

WHAT COMMUNICATION ABOUT HERITAGE CONSERVATION? A CHALLENGE FOR DIGITAL DOCUMENTATION CONTENT.

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ABSTRACT:

The technological methods for digital documentation and the experimental best practice standards used to document and describe the many artistic objects determine the challenges and the numerous uses of today's cultural heritage. Because of this, it's crucial to preserve heritage by documenting it consciously and using conservation techniques that don't diminish or affect its worth. The study examines the issues we faced in disseminating all of the technical content we have, rather than focusing on the general importance of digital data for the technical staff. To share our heritage, we must make the digital legacy we have built over the last twenty years accessible. Starting from practical examples of dissemination projects in the context of conservation items, the analysis discusses an investigation into the findings and disciplinary culture that have resulted from research conducted by academics in the field of digital heritage on papers, conferences and EU projects produced and conducted between 2018 and 2022. The paper reviews the digital cultural heritage framework outlined by research up to this point. Our findings demonstrate that, despite the fact that the DCH area is constantly changing, we still primarily consider the technical side of digital without considering it as a genuine possibility for openness and sharing.

1. INTRODUCTION, AIM AND STRUCTURE

1.1 Highlights

The research moves within the conceptual framework of Digital Cultural Heritage, outlining both its value from a scientific perspective and a certain lack of its application within dissemination projects;

The Conservation and restoration context is analysed, underlining the fact that, although its great potential in terms of dissemination to the public, it is less affected than other cultural sectors by the challenges of digital transition;

The use of cutting-edge technologies and a digital mindset can truly make conservation and restoration concepts accessible for non-professional, as proved by four museum and non-museum case studies analysed;

Scientific papers, conferences and EU projects within the DCH framework over the last five years (2018-2022) are analysed from a quantitative and qualitative point of view;

The analysis performed here shows that the world of DCH must open up to the humanities to create new models of accessibility to heritage starting from digital data.

1.2 Research Foreword

Today the term "Digital Cultural Heritage" (DCH) is used to identify a wide variety of topics and scholars from various fields. We are rather aware that this new type of heritage will contribute to our cultural future, and we are fully conscious that conservation techniques are changing as a result of the use of various performing digital tools.

Moreover, we cannot mention that the area of cultural heritage conservation is currently dealing with the expanding

digitalization without addressing it itself and instead delegating these issues to other study disciplines.

In fact, it appears that experts and academics from the technology sector and technical areas are particularly interested in heritage digitization but of course they are more focused on technical outcomes.

Because of this, the contemporary studies on digitalization for our historical, artistic, and architectural heritage have made significant technological advances but haven't been able to examine innovative content.

It appears that we are experimenting a lot with new computerised and automated workflows, which are becoming more cutting-edge, but do not take into consideration the development of an increasingly open society.

On the other hand, there has been a lot of interest and focus from a wide range of the public in situations where a new approach of narrating heritage has been explored alongside conservation processes.

So, the challenge facing us is how to ensure that technology and cultural artefacts can truly reinvent the field of conservation, making it accessible to a non-specialist audience and enabling the professionals involved in and responsible for preserving the world's history to actually grow.

1.3 Structure of the paper

Our research paper is structured as follows: First, we provide insight into the cultural context we move on in our endeavour, finding the approach of conservators and restorers with digital technologies and, alongside, pointing out new cases in which some museums or other institutions are trying to disseminate content about conservation issues, as well as through digital tools. The characterization of this changing context leads us to

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consider if these two research lines might be merged to create a new area of study.

We set up an investigation into the field of digital cultural heritage to see if there are any signs or if the foundation has already been done. So, chapters 4 and 5 are the core of our review, focusing on the research question and methodology of investigation. Here we define our research corpus. The following section of the document provides the findings and discussions of these. The paper ends with our detailed conclusions where we share with the scientific community our opinion with respect to what the future of digital cultural heritage dissemination technology and content on conservation looks like.

2. CONSERVATION, RESTORATION AND DIGITAL HERITAGE: WHAT IS MEANT?

First, it's important to recognize the current starting point, in order to understand the need for innovative and digital research into the preservation sector. What connection do experts and professionals in conservation have with digital issues?

According to a survey conducted by Belgian researchers in 2021 (Acke et al., 2021), in the recent past conservator-restorers are really becoming increasingly interested in 3D concerns and in the technology sector. In particular, the study discusses the different aspects and applications of digital 3D models in the conservation fields, including their use as tools for scientific investigation or as documentation projects or archival materials.

Actually, the scientific literature shows various studies handling the use of technologies for the restoration process, such as the use of digital tools in the first stages of the structural investigation of the objects (Abate et al, 2014; Baratin et al, 2016) or in the documentation processes (Gril et al., 2015; Apollonio et al, 2017; Beltrami et al., 2019) or related to the rehabilitation of cultural heritage elements with 3D printing (Albace et al, 2013; Ballarin et al., 2018).

As highlighted by Acke et al., however, the lack of technical knowledge for restorers forces them to search out from the laboratory the technicians to carry out digital tasks making this process unsustainable in terms of costs and inapplicable.

Despite the fact that there are still many open questions regarding the global application of ICT, particularly in relation to materials of 3D printing and other application issues, it is important to note that the term "digital" now refers to a specific area of study that is strictly related to the work that contemporary restorers do.

3. THE CURRENT EVOLVING CULTURAL CONTEXT

3.1 The dissemination of the conservative issues

When we discuss digital and innovation, we must not just consider new technical applications but also new awareness.

Since the early 2000s, conservators and restorers in the museum sector have been considering the cultural impact of scientific operations supported by more and more cutting-edge technologies.

The need of being able to communicate the process of conservation of our legacy into simple languages that are understandable to all audiences was noted by conservator Helen Jones (Jones, 2002) in an article published on the Victoria&Albert Museum website in 2002. The many benefits of including the public in conservation efforts were outlined by Jones in her article. The primary reason, in particular, is theoretical and relates to the decisions the conservator makes during the operational phase: which value should be conserved and according to what standards?

A few years later, a first voice in the Italian sphere rose to underline how restoration and in general any action of care on heritage could constitute a new way of communicating the heritage itself to users (Pracchi & Chiapparini, 2013). According to the authors, in fact, the contents of the restoration can be considered a further narrative level for a communication capable of reconstructing a relationship between people and art objects, thanks to its scientific and humanistic duality.

In the Anglo-Saxon context, and with reference to what Jones underlined in his writing, a 2009 conference entitled "Playing to the Galleries and Engaging New Audiences: the public face of conservation" raised for the first time within the community of restorers operating in museums the theme of opening the concepts relating to the care of heritage to the public, gathering interesting international experiences (Williams, 2013). Also in this case, what has emerged is the need to involve the public in conservation processes through projects that highlight the different methodological and practical choices adopted during the interventions.

In more recent years, the scientific debate with respect to the issue of communicating conservation processes to the public has begun to be treated in a more systematic way, highlighting the intrinsic duality in the practice of conservation, understood as manual work on the one hand and the need to open up that work on the other, in order to achieve greater museum sustainability (Crutcher, 2019).

Moving even further on this concept, some studies have come to hypothesise the direct involvement of groups of volunteers in museum conservation practice, underlining the potential deriving from the opening of decision-making processes in the field of collection management (Goskar, 2019).

Finally (Gustaffson, 2019), a paradigm shift is beginning to emerge in the way of understanding the conservation of cultural heritage, which sees it as a driver of social and territorial growth, moving from the concept of protection to that of proaction, and understanding the figure of the conservative as that of negotiator between different instances.

This state of the art with respect to the theme of opening conservation to the public, albeit fragmentary and still little investigated, nevertheless highlights the intrinsic potential of this opening in terms of greater social awareness of heritage.

In recent years, the context caused by the COVID-19 pandemic has further changed the characteristics of museum use, causing an online shift for many contents (Cicerchia & Solima, 2021), some of which are related to the themes of conservation and restoration.

As researchers, we asked ourselves at what point we are within this evolution in the way of understanding conservation data management and their possible dissemination: to answer this question, we took as an example four very recent case studies of innovative onsite and online storytelling in museums and restoration sites relating to the conservation aspects of the heritage.

In the following paragraphs, the case studies will be briefly described, and from these dissemination experiences we will try to extrapolate a standardised method of study that investigates the scientific potential of these experiences.

3.2 Brancacci VR project in Florence (2021-2023)

From 2021, a partnership developed between the City of Florence and DHI Lab at CNR-ISPC, called Brancacci VR project (2021-2023), is aimed at using diagnostic data to create an immersive experience for visitors, using cutting-edge technologies. The project's main objective is to create an interactive experience around the restoration of the Brancacci Chapel in order to foster an appreciation of cultural heritage and its care, and it is divided

in two main goals, mixing scientific and dissemination purposes. The first objective was to carry out the largest non-invasive and portable diagnostic campaign on the frescoes by Masaccio, Masolino and Filippo Lippi housed in the Chapel: to do this, a building site was set up inside the Chapel with a visitable scaffolding, on which various interdisciplinary research groups took turns to perform broad spectrum analyses to allow a full understanding of the work, from the rediscovery of the executive technique to the durability of previous and future interventions, to the static nature of the architectural structure. The second objective consisted in transferring all this pull of scientific information to the non-professional public, realising an enhancement project for the Brancacci Chapel, in collaboration with the Municipality of Florence. The project envisaged the creation of an interactive experience aimed at strengthening the sense of care for cultural heritage, and took the form of the Brancacci POV - Point of View prototype: the laser scanner and photogrammetric shots performed during the first analytical phase of the project have made it possible here to create an experience with immersive VR viewers and smartphones for on-site users.

3.3 Facelifts & Makeovers exhibition in Den Haag Mauritshuis (2021-2022)

From 7 October 2021 to 9 January 2022, the temporary exhibition entitled "Facelifts and makeovers" was held at the Mauritshuis, which had precisely the aim of shedding light on an aspect of the history of art and museums that quite always remains behind the scenes, that of the restoration of paintings. The exhibition, which saw the first-person participation of the Mauritshuis team of restorers for its realisation, aimed to explain to the public in a simple and clear way what restoration and conservation are, why they are necessary for our heritage and what secrets can be discovered during a restoration intervention on a painting. Playing on the title of the exhibition, the aim was therefore to show the aesthetic aspect of the paintings within the exhibition path before and after a restoration intervention, emphasising in particular how the cleaning operations can make visible again what was for a long time remained invisible.

To do this, the exhibition itinerary contained the paintings restored by the Mauritshuis laboratory over the last 25 years, and used the technical data produced by the restorers during the interventions to create ad hoc narratives on different visitor targets (including children aged 7 upward).

In this specific case it is important to underline that the technical data of the interventions have not only been "translated" into informative terms for the exhibition itinerary, but digital contents have also been created starting from the same data for the dissemination of the same concepts on the social channels of the museum, always involving the team of restorers.

3.4 Notre Dame cathedral in Paris (2022)

After the devastating fire of April 15, 2019, the extensive restoration work on the Notre Dame Cathedral in Paris has begun. The restoration project, immediately grandiose in terms of timing, funding and workers involved, has been variously presented to the population in the last year, in hybrid ways between online and onsite, as well as dialogue between professionals and the general public. As can be imagined, such a varied and important restoration site continues to produce a huge amount of technical-scientific data every day. What is interesting in the opinion of the writers are the onsite methods (right in front of the Notre Dame restoration site) for disseminating these data. In fact, throughout 2022, the perimeter walls of the Cathedral's restoration site have become a gigantic blank canvas on which

information and stories on the restoration process converged. A particularly innovative way of developing this storytelling saw the involvement of a group of cartoonists, who translated the progress of work on the construction site into comic strips, narrating the thoughts of the professionals involved and the reasons for their intervention decisions (Fig. 1). The project has not seen its digital translation (that is, the comic is usable only for those who physically go on site), but it remains interesting due to the wise use that has been made of the site's data management system, and which has allowed to translate them in a definitely innovative way, albeit fully analogical, to the public.



Figure 1 Covering of the Notre Dame restoration site in Paris.

3.5 Victoria & Albert Museum in Dundee (2019 -)



Figure 2 Dundee's Victoria & Albert interior.

The Victoria and Albert Museum in Dundee is a very recent construction commissioned by the Victoria&Albert Museum as a separate venue to house a collection dedicated to Scottish design. The structure of the V&A Dundee was designed by the Japanese architect Kengo Kuma. In the architect's intent, the complex was to form a reconnection between the city center of Dundee and the area facing the River Tay. For this reason, the building consists of (as it appears on the VAM Dundee website): "Curving concrete walls (there are no straight external walls) which hold 2,500 pre-cast rough stone panels, weighing up to 3000 kg each and spanning up to 4m wide, to create the appearance of a Scottish cliff face." Therefore, the architectural complex itself is considered as part of the museum design collection, a holistic heritage to know in order to take care of it. Precisely for this reason, within the museum itinerary a specific section meant to describe the modern-style structure that contains the collection is presented. The museum staff uses a specialised kit made up of the building's many components to demonstrate the construction, which improves public comprehension of the structure and how

to preserve it. Again, we are not addressing the use of digital, but communication is supported by the technical documentation of the architecture. Thanks to the work of curators and employees of the museum's educational-training services, in a small area of the itinerary there is what has been called the "Architecture handling box", containing all the materials used in the construction of the building, available to the visitor for be observed, touched and assembled together, thanks to some tools that are always available (Fig. 2). Also in this case, it is a project developed entirely for the public on site, but still it denotes a certain attention to the transition between correct scientific documentation (in this case, relating to the construction techniques of a particularly innovative building) and one of its necessary purposes, namely scientific communication.

A scientific analysis of the dissemination topics: a brief survey
After observing these four different cases, the implications of the transmission of technical-scientific information and its function on a social and cultural level to help people grasp the significance of conservation measures used to protect heritage appear obvious (Jones, 2002; Gustafsson, 2019). What catches the eye from these experiences, from the point of view of research, is that none of these was born from a scientific basis (or has had, up to now, any confirmation within the scientific community). What it seems (and what the second part of this contribution will try to demonstrate) is that dissemination projects related to the concepts of heritage conservation and restoration suffer from a chronic under-representation and, when they exist, are little considered within the broader debate related to Digital Cultural Heritage. In this sense, it would be desirable that museum projects were also taken into consideration by the scientific community and analysed on a qualitative level according to standardised methodologies, in order to arrive - in a process of bottom-up knowledge - at a certain theorization of strategies adopted from time to time.

A possible scientific analysis of these experiences should start from these research questions: in the museum and para-museum context, how are technical-scientific data concerning conservation and restoration aspects of Cultural Heritage manipulated to make them accessible to the public? Do these operations have repercussions on a social and cultural level?

To find an answer to the research question, it would be necessary to analyze each individual case study through the in-depth interview tool (widely used in the field of qualitative research), after having identified the person responsible for each project, to whom the questions should then be submitted for the interview. For the case studies mentioned above it is not always easy to trace the project manager, or more precisely the professional who was responsible for following the workflow from start to finish, which goes from data collection within the restoration site to the final output for the public: these case studies are perceived as detached from the scope of scientific research, resulting in a certain difficulty in recognizing information about the work team that developed the projects.

However, once the project manager has been identified, the interview to be submitted to him should be structured hierarchically in order to analyze macro-themes by dividing them into micro-topics, as follows:

- Some questions about the type of Heritage of the case study (What type of heritage is analysed? Is it archaeological, architectural, movable, museum, etc.? Is it an historical or contemporary heritage? Are there some specific reasons for treating this Heritage for the project, for example is it a temporary exhibition, a traumatic event, etc.?).
- Some context/environment questions (Where is the project established? Does the geographical context affect the project in any way? Is this a transitional/temporary or ongoing project? What is the reference period? Where is the project location? Is it

only a physical and stable location or are there "digital" locations?).

- Some questions about the project objectives (What are the main and ancillary objectives of the project? Are there one or more target audiences identified for the project?).

- Some questions about the professions involved in the project, from start to finish (How many people does the project team consist of? What professions are involved and what is their quantity? Do they come from an academic or business environment? Are any conservators/restorers involved? What is their role?).

- Finally, some questions about the tools used, both at back-end and front-end level (How did you manage the technical-scientific data within the team? How and why did you decide to make them usable in this way? What tools do you have used to build the dissemination part of the project? Are they analogical or digital instruments? What is the role of digital in the process of translating data from technical to informative?).

Indeed, all these questions, divided into the identified macro-categories, contribute to providing an answer to the research question, and above all constitute a basis for starting to evaluate the parameters for implementing innovative projects in the museum environment with respect to the themes of conservation and restoration and their possible impact on the public.

4. THE RESEARCH QUESTIONS

At this point, our overarching research question is as follows: how can the amount of DCH content produced promote or increase the dissemination of particular issues, such as the conservation of artistic artworks, in an increasingly more digital world, in which as well as the restorers reach out some of their results? And, how can the great digitalization work being done by the scientific community be shared using digital resources in an open way?

One prominent approach to this study is characterised to the analysis of the teams which normally investigate the topic of DCH and what kind of heritage is explored. The feeling is that the contemporary landscape, mapping the use of digital methods and tools, mostly includes technicians and technology experts. This conducts an in-depth analysis of digital technical workflow and not to the development of the quality of digital content.

For this reason, we would consider in our investigation who now leads research on the DCH topic, who develops digital content for CH, and what aspects are examined provided as the foundation for our analysis in this area.

5. METHODOLOGY

The presented research is about a two-stage investigation on publications, congresses and European projects in the field of DCH. The research community was investigated through its scientific papers by a quantitative analysis of scholar typology, type of heritage explored, and the selection of key-words defining their works.

The second step involved a qualitative study of the community research, conducted in accordance with the same investigational criteria but in the context of international conferences and EU projects.

This kind of research, using the tools of bibliometric analysis (although in a simplified way), can provide in-depth reporting on the scientific community's perceptions on the DCH concept and the people involved in it. Indeed, the process has identified and quantified groups of scholars and their works, journals and space of research, helping us to understand over- and under-investigated topics and typologies of heritage.

In many different study fields, a precise bibliometric analysis has been utilised to explore the literature and pinpoint the advantages and disadvantages of previous studies (Ball, 2017).

5.1 Related works

From a methodological point of view, this research analyses papers and researches from the academic and scientific context, in order to sketch-up the DCH concept's borders, define its primary applications, and identify the types of scholars and professionals who are active in its development.

This particular interest was generated by the examination of some research published by Sandro Munster, who over the years has contributed to identifying the types of scholars and the topics that determine digital heritage.

In his first paper on the subject (Munster, 2017), the researcher demonstrates how the community is headed by scholars who are predominantly from the humanities (specifically from the field of archaeology), who are concerned with data acquisition, management, and visualisation.

When compared to the themes mentioned by the survey, these answers are clearly compatible. In actuality, the topics that were mostly studied were those that were closely related to the technological aspects of data management and acquisition.

It is evident that a lot has changed since 2017—both technically and in terms of the increased interest in parts of digital culture that have permeated academic sectors and beyond since the pandemic period.

In a later study primarily focused on examining how data-driven methods can support the identification of developed themes within the heritage sector (Munster et al., 2021), Munster demonstrates how the research trend is increasingly shifting to technological aspects. In particular, the findings of this study demonstrate how the field of digital heritage research views interdisciplinary connections between computer science, archaeology, and the natural sciences through the use of cutting-edge technologies like remote sensing, laser scanning, and photogrammetry.

According to the paper by (Santana Quintero et al., 2019), we know that the digital information generated by documentary workflows influences conservators' decision-making and, consequently, it affects the preservation of our legacy.

Because of this, the authors of the study highlight the importance of defining technical and ethical standards in order to create a framework of universally accepted norms for heritage documentation. This is to ensure that sustainable methods, rather than only cutting-edge technologies, are used to share the data created in the present and the future.

In light of the information gathered by Munster and combined with the Santana Quintero group's discussions, we thought it would be interesting to continue investigating the digital cultural heritage sector from a different point of view, that of the conservator.

In fact, it was interesting to learn whether conservators were taken into account in light of already-collected data and within a changing cultural context.

5.2 Our approach between bibliometric analysis and qualitative evaluation

Previous reviews often studied the adoption of digitization technology in cultural heritage fields (Salleh & Bushroa, 2021) or some specific applicatives as Augmented Reality (Boboc et al., 2022). In these cases, the scientific literature is examined in several ways, both through surveys and bibliometrics analysis.

In this specific case, only the tool of bibliometric analysis has been used, since we thought it was less error-affected. In fact, the

assumption of this analysis is that people who already work in the field of conservation would be willing to respond to a survey on technologies only if they already use them, while the specific purpose was to evaluate whether any scientific research had been conducted directly by conservators.

On the other hand, through a study of European conferences and projects on the subject of DCH, we wanted to evaluate whether there are appropriate settings for the study in the subfield of conservation and digitization. To do this, we no longer referred to the bibliometric analysis (it was in fact a path that could not be pursued from a methodological point of view due to the lack of comparability of the data), but we developed a qualitative study between the topics investigated by the calls and research fields involved.

5.3 The scientific journals

The data used for the present study - i.e. in order to perform the bibliometric analysis - were retrieved from six scientific journals: *Digital Applications in Archeology and Cultural Heritage*; *Heritage* (section 'Digital'), *Conservation Science in Cultural Heritage*, *Journal of Cultural Heritage*, *Journal on Computing and Cultural Heritage* and *Scientific Research and Information Technology (SCIRES)*. Since we are Italian scholars, we selected these journals firstly because they are mentioned in the ministry list that contains the most relevant scientific publications (Elenco Riviste Fascia A, area 08). Moreover, each of these contains the word 'Cultural Heritage' and in the description of research aims refers to technological innovation.

The period selected to accomplish the goal of this research was between 2018 and 2022.

A list of selected documents was created in Excel, that totally included 1416 papers. For each paper, we extracted and inserted in our manual database the following information: years of publication, title, names of authors, typology of investigated heritage, scientific provenance of researchers, list of keywords. Because the results of DCH field of interest frequently included the innovation for diagnostic issues as well, a filter search was used to restrict the number of articles to only those examining the digital heritage topic. Moreover, some journals offered monographic issues on particular subjects - i.e. SCIRES, which focused its first 2019 issue to a review of the outcomes of the 2018 European Year of Heritage. Even in this case, we fell to excluding volumes that did not specifically address the topic of DCH. Otherwise, the results could be distorted by further investigation. The final number of analysed papers is 637.

5.4 The conferences

Conferences were identified using a partially different search strategy.

The goal was to look into the contexts for study and the forums for conversations around digital cultural heritage.

For this reason, we chose the most relevant conferences in the European region that include both the digital and cultural heritage issues (movable heritage, architecture, and archaeology).

In the case of conferences, our review is structured as follows: in the same date range from 2018 to 2022, we selected and analysed the contents of the calls, the titles of key-note, the titles of the sessions presented during the meetings, and (if present) the titles of the organised workshop.

The next conferences were investigated: CAA - Archeologists, mathematicians and computer science (5 editions); 3D-arch: 3D Virtual Reconstruction and Visualization of Complex Architecture (2 editions); EVA - Electronica Visualisation and the Arts (5 editions); CIPA (2 editions); EUROMED (3 editions); CHNT Cultural Heritage and New Technologies (5 editions) and

Digital&Documentation conference (5 editions). In particular, since the research was done by Italian scholars, the D&D conference is a University of Pavia event and it was selected to look specifically at the Italian context. From this analysis, the most commonly occurring words were determined, and they provided an outline of the academic content and scope of the studying area.

5.5 The European projects

We also carried out research in the context of European programmes. The political interests around the subject of digital cultural heritage had to be identified. In truth, public funding fuels targeted development channels and permits research to advance.

The CORDIS information space, a website platform that collects all European research activity, was the principal source of information for searches involving European projects.

Due to the issue with financing periods, the time frame (2015–2022) was longer than that used in previous sections. In order to clarify the direction of funding in the post-pandemic period, ongoing projects were added to these.

Approaching this part of research, filters were used in the research to examine financing initiatives. In particular, we applied the following: Cultural Heritage (CH), Digital Cultural Heritage (DCH), and Conservation and Restoration of Cultural Heritage (CRCH).

The projects were primarily examined with the aim of identifying the research topics studied. In addition, the participating countries were taken into account in order to highlight the interest and distribution of partners within and outside Europe. This type of analysis allows us to understand the political relationships and to whom the cultural heritage world is primarily addressed. Finally, for projects that have already been completed, we wanted to observe what kind of dissemination the results had.

6. FINDINGS

6.1 The quantitative investigation

Once the research corpus of quantitative and bibliometric analysis has been defined, i.e. the group of scientific journals to draw on to evaluate how the subject of Digital Cultural Heritage is investigated by academics, we now analyze the ways in which the investigation has been performed within this research. The defined research corpus of scientific journals between 2018 and 2022 was inserted semi-automatically into a database specially created within the Excel software environment. For each individual paper involved in the research, the listed above data were entered into the database: name of the journal, year, volume number, title of the contribution and authors. Subsequently, each scientific paper included in the database was analyzed manually, mainly thanks to the reading of the abstract available online for each contribution. From reading the abstract and the available metadata, three classes of information were manually extrapolated and entered into the database for each contribution. The first class concerns the type of heritage covered by the research presented in the paper: in this regard, it was decided to define standard types of assets in order to obtain a quantitatively appreciable result. The heritage categories identified for the research are: museum environment, archeology, architecture, audiovisual, paper and archives, contemporary art, demo-ethno-anthropological heritage, intangible heritage, movable artworks, landscape. Some of the papers didn't refer to a specific class of heritage, so they were classified as undefined. The second class of information extrapolated from the scientific contributions analyzed concerns the scientific extraction of the authors. To do this, it is important to underline that we have not limited ourselves to taking into consideration only the affiliation of the author, which in some cases was imprecise or too generic, but for each individual author his research field has been defined, taking into consideration both the information available directly at the bottom of the abstract of the contribution and resorting to a search with the Google search engine analyzing the author's academic CV, where available on the website of his institution and on his

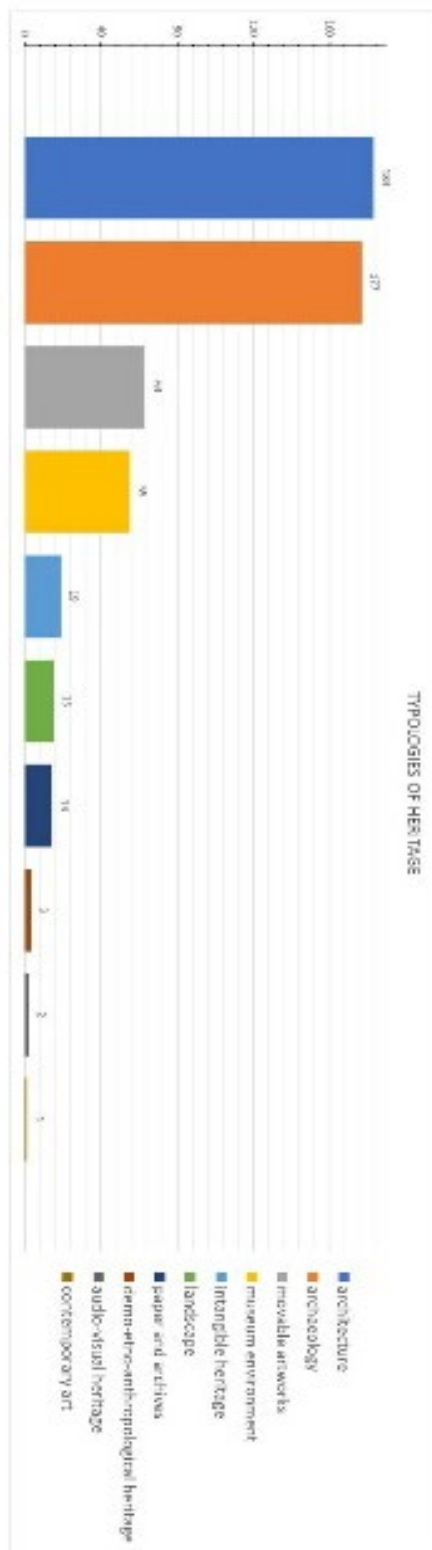


Figure 3 Graphical summary typologies of heritage.

LinkedIn/Academia/Google scholar profiles. The third class analyzed concerns the keywords declared by the authors themselves at the bottom of the abstracts to describe their contributions.

Once the database was completed with this information for each paper analyzed (i.e. for a total of 637 samples, as stated above), specific queries were created for the three variables to be investigated, i.e. the type of heritage, the origin of the researchers/authors, the keywords. The interpolation of data through specific queries has made it possible to create graphs and tables that highlight the study trends in terms of Digital Cultural Heritage in the last five years.

6.2 Topics, researcher fields and typologies of heritage

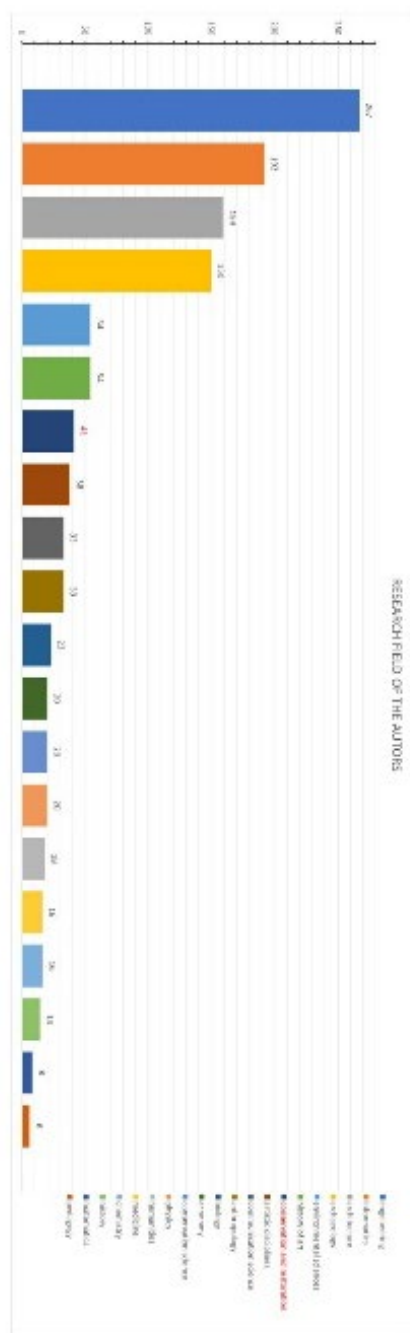


Figure 4 Graphical summary of research field of authors.

Going to the main results of the bibliometric/quantitative analysis here performed, we can see from Fig. 3 the main result concerning the typologies of heritage used as case studies for the corpus of scientific papers analysed. Out of a total of 532 papers taken into consideration for this analysis of the initial 637 (of these, in fact, 105 papers were classified as "not defined" with respect to the type of heritage because they did not refer to a precise case study or to a type of heritage attributable to the 10 identified classes) we clearly see that the two most extensively investigated heritage classes are architecture (n=183) and archeology (n=177). However, in third and fourth position are the patrimony of movable works of art (n=63) and the museum environment, understood as a set of several movable objects of various kinds (n=55). From the bibliometric analysis it was also possible to note a significant increase in the treatment of these two classes in the last two years analyzed (2021-2022). Therefore, if in the first part of the analyzed period the academic discussion around the DCH almost totally concerned the entire large-scale heritage (architecture and archeology), gradually this scientific comparison is starting to consider the small-scale heritage. Future research could investigate how much this increase in attention to movable/museum heritage is linked to the dynamics related to the COVID19 pandemic (Cicerchia & Solima, 2021).

Moving on to the second area analyzed by the bibliometric research, that concerning the academic extraction of the authors of the contributions, Fig. 4 shows how the main academic figures involved in the debate around the Digital Cultural Heritage (also as a function of the majority of contributions concerning architecture and archeology compared to other types of heritage) are related to the STEM area (engineering n=267 and informatics n=192) or to architecture (n=159) /archaeology (n=150). This data confirms our initial hypothesis regarding the fact that the DCH is mainly investigated from a technical/technological point of view, mainly excluding scholars belonging to humanistic fields and conservation and restoration professionals from the academic discussion. The analysis shows that the conservators-restorers included in the debate around the DCH hold the seventh position among the 20 academic classes identified: this figure, together with what identified by Munster and Acke in their respective studies, highlights on the one hand a small opening of the world of restoration with respect to the great digital theme, on the other it shows how technologies are perceived by restorers as "too technical/specialist" and therefore are still little used in daily conservation practice.

Finally, the third class of variables studied with the bibliometric analysis method concerns the keywords identified by the authors themselves for their papers. Given the very high variability of the keywords used, Fig. 5 shows the 30 most frequently repeated. It can be seen that in first place is the keyword "Cultural Heritage" with 98 repetitions, in second place "3D model" (n=55) and in third place "Photogrammetry" (n=54): this means that for scholars once identified, the discourse around the theme of DCH is mostly referred to techniques/technologies (such as 3D and photogrammetry). These data combine well with those previously analyzed with respect to the academic extraction of the researchers, who are mostly engineers and computer scientists and therefore have a logical tendency to investigate the more technical part of the DCH and to overlook its dissemination potential.

In addition, from Fig. 5 it can be seen that among the 30 most used keywords, items containing the concept "3D" appear several times: for this reason, the data was further interpolated by grouping all the keywords that contained "3D" in one group. Fig. 6 therefore shows the 10 most repeated keywords after having carried out this grouping: this manipulation of the data clearly

academic categories that focus on differences in issues relating to the DCH .

Nonetheless, we are well aware of the reality that finding and identifying qualitative evidence can be challenging, and we are unsure of the efficacy of various search methods. Anyway, to our comprehension of the overall field of research, this part of qualitative research was incredibly useful.

Usually, the methodology of qualitative linguistic research is based on corpora and examines occurrences (Spina, 2001). This rigorous and scientific approach won't be used in this section of the study because the data collection process is still in its beginnings. In fact, more thorough research is needed than simply counting semantic fields in order to demonstrate the meaning of texts and phrases and, by extension, the true scientific intent and significance of the extracted words.

Therefore, we did not define requirements for a rigorous linguistic analysis; instead, we started the analysis by extracting the terms that kept coming up in the different selected conferences. So, for each conference, we were able to create a word cloud using a free web application, which gave us an easy way to see the most commonly used words (Fig.7).



Figure 6 Word cloud from topic studied in Euromed conference.

The outcomes confirmed the interpretation of the context reached from the examination of papers published in academic journals. In fact, second to "Cultural Heritage," "Technology" is the one that comes up most frequently.

It's also important to note that the major references in the Italian context (D&D and 3D-arch) are to architecture and its 3D elaboration. No less significant is to note that the terms "Restoration" and "Preservation" only stand out in the context of the Euromed meetings, without any link with the communication issues.

As the CIPA conference is the unique place in which terms like "Dissemination" and "Documentation" coexist, we think it is interesting to discuss our research in this context (Fig.8).



Figure 7 Word cloud from topic studied in CIPA conference.

Basically, from this interpretation, it is simple to deduce that there isn't a specific forum where researchers may talk about the preservation, sharing and dissemination of cultural heritage.

Actually, the findings of the analysis of European programmes concur with this.

As mentioned earlier, the topics addressed by each project are first divided into three groups, as the table below indicates (Fig.9): those that deal with CH, those that deal with DCH, and those that deal with the conservation and restoration of CH (CRCH). Since a bibliometric analysis cannot obviously be performed on this material due to the lack of comparable metadata, we may continue on to make some qualitative observations based on these data, which already demonstrate that DCH and preservation are treated differently than CH.

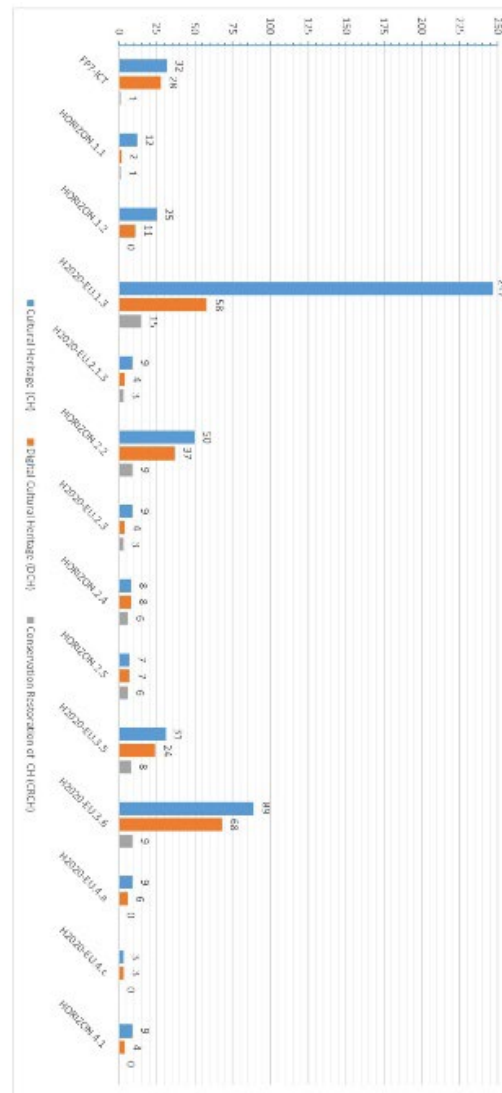


Figure 8 Graphical summary of EU project analysis.

In particular we can read that the Special Programme 'Cooperation: Information and Communication Technologies' (FP7-ICT) was an exception in our analysis that defocuses research around cultural heritage and its preservation. In fact, ICT research activities were focused on other strategic priorities than cultural heritage, in industrial and technological sectors in which Europe has excellence, such as communication networks, integrated computing, nanoelectronics and audiovisual technologies.

Within the framework of Horizon 2020 - programme that covers cultural heritage issues from various perspectives -, a total of 540 projects dealing with cultural heritage were examined, each in their own particular articulation and always through the specified filters (CH, DCH, CRCH). Of these, 264 were concentrated on digital aspects and 61 on subjects pertaining to conservation and restoration.

According to a preliminary review, the 264 DCH projects are mostly concerned with challenges relating to architecture, archaeology, and the better use of digital media in museums.

Regarding the 61 projects connected to CRCH, the majority of these also deal with preserving historical sites and archaeology, with a focus on material research and the best products for restoration. Only a small number of these projects address handling issues with artwork and the environments in which it is displayed, and the remaining ten deal with issues related to museum use and conservation.

The exploration of other characteristics (time, outcomes, key words, partnership composition, etc.) that can enhance these initial considerations in the many theme areas will later be made as the research is furthered.

7. FUTURE PERSPECTIVES

We are aware that we are only at the start of this data collection process. We are trying and directly observing how the facts we have previously mentioned are not always able to provide us with a single key.

We began by framing an issue based on our findings, with the need for scientific debate spaces at the top of the list. When the London Charter was issued in 2009, it was hoped that each field of study applied to the study of cultural heritage would interpret these broad ideas. Archaeology also did so, having already presented its Seville Charter in 2011.

Digital technologies are implicated with the historical transformation of society and our legacy, as well.

For this reason the research issue we must answer in the upcoming year is: What are the most important digital technologies we must use for cultural heritage conservation? How might they be included in research infrastructures to serve our target audiences more effectively?

7.1 Digital heritage vs heritage conservation

What is digital heritage? And more, what is the conservation practice related to digital heritage? How can we communicate its principles and its innovative workflow?

Today we know that, in contrast to the most usual descriptions of the profession, conservators do not work only with hands and materials, but they face the use of digital tools for study, analysis, documentation and dissemination. Conservators use digital data and digital products to do so many activities.

Today's challenge is to connect two historically dissimilar disciplines, like digital research and cultural conservation practices. It is important to make sure that the more conservation-focused elements of artistic research actually contaminate technological research contexts.

We have previously accomplished this between digital humanities and heritage in previous years. We have already looked into the potential impact of the data generated by digital tools on the growth of the digital humanities infrastructure (Benardou et al., 2018). However, the discussion is more complex when it comes to the topic of heritage conservation.

Our study demonstrates how the topic 'digital humanities' only emerges after significant technologically focused research. The technological disciplines today define the digital heritage. The fields of computer science and engineering are those that focus

primarily on issues connected to architecture and archaeology. These areas have been established by the academic and research communities, inside conferences and workshops.

Johanna Drucker says: "Humanities content met digital methods and created projects in which the terms of production were, necessarily, set by technological restraints." (Drucker, 2012). Actually, this is the first case in history in which technology has influenced cultural processes results, and not vice versa.

We need to research how to use digital data so that they can be beneficial for conservation, for fruition, and so that they are open to an ever-larger public, in addition to learning how to gather, produce, and organise them.

We require international research initiatives and projects that focus on this issue as well as financial and cultural investments that recognise the importance of a new field.

It will probably be required to start a discussion on an innovative approach to educating those who will be working as conservators in the future. To enable the new conservation professionals to work with this new type of heritage as well, it will be crucial to consider new skills to be incorporated in cutting-edge degree programmes.

7.2 The digital documentation applied to dissemination of a new culture and to accessibility to an innovative cultural heritage

At the end of this long process of analysis, it seems necessary to go back to the first research questions, to show what are the real development trajectories of this study, which is only meant to be a preliminary analysis of a broader scientific debate. The data obtained from the research show how, all in all, the DCH is still fully the prerogative of the technical-scientific disciplines and is seen more in its potential for applying new technologies rather than disseminating these results to the public. We hope that in the future the debate on the DCH will really open up towards digital humanism, creating an increasingly applicable workflow that starts from the documentary processes (also in relation to conservation and restoration interventions), and uses digital resources in order to obtain a corpus of information translatable to the public. Only in this way, i.e. by interpolating technical data digitally with fascinating and engaging narratives, will it be possible to offer the public a new model of accessibility to our heritage, through enriched and scientifically validated information.

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