods used.

The goals and objectives of the research are designed in order to enable a clearer understanding of the methodology of integrated research for the purpose of digital documentation of architectural heritage, taking into account its specific nature. The results of the research should point out the importance of an integrated research methodology, as well as the reasons for using each of the individual methods.
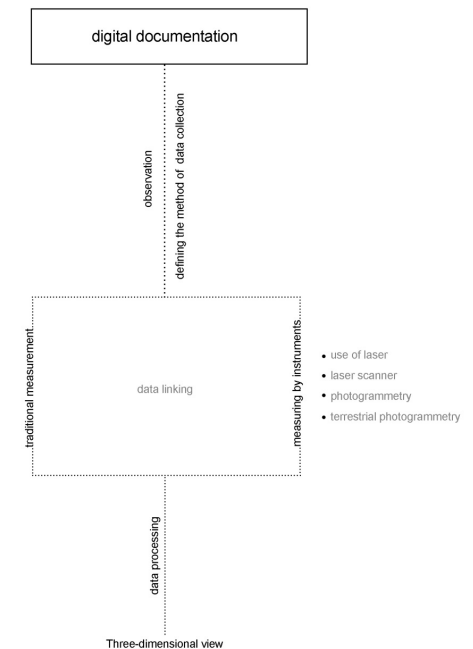

Fig. 1 - The scheme of the process of integrated research in the digitalization of heritage (author, 2018).

DISEGNARECON   volume 12/ n. 23 - December 2019   EXPERIENTIAL DESIGN FOR HERITAGE AND ENVIRONMENTAL REPRESENTATION   KONTIC - JADRESIN MILIC - MRLJES   2.3

ISSN 1828-5961   Defining the methodology of integrated research in the process of digital documentation of architectural heritage: case study Lizori, Italy

METHODOLOGY OF INTEGRATED RESEARCH

Builders have always been attached to drawing, intuitively creating canons to represent a conceived space or creative idea (Petrović, 1972, 9). The drawing itself represents one of the oldest expressive skills of man, and probably the oldest communication tool of humanity. The methodological advancement of 3D modeling techniques, with the aim of simplifying visualization and graphical transcription into a 2D plan, today represents new ways of presenting architectural heritage. In the process of visual transcription based on the use of digital tools, the drawing moves from its traditional position, defined by the graphic of expression and awareness of the sign; 3D modeling tools go beyond graphics, and drawing becomes a multi-scalar model that contains all the possible views and

ways of presenting a historic building (Amoruso et al., 2016). Furthermore, international charters emphasize the importance of documentation in the process of identifying, preserving and managing of cultural heritage. UNESCO (*United Nations Educational, Scientific and Cultural Organization*) in its "Recommendation on the Historic Urban Landscape", issued in 2011, states that: "Knowledge and planning tools should help protect the integrity and authenticity of the attributes of urban heritage. They should also allow for the recognition of cultural significance and diversity, and provide for the monitoring and management of change to improve the quality of life and of urban space. These tools would include documentation and mapping of cultural and natural characteristics. Heritage, social and environmental impact assessments should be used to support and facilitate decision-making pro-

cesses within a framework of sustainable development" (UNESCO, 2011). Therefore, the advantage of integrated research methodology is its ability to adapt to the different morphological characteristics of the elements that make up historical construction. All the specificity and complexity of the architectural heritage is reflected in the complexity of the methodology of integrated research, and the scope of multi-layered action within the methodology must first be considered. Each drawing, architecturally defined, is an architectural drawing. The digital documentation of the architectural heritage provides space for the expressive quality and authenticity of the building, thereby indicating, sharing and preserving the heritage. Some of the goals of the digital documentation process for architectural heritage are:

- *Replace physical archives with digital documents:* The use of digital technologies produces information available for use in scientific, educational and informational purposes. By converting data sets into electronic form, by forming an electronic archive, buildings protect against physical degradation over time, but also allow automatic duplication of data, which increases the degree of protection and security against data loss.

- *Use digital data for various scientific analyses and tests:* The 3D digital model contains a collection of historical building information. This increases the accessibility of heritage to the public and creates space for the expression of cultural significance and diversity. Three-dimensional modelling enables the reversibility of the virtual restoration process, thus becoming a platform for exploring and testing different approaches to find adequate solutions and interventions.

- *Understand, present and learn about the qualities of architectural heritage:* Three-dimensional modelling allows manipulation and detailed observation of the historic building. Continuous accessibility becomes one of the major benefits of analysing, reviewing, and ultimately, interactive learning and familiarisation with historic buildings.

Fig. 2 - Lizori

DISEGNARECON   volume 12/ n. 23 - December 2019   EXPERIENTIAL DESIGN FOR HERITAGE AND ENVIRONMENTAL REPRESENTATION   KONTIC - JADRESIN MILIC - MRLJES   2.4

ISSN 1828-5961   Defining the methodology of integrated research in the process of digital documentation of architectural heritage: case study Lizori, Italy

The sequence of defining the digital documentation activities path of a historic building, from observation to its three-dimensional representation is presented in the following scheme (fig. 1). The first step in the process is observation and definition of morphological characteristics of the building, ''recognizing connections and relations'' according to which groups of elements where the same method can be applied are identified.

A brief overview of the features used in the methodology of integrated research is presented below:

- *Traditional measuring*: Method of direct data collection. It requires the use of a measuring tool, as well as the entry of the data obtained in a previously formed sketch, which contains the basic characteristics of the element; the sketch represents the most significant details of the element observed.

- *laser measuring*: The measuring instrument is a laser, which provides data like an ordinary meter but requires less time. Works on the principle of point and laser. Once activated, the instrument sends a laser signal to the obstacle, and obtains information about the distance of the sent point from the zero points of the laser, in the body of the instrument. The process is from element to element.

As with traditional measurement, there is no automatic memory of the data, so it is necessary to enter the obtained data, in the sketch above, with the main morphological characteristics of the space.

- *Laser scanner*: The measuring instrument is a scanner. An advancement on the classic laser principle. The main difference is that the emitted point is not a 2D point, but a 3D cloud, a point defined by three coordinates. Point cloud, for each broadcast, is stored in the device, so data does not have to be written manually. The result is an orthophoto display, which shows the characteristics of the assembly, without color display, a monochromatic display by which we read the surfaces, levels, and spatial dimensions of the assembly (Historic England, 2018).

- *Photogrammetry*: Photogrammetry is a process of photo processing, which gives the spatial dimensions, shape and position of the spatial structure in the real world. A method of collecting three-dimensional information, by the recording process. The goal of photogrammetry is to reconstruct the captured 3D space. The geometry of the object is reconstructed. This method allows for a complete

analysis of the observed phenomenon and object, with reliable color data (Historic England, 2017).

- *Terrestrial photogrammetry:* This is a combined method of laser scanner and photogrammetry, where data on dimensions, shape, position and color are obtained. The result is an orthophoto view, which uses a technique of overlapping photographs (photogrammetry), as well as point clouds for defining spatial dimensions, and by recognizing characteristic points that define the geometry of a building, a synthesised view is obtained.

The three main criteria for selection of the appropriate method (for a particular group of elements) from the previous table are connected with the following questions:

1. What is the defined purpose of that particular measuring for which the research is conducted?
2. What is the required quality and precision, since each method produces data of varying degrees of accuracy?
3. What is the morphological characteristic of the heritage building?

The methodology of integrated research is able to adapt to the specifics of the elements that make the historic building. The overall organization of the presentation of the morphological characteristics of a building is based on the division of elements of the assembly by their specificities, so that an appropriate method for data collection is defined for each group:

- *Group 1*: It consists of simple geometric elements (walls, columns), to which the method of photogrammetric testing is applied. The data are obtained from a set of photographs.

- *Group 2:* This group includes elements of the assembly which are of a simple plan. The use of laser scanning and manual laser for obtaining more accurate information. Also, to obtain the base of the roof, and to form the cross-section of the object, a drone with a laser is used. This provides a series of data on each point cloud sent. Since every three such points form a surface, the result is a

Fig. 3 - Lizori (Private archive, June 2018)

Fig. 4 - Lizori-studio (Private archive, June 2018)

DISEGNARECON   volume 12/ n. 23 - December 2019   EXPERIENTIAL DESIGN FOR HERITAGE AND ENVIRONMENTAL REPRESENTATION   KONTIC - JADRESIN MILIC - MRLJES   2.5

ISSN 1828-5961   Defining the methodology of integrated research in the process of digital documentation of architectural heritage: case study Lizori, Italy

3D drawing showing all the points where the scanner defined the geometry.

- *Group 3:* The third group refers to the structural and decorative elements, which can best be examined by traditional methodology and tools, where accurate formal and morphological characteristics are defined.

CASE STUDY: LIZORI, ITALY

The imaginary name Lizori was created about 40 years ago, and was assigned to a hamlet in the municipality of Campello sul Clituno, in Perugia, Umbria. The present-day name for the former hamlet of St. Benedict consists of three syllables, each of which has its own meaning: "Lì" - the affix for the place, in Italian, means "there"; "Zo" - the old form of the Greek verb "to live"; "Ri" - the conjunctive of the Greek verb that means "to see." So, the name *Lizori* means "There where life sees'' (Menghetti Foundation, 2012).

Lizori has historically been a refuge for many segments of imperial Roman society: a resting place for emperors and popes, and a military stronghold within the walls bounded by the city of Spoleto (Spoleto), Trevi (Trevi), and Foligno (Foligno). In the Middle Ages, a settlement, whose structure we still recognize today, was built on this site - a terraced triangular fortification bounded by walls, with residential buildings in parallel streets, and the main tower at the highest point. In Italy, Lizori is a rare example of the three-cornered slope castle that has been perfectly preserved (Fondazione di Ricerca Scientifica ed Umanistica Antonio Meneghetti Borgo Lizori, 2019).

Neglected and abandoned in the 1970s, Lizori disintegrated into a pile of rubble. However, the Italian artist and philosopher, Antonio Meneghetti, recognizing the cultural significance and identity of this approximately 2700 year old settlement, began the process of reconstruction (fig. 2).

The entire recovery of Lizori was made possible by the initiative of a group of engineers, architects and artisans, in coordination with Menegeti.

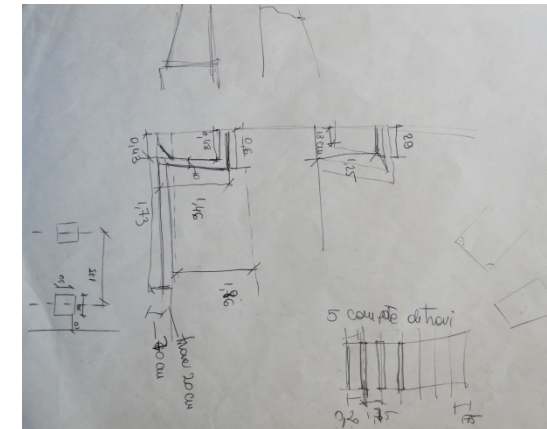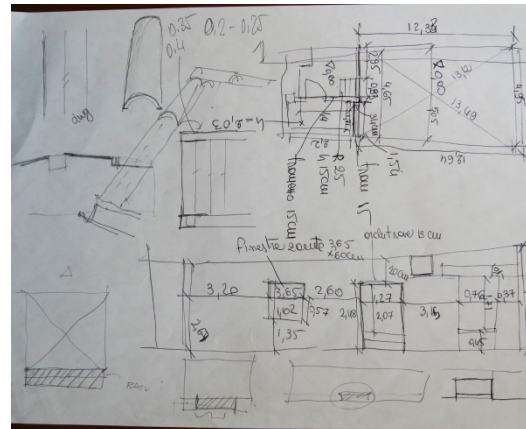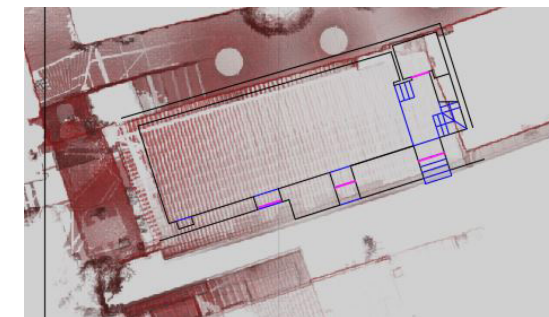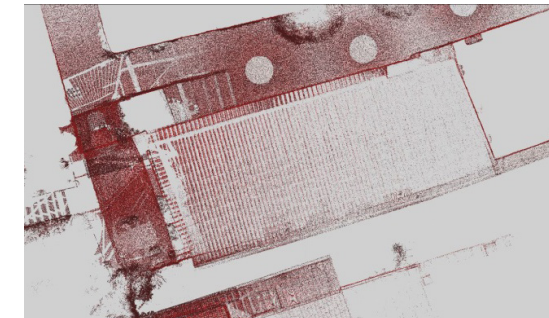Recovery has been achieved restoring historical and architectural value to space, which over time

Figg. 5 and 6 - Field sketches (Alessandra Tata, 2018)

Figg. 7 and 8 - Laser scanning measurement. Laser scanning – overlapping results (author, 2018)

has has become an art, cultural and educational laboratory.

In June 2018, an architecture professional workshop - summer school was organized in Lizori, with practical and theoretical modules that provided both taught and hands-on experience, with many opportunities for discussion, debate, and learning. The project was designed and organized by INTBAU Italy (INTBAU Italia), a part of the INTBAU platform, which promotes heritage, traditional architecture, and encourages local character to create a better place to live (INTBAU, 2011).

An international program, "Cultural Landscape and Heritage Skills", organized in Lizori, supported by the University of Perugia (Università degli studi di Perugia), the Politecnico di Milano (Politecnico di Milano), the Italian Ministry of Culture and Tourism (Ministero dei Beni e delle Attività Culturali e del Turismo), brought together participants from New Zealand, the Netherlands, Italy and Serbia. The programme was recognised as one of the major events for the European Year of Cultural Heritage 2018. The participants were tasked with starting the digital documentation process for Lizori.

Work on measured and freehand drawing, digital heritage skills, three-dimensional modelling, computer graphics, and cultural heritage

DISEGNARECON   volume 12/ n. 23 - December 2019   EXPERIENTIAL DESIGN FOR HERITAGE AND ENVIRONMENTAL REPRESENTATION   KONTIC - JADRESIN MILIC - MRLJES   2.6

ISSN 1828-5961   Defining the methodology of integrated research in the process of digital documentation of architectural heritage: case study Lizori, Italy

Fig. 9 - Photogrammetry (author, 2018).

Fig. 10 - Photogrammetric points (author, 2018).

communication was supplemented by field and software work in 3D laser scanning – point clouds, photogrammetry and B.I.M. technology.

The results are expected to be published in the *Lizori Pattern Book (Codice di Lizori)*.

The international programme "Cultural Landscape and Heritage Skills" aspired to the following objectives, divided into analogue and digital surveying practices as a method to cataloguing and upholding the preservation of one of Italy's "rarest slanting, triangular castles" (Fondazione di Ricerca Scientifica ed Umanistica Antonio Meneghetti Borgo Lizori, 2019):

1. Rilievo a vista – Observational Drawings
2. 3D Capturing – Laser Scanning and Photogrammetry
3. 3D Modelling – BIM/Parametrics.

DATA COLLECTION: METHODS

The specificity of Lizori, the geometric characteristics of its buildings, the methods of construction, the material used, as well as the disposition of the buildings, altogether indicate the complexity of the digital documentation of Lizori. In order to properly represent the characteristics of Lizori, the first step was to interpret the spatial characteristics and built architecture as the basis for interpreting built elements with a three-dimensional representation. To address appropriately this complexity, it was necessary to clearly identify all the elements, to understand their specificities, and to define appropriate methods for data collection. The process of digitisation of one of the buildings is presented in this paper.

This one storey building consists of the ground floor with a workspace - a studio, in which theoretical and practical classes were organized during the programme (fig. 4). On the first floor, there is a conference room. The building covers an area of approximately 40m2. The recording of the building's multitude of details, both interior and exterior, was organised into four groups:

*   *Group 1*: The first group is related to manual laser shooting, where both levels were taken. In addition to the measuring, it was necessary to have a sketch of the level where the measured data was recorded. The biggest disadvantage of this method is that it was suitable only for the interior. The three layers of the stone wall had different thicknesses. Thus the inner and outer edges of the wall were not parallel, and it was not possible to precisely determine the dimensions of the building with the laser used in the interior (fig. 5 and fig. 6).

*   *Group 2*: This group includes plans and elevations obtained by laser scanning. Due to the vertical shortening, laser scanning is an adequate way of taking external elevation measures which defines the highest geometry points. They have the coordinates, on the basis of which information about the exact heights is obtained. Also, the use of the drone gives information about the plan, and

DISEGNARECON   volume 12/ n. 23 - December 2019   EXPERIENTIAL DESIGN FOR HERITAGE AND ENVIRONMENTAL REPRESENTATION   KONTIC - JADRESIN MILIC - MRLJES   2.7

ISSN 1828-5961   Defining the methodology of integrated research in the process of digital documentation of architectural heritage: case study Lizori, Italy

all the spatial dimensions in the plan, which cannot be obtained by direct measuring. Figure 7 shows the laser scanner results obtained with the help of a drone, showing the roof plan. However, when these results are overlapped with previously obtained data from the laser method (fig 8), the two data do not match. This demonstrates the essential benefits of integrated research, as by simply overlapping the results obtained by different methods, taking into account the possibility of errors in each method, a higher degree of accuracy is obtained.

- *Group 3*: The third group consisted of surfaces that are characterized by colors, textures, and shapes. The photogrammetry method was applied here which records data on the shape and structure. Also, the photogrammetry method was used to collect data on the decorative glass partition, since color and ornament are the main characteristics of the element.

Photogrammetry works on the principle of points, whereby photos are formed, which the program recognizes as a set of points. The points recorded in multiple photos are recognized as common points, merged, and they form a model. For that reason, it is important that the photographs used in the photogrammetry method overlap one relative to the next one 40%. Specifically, at least 40% of the information in one photo must be found in the next, in order for them to be properly combined in the process of model formation (Historic England, 2017).

- *Group 4*: The fourth group consisted of decorative elements, specific in their characteristics, where the most accurate method was the traditional measurement. This method was used to model the fence, where the element was first observed, then sketched, and entered directly in the sketch. After that, modelling was done in Revit, and it was included with other parts of the model.
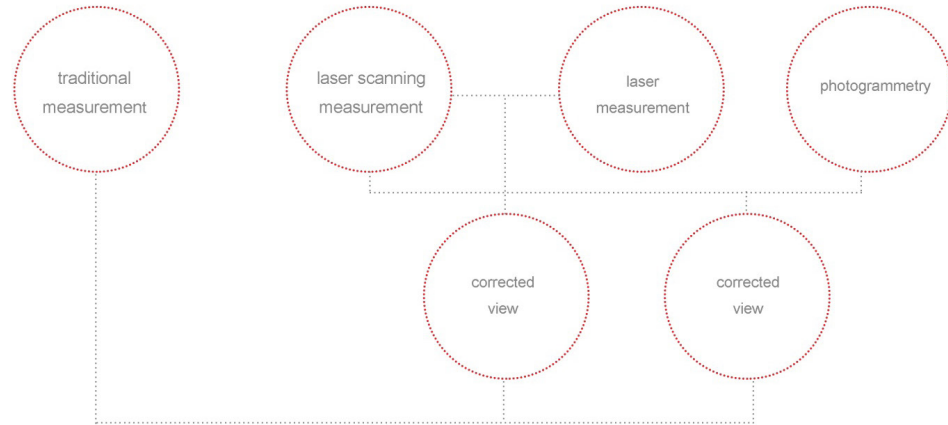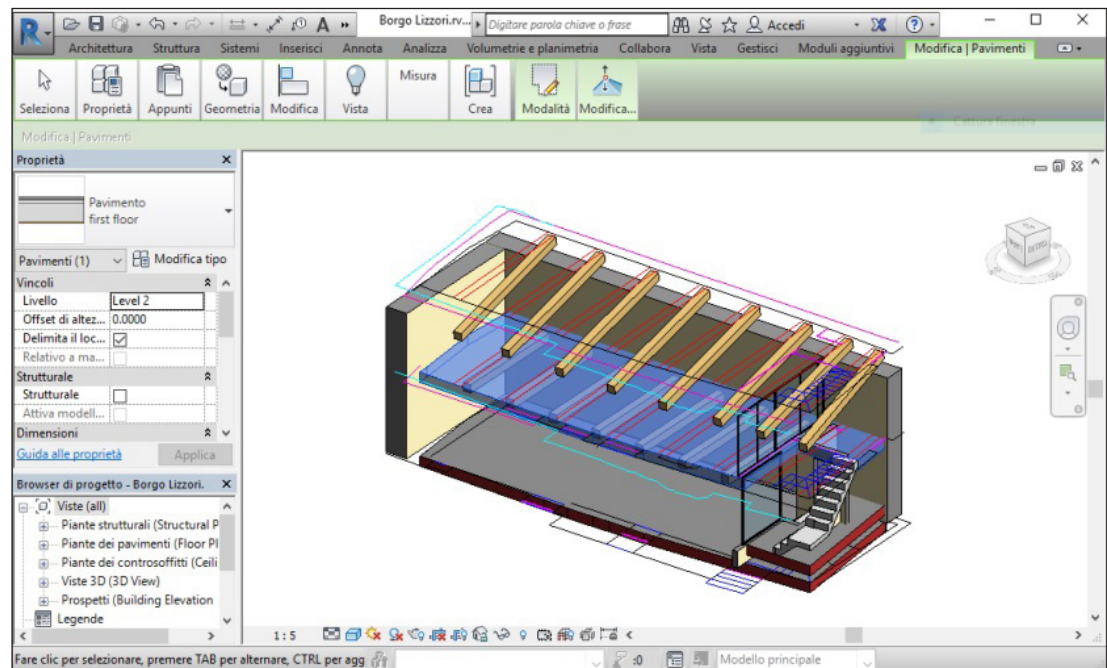

Fig. 11 - Scheme of the methodology applied (author, 2018).

Fig. 12 - Immediate results (author, 2018).

DISEGNARECON   volume 12/ n. 23 - December 2019   EXPERIENTIAL DESIGN FOR HERITAGE AND ENVIRONMENTAL REPRESENTATION   KONTIC - JADRESIN MILIC - MRLJES   2.8

ISSN 1828-5961   Defining the methodology of integrated research in the process of digital documentation of architectural heritage: case study Lizori, Italy

EVALUATION OF THE METHODS APPLIED

"If we tell a person to describe an object, he will solve the problem by describing all the simple elements of the object with all their attributes and character, and their relationships" (Siza, 2006, 15). This quote of Alvaro Siza describes the beginning of the process of creation of a 3D model. 3D modelling is the creation of a three-dimensional model that represents a real or imagined spatial structure. The methodology of integrated research involves the use, and then the integration of different methods of data collection. The case study clearly shows the flow of data collection and the need to combine one method with another. The complexity of the methodology is in that very integration of the various actions taken, with a goal to maximizing the accuracy and comprehensiveness of presentation of a historic building.

The use of digital technologies makes it possible to identify, synthesise and map reference data through a 3D model. This implies research, testing, analysis of each suitable method, and careful organisation of the research according to the possibilities and disadvantages of each applied methodology. One of the important steps is precisely defining the possibilities and disadvantages of each method used, and in this context, determining the appropriate research plan.

CODA - CONCLUDING CONSIDERATIONS

The methodology of integrated research in the process of digital documentation is presented in this paper. It is first described through analysis, breakdown into methods, and through the criteria for selection of each method. In the following chapter, through the Lizori case study, previously conducted analysis of the methodology is presented on a concrete example. It has been confirmed that this methodology is actually a platform on which, using different methods, the historical building in detail can be examined and the data obtained can be systematized.

With the digitization of the architectural drawing, the field of its activity was expanded, and thus

method	opportunities	disadvantages
traditional measuring	Allows immediate data collection. It does not depend on the morphological characteristics of the element. The possibility of an error depends on the one who collects the data.	It takes a considerable amount of time, with the preparation of the sketch on which the data is written. It often requires an additional member to reduce data collection time. The possibility of an error depends on the one who collects the data..
laser measuring	Reduces data collection time compared to traditional measurement. Suitable for interiors. Independent work is possible.	Error is the same at 20cm and 200m. It requires preparation of the sketch since there is no possibility of storing the data. As the only method, it is not suitable, but rather as a method of initial data collection.
laser scanner	A suitable method for recording architectural heritage. It does not depend on the complexity of the object. It stores data, which is defined by three coordinates. Suitable for measuring elevations. (Historic England, 2018)	Bright light and shade can interfere with recording and influence negatively recognizing of geometry. The financial aspect is not negligible. (Historic England, 2018)
photogrammetry	The only tool is the camera. It faithfully displays colors, and the possibility of geometric error is minimized. A method that does not require large financial investments. (Historic England, 2017)	The way of taking photos is specific. It is necessary to take photographs at certain times, preferably before 9.00 am. Strong shadows interfere, as does vegetation. All photos must be taken with the same camera and in the same series. (Historic England, 2017)

Tab. 1 - A Comparative overview of the methods used(author, 2018).

DISEGNARECON   volume 12/ n. 23 - December 2019   EXPERIENTIAL DESIGN FOR HERITAGE AND ENVIRONMENTAL REPRESENTATION   KONTIC - JADRESIN MILIC - MRLJES   2.9

ISSN 1828-5961   Defining the methodology of integrated research in the process of digital documentation of architectural heritage: case study Lizori, Italy

the experimental possibilities of various forms of visual research were expanded (Kovač, 2017). In a digital environment, drawing becomes open to accepting the features of virtual space (Kovač, 2017, 197). Digital documentation requires and encourages collaboration across disciplines and, therefore, dialogue and knowledge sharing can enrich and stimulate research questions. Visualization is an example of the collaboration of historians, architects, engineers, and as such opens up various fields and aspects of research and examination, in order to advance knowledge of the importance and quality of architectural heritage.

Through the example of Lizori, a multi-layered and rich historical and architectural asset, one can see the complexity and wide range of methods used to digitize the heritage. At the same time, the importance of such complex research is recognised as the only true way to test the quality of a historic building. Seen as a specific research methodology, digital documentation is the result of combining methods, each of which anticipates certain findings.

This project was an introduction to the topic of integrated research for the team. It provided basic guidelines and developed basic skills, but most significantly, pointed to the importance of collaboration between different disciplines, and combining knowledge and different aspects of observing historical buildings.

At present, information about historic buildings is usually represented as a collection of individual documents, reports, drawings, computer-aided design (CAD; 2D or 3D) files, and various data provided by different professionals, each working with their own tools and standards (Historic England, 2017). Information about a single historic building can be dispersed across a number of locations (electronic data repositories, databases and physical archives) and in various formats (paper and electronic).

The status and quality of individual pieces of information may be unknown (superseded, uncoordinated or incomplete).

In many cases, there is no single source of reliable and consistent information about a heritage

Fig. 13 - Collage.

asset. It means that B.I.M. really can be seen as a solution for historic information management. It allows the structured integration of both geometric and non-geometric information (including tangible and intangible values); and external documents into a single model, becoming a central hub for all information relating to a historical asset (Historic England, 2017).

Ultimately, it is the overriding merit of this approach that provides a strong rationale for its use.

RESULTS OF LIZORI SUMMER SCHOOL

Participants got a strong understanding of Umbria's diverse history, culture, traditions, art, planning initiatives, and architectural practices. One day of the programme was organised in Norcia and was devoted to issues of resilience and vulnerability of places after a natural disaster (fig. 13). Analogue surveying was introduced on that first practical day in Norcia - a small town south of Lizori, the birthplace of St. Benedict. In 2016 the town endured two earthquakes, destroying the majority of the significant buildings. Partici-

DISEGNARECON   volume 12/ n. 23 - December 2019   EXPERIENTIAL DESIGN FOR HERITAGE AND ENVIRONMENTAL REPRESENTATION   KONTIC - JADRESIN MILIC - MRLJES   2.10

ISSN 1828-5961   Defining the methodology of integrated research in the process of digital documentation of architectural heritage: case study Lizori, Italy

pants visited several construction sites (including the Basilica of San Benedetto) with professional guidance and got acquainted with techniques of damage identification, the significance of digital documentation and the approach to the static rehabilitation of damaged buildings. Immediately after that, all participants were given the task to conduct field recording of the damaged object of their choice around the central area of the town, and to identify the damage according to the instructions. On the same day, a tour of the small medieval town of Castelluccio di Norcia that was also severely damaged in the earthquake was organized. Rilievo a vista – Observational Drawings. Participants performed measured drawings, observational sketching and typological survey of Lizori street elevations (fig. 14). They also practised the observational drawing of the Temple of Clitumnus, a small paleochristian church (UNESCO World Heritage Site from 2011).

All the surveys and recordings were made in the town of Lizori. Participants had field and software training of 3D laser scanning - point clouds, photogrammetry and B.I.M. technology (which, in addition to 3D images and displays, provides the creation of a database of the object itself through recording and modelling). The participants were divided into teams that were assigned different tasks, with the common goal to create a Pattern Book of Lizori. The outcomes of the international program "Cultural Landscape and Heritage Skills" were technical drawings, 3D models, orthophoto, 3D point cloud processing, digital panoramas, freehand sketched and watercolour wash. The combination of individual projects, group work, and one-to-one support from tutors provided a unique learning experience for participants (fig. 15).

Figg. 14 and 15- Collage (Private archive, June 2018).

Fig. 16- Assisi conference- participants and annunciation (Private archive, June 2018).

DISEGNARECON   volume 12/ n. 23 - December 2019   EXPERIENTIAL DESIGN FOR HERITAGE AND ENVIRONMENTAL REPRESENTATION   KONTIC - JADRESIN MILIC - MRLJES   2.11

ISSN 1828-5961   Defining the methodology of integrated research in the process of digital documentation of architectural heritage: case study Lizori, Italy

The International Open Conference "Cultural Heritage In Practice" was organized in Palazzo Bernabei, L'Universita degli Studi di Perugia in Assisi. Participants joined the Open Conference in Assisi where they had the chance to interact with the panel of visiting keynote speakers. Their active participation was a way to encourage debate on the process and make them aware of the contemporary practices in Italy. Participants were invited to share and present their work during the final review, as well as in Assisi. A final document - a Pattern book of the town of Lizori, was drafted and released: it is preliminary documentation of the landscape and built environment features and character. The Pattern Book will in the future serve as a model for identifying and recording spatial cultural and historical sites, and to form a database of architectural and urban heritage.

REFERENCES

Amoruso, G. (2009). Historical Centers Rehabilitation: Documentation, Survey and Communication Achieving Sustainable Development and Seismic Protection, Disegnarecon 2(2)

Amoruso G. & Manti A. (2016). A BIM for the identity of historic urban landscapes, Disegnarecon, Vol9(16), L'Aquila, 17.1-17.7.

Amoruso, G. (2018). Rilievo a Vista. Lecture, Borgo Lizori, Perugia, Italy, June 22th 2018

Amoruso, G. (2018). Welcome to the International Summer School. Lecture, Borgo Lizori, Perugia, Italy, June 20th 2018

Brusaporci, S., Maiezza, P. & Tata, A. (2018). A Framework for Architectural Heritage HBIM Semantization and Development. The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, Volume XLII-2.

Brusaporci, S. The Representation of Architectural Heritage in the Digital Age, in: Mehdi Khosrow-Pour (Ed.) Encyclopedia of Information Science and Technology, Third Edition.

Beltramo, S., Diara F., Rinaudo F. (2019). Evaluation of an Integrative Approach Between HBIM and Architecture History. The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, Volume XLII-2/W11.

Bruzelius C. (2017). Digital Technologies and New Evidence in Architectural History. Journal of the Society of Architectural Historians, 76 (4), 436- 439.

Chiabrando, F., Sammartano, G., Spanò, A. (2016). Historical Buildings Models and their Handling via 3D Survey: From Points Clouds yo User-Oriented HBIM. The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, Volume XLI-B5.

Centofanti, M. & Brusaporci.S. (2018). Architectural 3D Modelling in Historical Buildings knowledge and Restoration Processess, Le Vie dei Mercanti.

Fondazione di Ricerca Scientifica ed Umanistica Antonio Meneghetti. "Between History and Legend". Retrieved November 2, 2018, from https://www.lizori.it/en/tra-storia-e-mito/

European Year of Cultural Heritage, Our heritage: where the past meets the future. Retrieved from https://europa.eu/cultural-heritage/

Fondazione di Ricerca Scientifica ed Umanistica Antonio Meneghetti Borgo Lizori, (2019). Between History and Legend. Retrieved November 2, 2019, from https://www.lizori.it/en/tra-storia-e-mito/

Historic England (2018). 3D Laser Scanning for Heritage, Advice and guidance on the use of laser scanning in archaeology and architecture. Retrieved from https://historicengland.org.uk/images-books/publications/3d-laser-scanning-heritage/

Historic England (2017). BIM for Heritage: Developing a Historic Building Information Model. Retrieved from https://historicengland.org.uk/advice/technical-advice/recording-heritage/

Historic England (2017). Photo-

grammetric Applications for Cultural Heritage, Guidance for Good Practice. Retrieved from https://historicengland.org.uk/advice/technical-advice/recording-heritage/

INTBAU (2011). Charter, INTBAU Steering Committee. Retrieved from https://www.intbau.org/

Kovač, V. (2017). Arhitektonski crtež u istraživačkom radu Đorđa Petrovića, period od 1971-1989, (Doctoral dissertation), Arhitektonski fakultet Univerziteta u Beogradu, Beograd

Menghetti Foundation. (2012). Lizori. Directed by Antonio Meneghetti. Perugia, Italia: Source Audio Holdings, DVD

Mitrović, B. & Wassell, S., ed. (2006). Andrea Palladio Villa Cornaro in Piombino Dese. New Zealand: Acanthus Press

Morton, P. A. (2017). Editorial: On Evidence. Journal of the Society of Architectural Historians 76 (4)

Petrović, Đ. (1972). Vizuelne komunikacije. Beograd: Arhitektonski fakultet Univerziteta u Beogradu, Savez studenata Arhitektonskog fakulteta

UNESCO, Recommendation on the Historic Urban Landscape. Paris, November 2011; 4. https://whc.unesco.org/uploads/activities/documents/activity-638-98.pdf

Siza, Á.(2006). Zapisi o arhitekturi, prev. Jasenka Gudelj.Zagred: AGM

Sullivan, E. A. & Snyder L. (2017). Digital Karnak: An Experiment in Publication and Peer Review of Interactive, Three Dimensional Content. Journal of the Society of Architectural Historians 76(4)