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THE USES OF 3D DIGITIZATION IN ARCHAEOLOGY. RESULTS OF A SURVEY CONDUCTED AMONG PROFESSIONALS

1. Introduction

Since the 1980s, in a global context marked by the emergence and subsequent development of computer and digital tools, 3D digitization and modeling have gradually spread throughout the archaeological community (Tuffery 2022). These tools have led to a quantitative increase in data and new practices in the methods of documentation, analysis, communication, transmission, and promotion of archaeological data. Beyond their visual and aesthetic qualities, the use of 3D digitization in archaeology raises epistemological issues. Why have archaeologists adopted these new tools? How do 3D digitization methods fit into archaeological practice? What are the benefits and limitations of 3D acquisition? And finally, how do these new practices impact the discipline?

With this in mind, this article takes an analytical approach focused on the uses of 3D digitization by archaeology professionals. Conducted between 2020 and 2022, the survey gathered 175 responses, predominantly from France (88%), via an online questionnaire. This sociological approach, based on collecting quantitative and qualitative data, provides theoretical and technical insights into the place of 3D digitization in the discipline. It allows us to explore the heterogeneity of uses, the concrete conditions of their implementation, and how actors perceive their own practices.

This article examines the survey results along several lines: the adoption and dissemination of 3D digitization in professional archaeological circles, the motivations and purposes for its use, its integration into the research process, the constraints encountered, the skills mobilized, and the prospects for development as perceived by the respondents.

2. Methodology

2.1 *Target population and sampling*

The questionnaire consists of 24 questions divided into three main sections: preparation for the archaeological operation, acquisition of 3D digitization data, and use of the results. Some questions are multiple choice or tick boxes (qualitative data), while others allow open-ended answers so as not to influence or limit the respondents' answers (descriptive data).

2.2 *Data processing and statistical analysis*

Data processing required several stages of transformation. Multiple-choice and checkbox responses were converted into frequency count tables and presence-absence tables, allowing identification not only of individual frequencies, but also of associations between different modalities (Saly-Giocanti 2005; Desachy 2018). For open-ended questions, manual harmonization work was first carried out when possible, transforming descriptive data into statistically exploitable qualitative data.

The longest responses, in the form of sentences or paragraphs, were analyzed through lexicometry using Tropes software. This tool, developed by Pierre Molette and Agnès Landré based on the work of Rodolphe Ghiglione, performs statistical analyses by measuring the frequency of occurrence of major word categories, processing co-occurrences and linkage rates between terms (Molette, Landré 2013; Khelifi 2018). It thus enables the identification of general themes addressed without the researcher's intuition or subjectivity. However, like all lexicometric software, Tropes has the disadvantage of decontextualizing discourse (Glady, Leimdorfer 2015). To mitigate this limitation, each lexicometric analysis was systematically complemented by a complete reading of the corpus of responses in their raw format, without correction or harmonization (Delamare 2024, 98-219).

The frequency count tables were then transformed into cross-tabulation pivot tables, allowing analysis of responses according to two main extrinsic variables: the professional status and institutional affiliation of respondents. These cross-tabulations revealed trends according to professional profiles and institutional contexts.

3. Adoption and dissemination of 3D digitization in archaeology

3.1 *Institutional and statutory profiles*

Despite a clear desire to carry out a comparative analysis at the European level, the survey results reveal a strong predominance of responses from people working in French institutions. Of the 175 responses collected, 155 came from France, representing 88% of the sample, compared to only 20 responses from other European countries (Fig. 1). This disparity limits any attempt at a differentiated analysis by country, but allows us to paint a nuanced picture of French practices. This imbalance can be explained in particular by the diversity of the methods used to distribute the questionnaire. In France, several channels were used: direct mailings to personal contacts (with a good response rate), distribution by ANACT (National Association for Local Government Archaeology), UMRs (Joint Research Units), and publication on the website of the French Federation of Conservator-Restorers. The questionnaire

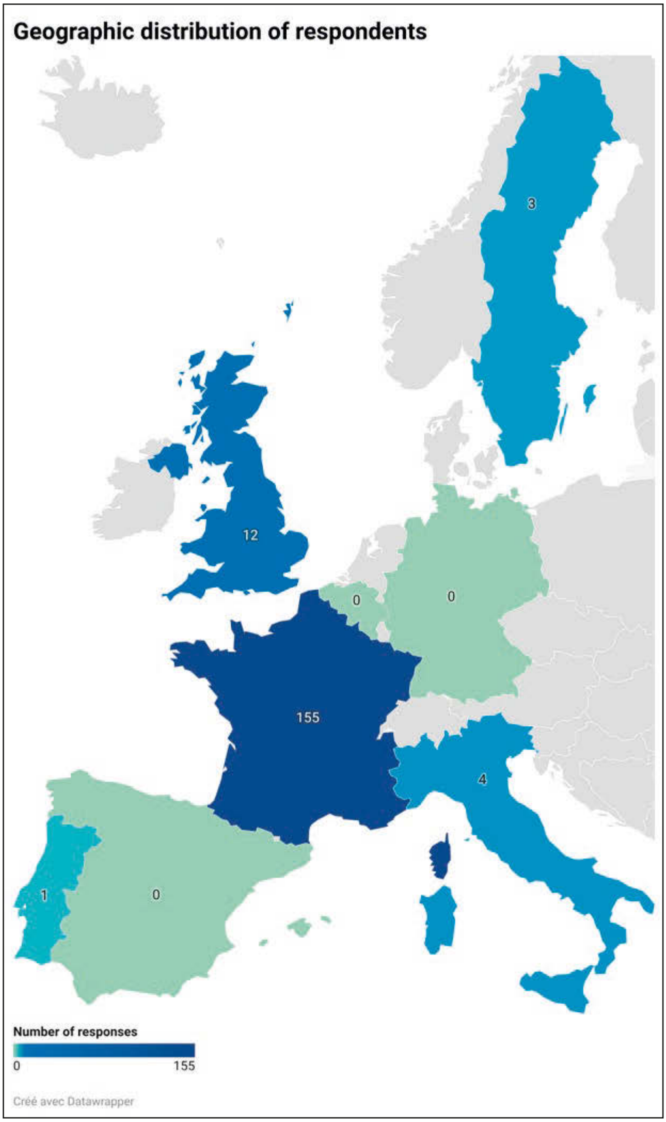

Fig. 1 – Geographic distribution of respondents (elab. S. Delamare).

remained online for approximately two years (2020-2022). In contrast, the European campaigns, relayed by the company Digitage through an automated mailing system (Lemlist), were hampered by spam filters, invalid addresses, or a clear lack of interest.

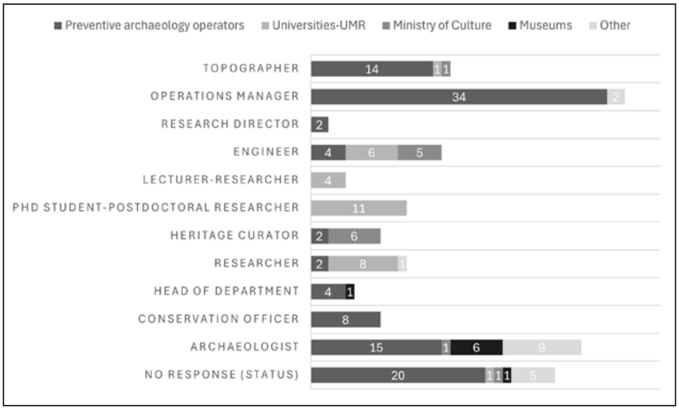

Fig. 2 – Distribution of survey respondents by professional status and institutional affiliation (elab. S. Delamare).

The data reveal a predominance of actors from preventive archaeology (33%), followed by local authorities (27%), universities and joint research units (18%), the Ministry of Culture (8%), and museums (5%). These results highlight the importance of field workers, who are particularly involved in conducting operations and producing archaeological data (Fig. 2). This contrasts with the more marginal representation of research institutions such as joint research units and universities. From a statutory point of view, the majority of respondents are operation managers, field archaeologists, surveyors, doctoral students, post-doctoral students, heritage curators, and researchers. This diversity of statuses shows a high degree of heterogeneity in profiles and levels of involvement in the production of 3D digitization data.

3.2 *Chronology of adoption*

Cross-referencing the chronological data with statuses and institutions reveals interesting nuances in adoption patterns. The first reported use, dating from the 1980s, comes from a university-affiliated teaching-researcher/research unit member, suggesting that academic research environments were the first sites of experimentation. In the 2000-2004 period, the emergence of sporadic practices manifests mainly within research institutions, preventive archaeology operators, and the Ministry of Culture.

It was during 2005-2009 that these methods began to spread more widely across all institutions and statuses, with notable acceleration between 2010 and 2014, a period coinciding with the democratization of digital photogrammetry and the emergence of more accessible software. The years 2015-2019 mark a true turning point: during this period, the majority of

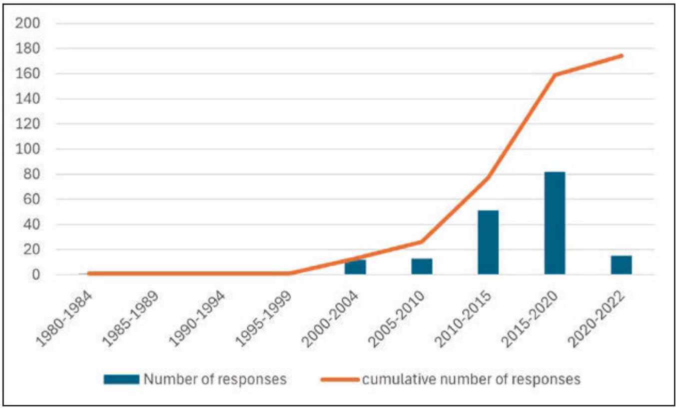

Fig. 3 – Distribution of responses by period of data acquisition (elab. S. Delamare).

professional statuses began using these methods, with particularly marked adoption among operation managers, surveyors, archaeologists, and doctoral students. The final 15 responses, dating from 2020-2022, show that adoption continues (Fig. 3).

3.3 *Gradual dissemination*

The data illustrate a bottom-up dissemination dynamic, driven by practice and operational needs rather than formal institutional requirements. Individual initiative plays a central role: in several cases, it is field archaeologists who introduce 3D digitization technology into their departments, often without structural support. This situation reinforces the idea that practices are still dependent on personal trajectories, although they are increasingly legitimized in professional use. Thus, 3D digitization seems to have gradually established itself in concrete operational contexts before its use was institutionalized.

4. Motivation and purposes for using 3D digitization

4.1 *Motivations*

There are many motivations for using 3D digitization technologies in archaeology, reflecting practical, methodological, heuristic, and communicational expectations. A large majority of respondents highlight time savings as the main advantage of digital acquisition (Fig. 4). This concerns both the speed of execution in the field and the reduction in processing time for certain tasks (surveys, orthophotographs), as well as the ability to process complex data

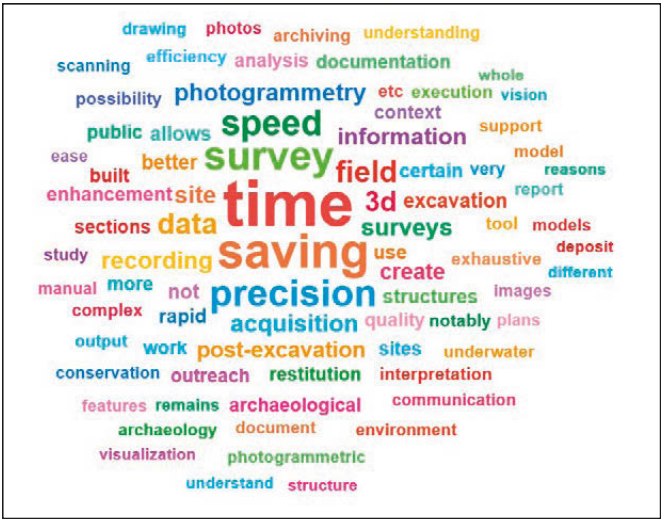

Fig. 4 – Key motivations for 3D adoption in archaeological practice (elab. S. Delamare).

offline. One archaeologist said: «The time savings in the field are undeniable [...] the time spent on drawing, surveying, and topography is significantly reduced» (Delamare 2024, Appendix 1).

Lexicometric analysis reinforces this interpretation: the terms 'time' (52 occurrences), 'gain' (42), 'reading' (35), 'accuracy' (28), and 'speed' (25) are among the most frequent in the open-ended responses. The most significant co-occurrence relationships are also found between 'gain' and 'time' (44 times), as well as between 'time' and 'field' (15 times), highlighting the centrality of time in recording practices. Among the recurring purposes, we also find the accuracy and comprehensiveness of the recordings produced, often considered more effective than traditional methods. These two elements are strongly correlated with the notion of scientific quality. In this sense, 3D digitization is perceived as a methodological guarantee allowing for better reproducibility of observations and more complete documentation of archaeological structures, particularly in emergency excavations. 3D digitization is also seen as a heuristic tool, capable of generating new hypotheses or enabling retrospective analyses of structures that no longer exist.

Other respondents emphasize the usefulness of 3D digitization for visualizing complex structures that are difficult to understand from 2D plans or sections. This modeling capability not only provides a better understanding of spatial organization, but also facilitates communication with project partners, sponsors, and the general public.

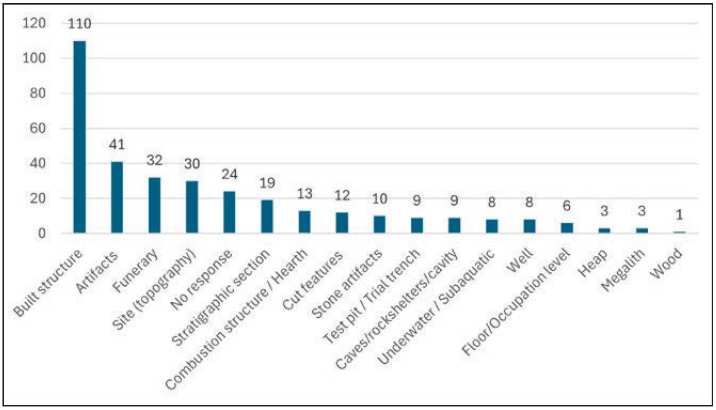

Fig. 5 – Archaeological features documented with 3D methods (elab. S. Delamare).

4.2 *Applications in the field*

Detailed analysis by structure types reveals differentiated practices according to institutional and status contexts. Built structures, including terms such as 'building', 'wall', 'masonry', and 'architecture', account for 101 mentions in the lexicometric analysis, confirming their dominant position. This predominance is particularly observed among preventive archaeology operators and local authorities, where built structures represent the overwhelming majority of digitized objects (Fig. 5). Archaeological artifacts (objects, ceramics) with 39 mentions occupy the second position, but this average conceals significant disparities. In universities and joint research units, artifacts rank even slightly ahead of built structures. Funerary structures (22 mentions) constitute the third coherent group, particularly present in responses from surveyors and operation managers in preventive archaeology. Beyond these three major categories, respondents also mention site topography, stratigraphic sections, combustion structures, wells, and stone artifacts, but more sporadically. It is crucial to emphasize that most respondents do not use 3D digitization methods on only one type of structure or artifact: multiple responses are the norm, demonstrating that 3D digitization is perceived as a versatile tool applicable to all types of remains.

Beyond scientific functions, 3D digitization is frequently used for communication, promotion, or publication purposes, whether to produce illustrations for reports or articles, to feed cultural mediation media, or to experiment with virtual reconstructions. Nearly 42% of respondents say they use reconstructions, mainly for cultural mediation. However, some use models to test hypotheses or facilitate interpretation.

4.3 *Contributions*

Finally, some respondents mentioned 3D digitization as a faster way to produce analysis documents, reduce time spent on manual drawing, provide a better overview via overhead shots (drones), or assist in organization of the site. These elements reflect the growing use of 3D digitization in the organization of archaeological operations. In short, users' motivations relate to both operational efficiency and scientific quality. 3D digitization methods are perceived as efficient, cross-disciplinary methodological tools capable of addressing multiple challenges, from detailed documentation to heritage mediation, analysis, and publication.

One respondent explains why they use 3D digitization: «For the speed of execution, the comprehensiveness of the information acquired, and the reliability of the results, but also for the benefits it brings in terms of transcribing and understanding data in excavation reports» (Delamare 2024, Appendix 1).

5. Integration of 3D digitization into the archaeological data production process

5.1 *Timing and methods of use of 3D digitization*

One of the objectives of the survey was to better understand when 3D digitization is used and how it fits into archaeological research. The results show a differentiated distribution according to the phases of operation: study (37% of mentions) and excavation (28%) are the preferred times for using 3D digitization, followed by promotion (19%) and site preparation (13%). These data show a high concentration of uses during documentation and analysis. Integration in the preparatory phase remains minor, although it is growing thanks to the use of drones for preliminary flyovers or topographical surveys.

Some respondents report that 3D digitization is well integrated into the organization of the site, while others mention a more nuanced integration depending on the objectives and needs of each operation: «3D acquisition is widely integrated into field methodology and assimilated into conventional surveying» (Delamare 2024, Appendix 1); «It varies greatly. There are no rules set in stone. The objective and purpose are the determining factors» (Delamare 2024, Appendix 1). This hierarchy is confirmed by cross-referencing with job descriptions: all professional categories use 3D digitization mainly during excavation and study (Fig. 6).

5.2 *Temporality of the presence of the 3D referent*

Regarding the presence of '3D digitization specialists', the survey reveals that only 34% of respondents are present full-time in the field, while 46% work part-time and 15% work according to specific needs of the site. This

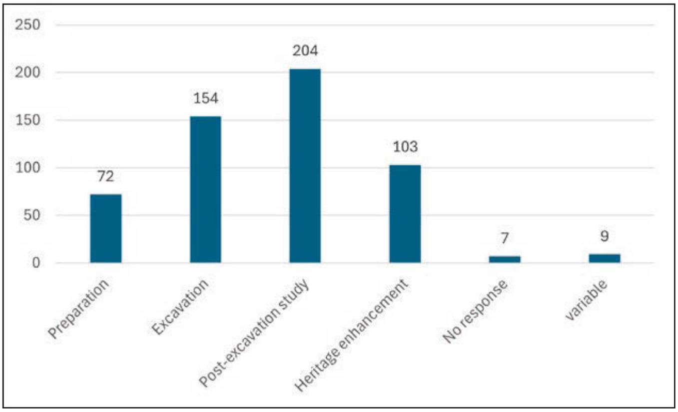

Fig. 6 – Temporal distribution of 3D use in archaeological workflow (elab. S. Delamare).

variability shows that 3D is rarely thought of as a continuous recording method, but is more often used on an ad hoc basis, depending on logistical constraints or key moments in the project (excavation stage, surveyor availability). Some respondents emphasize the arbitrary nature of 3D acquisition: it occurs when the context is right (good lighting, clear access, equipment available) or when the object to be documented is considered 'remarkable'. In this sense, 3D digitization still often functions 'on demand' rather than continuously.

Furthermore, one point comes up repeatedly: time. 3D digitization is often perceived as a tool that saves time in the field, but at the same time it generates a significant workload in post-excavation (processing, cleaning, archiving data). This dual status, a tool for simplification and a source of complexity, illustrates the ambivalent status of 3D digitization in current practices. 3D digitization modeling methods complement other recording and analysis tools without fundamentally disrupting the organization of the site. However, this integration comes at the cost of a compromise: while 3D digitization offers fast, accurate, and reusable surveys, it also requires significant processing time, which can extend well beyond the field phase. This duality, gains in the field, overload in post-excavation, shows that it can have an impact on certain stages of archaeological research.

5.3 *Production and use of 3D digitization data*

Most 3D productions are converted into 2D documents (orthophotographs: 32%, digital models: 25%, plans and sections) (Fig. 7). This trend reveals difficulty in appropriating 3D formats in conventional analytical routines, as well as a lack of tools to exploit this data in three dimensions.

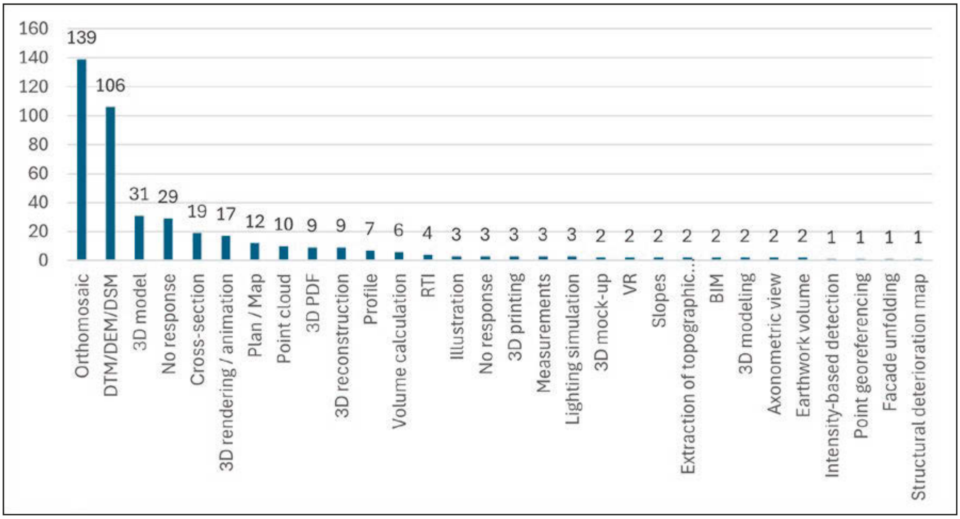

Fig. 7 – Products derived from 3D recording (elab. S. Delamare).

3D digitization is therefore often used as a transitional medium: it feeds into 2D deliverables better integrated into reports and databases. This 'reduction' to 2D sometimes limits the scientific exploitation of the models produced. Ultimately, 3D digitization is now being integrated into archaeology pragmatically: as a flexible tool, used according to opportunities, available human resources, and the objectives of the operation. While it is becoming a regular feature of excavation work, its full integration still requires structural changes, both organizational and technological.

6. Constraints and limitations of 3D digitization use

While the benefits of 3D digitization are now well established (time savings, technical efficiency, heuristic value), the professionals surveyed also highlight a number of structural and organizational barriers that hinder wider dissemination and more systematic integration. These obstacles can be grouped into three main categories: technical, human, and institutional.

6.1 *Technical constraints*

Lexicometric analysis of encountered constraints reveals a semantic field dominated by the material and technical dimension. The term 'problem' appears 51 times in responses, while 'hardware' is cited 33 times, 'software' 29 times, 'time' 24 times, 'processing' 20 times, 'purchase' also 20 times, 'information' 15 times, and 'cost' 14 times. These raw frequencies are revealing, but the study of co-occurrences is even more so: the words 'problem' and 'hardware' appear in relation 14 times, forming the most significant pair in the corpus. The relationships between 'processing' and 'information' (7 occurrences), as well as between 'purchase' and 'hardware' (also 7 occurrences), complete this semantic network. This lexicometric analysis reflects a concrete reality: the lack of resources for purchasing adequate equipment is the most commonly encountered problem.

The volume of data generated by 3D digitization surveys poses multiple challenges: difficult storage, slow transfers, and long-term archiving difficulties. Several respondents even admit to destroying their source data (photographs) deemed too voluminous, retaining only final results. This practice, dictated by lack of storage space, obviously raises ethical questions regarding the preservation of digital data and data reuse.

6.2 *Human constraints*

Skills and training gaps are a recurring theme. The survey shows that many users have acquired their skills through self-teaching or from more experienced colleagues. Photogrammetry, still perceived as more accessible than LiDAR or geometric modeling, is mainly practiced by self-taught individuals. This lack of training is often compounded by a lack of dedicated staff, resulting in an excessive workload for the few trained individuals and a high degree of dependence on isolated individuals. The survey also reveals that data management is often problematic due to this lack of time and skills. Several respondents indicate that the workload involved in processing 3D models far exceeds the time allocated to the project, making these operations difficult to justify within standard deadlines and budgets: 'Time saved in the field but working time in the office greatly increased'.

6.3 *Institutional constraints*

3D digitization methods are rarely taken into account when drawing up specifications, though this is gradually changing, particularly for orthophotographs, which are increasingly in demand. In most cases, the decision to use 3D digitization technology is left to the operations manager, with no official institutional framework. Specific administrative constraints are also mentioned, including legal restrictions on remote piloting of drones, difficulties in financing external services, and slow validation processes for equipment purchases. This situation leads to significant inequalities between institutions depending on their internal policies, financial resources, and openness to technical innovation. Several professionals regret the lack of a common framework promoting the judicious use of 3D digitization.

Some professionals also fear that 3D technology will be overvalued at the expense of direct observation: considering 3D acquisition as an end in itself could hinder archaeological reasoning, particularly if modeling is favored over in situ analysis. One archaeologist regrets the lack of 'direct feedback on the quality of acquisition and absence of real-time verification'. In short, 3D digitization appears to be a promising approach, but one that still faces a series of material, human, and institutional obstacles that may limit its use. These limitations directly raise the question of the conditions for perpetuating expertise and recognizing these practices in professional standards.

7. Skills, training, and professionalization

The survey provided an overview of the skills used by professionals responsible for producing or using 3D digitization data. The results reveal a reality marked by self-teaching, diverse career paths, and a relative lack of academic or professional structure.

7.1 *Learning and training*

The issue of training is central. A majority of respondents said they had acquired their 3D digitization skills independently (Fig. 8). In particular for photogrammetry, the most widely used method, learning took place 'on the job', through tutorials, informal exchanges between colleagues, or direct experimentation in the field. Thus, 29% of those surveyed said they were self-taught, 23% had taken training in photogrammetry, 8% in drones, and 8% in 3D software, while specialized university training accounted for only 2% of cases.

Cross-analysis of training undertaken according to status reveals notable differences. Surveyors have predominantly taken photogrammetry training (their initial topography training constituting a favorable foundation), while operation managers are essentially self-taught, occasionally supplementing their training with courses in photogrammetry or drone piloting. Engineers favor photogrammetry and adapted software training, with some also being self-taught. For doctoral students, postdoctoral researchers, heritage curators, and researchers, the pattern is similar: most declare themselves self-taught, while others have taken photogrammetry training or received training during their university curriculum.

University or specialized training courses that directly incorporate 3D digitization and modeling tools remain marginal. A few master's programs (archeology, geomatics, heritage) offer introductory modules, but these are often limited to a theoretical introduction to the methods. Very few courses cover advanced methods such as LiDAR, parametric modeling, or virtual

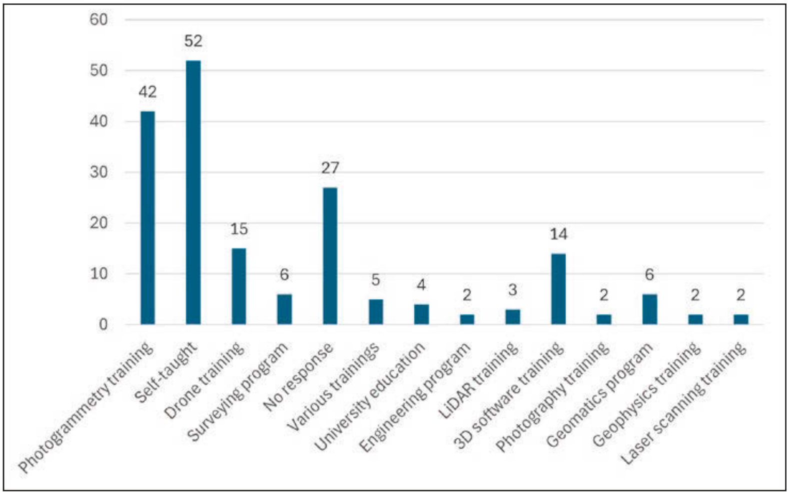

Fig. 8 – Types of training received for 3D technology use (elab. S. Delamare).

reality. At the same time, some major archaeological operators have set up internal training programs. The French national institute for preventive archaeological research (https://www.inrap.fr), in particular, has been building a network of photogrammetry experts since 2016. This group organizes several training sessions each year, although the availability of trainers still limits the range of courses on offer and their accessibility.

7.2 *Internal skills and outsourcing*

The distribution of skills within organizations is also uneven. Nearly 56% of respondents indicate that 3D digitization skills are provided internally, often by multi-skilled staff. On the other hand, the use of external service providers remains relatively limited (around 10%) for specific services, such as remote drone piloting or the use of advanced techniques (LiDAR, point clouds). This internal autonomy is a double-edged sword: it encourages teams to embrace 3D technology, but relies on a small number of individuals who are often not replaced when they leave or change jobs.

Institutional analysis shows that universities, joint research units, preventive archaeology operators, and local authorities largely favor internal skills. The trend reverses for Ministry of Culture staff, who more frequently resort to external service providers. This difference is probably explained by distinct budgetary and organizational logics: the Ministry has the means to outsource occasionally, while operators develop their internal skills for reasons of operational efficiency and long-term cost control.

7.3 *Towards professionalization?*

The lack of dedicated courses, the distribution of new practices among archaeologists from different specialties, and the lack of official recognition are obstacles to the true professionalization of 3D digitization in archaeology. In fact, there are no positions for archaeologists specializing in 3D digitization. Furthermore, skills are rarely identified in job descriptions, calls for tenders, or funding criteria. This leads to great variability in practices between different organizations.

The integration of 3D digitization requires better integration into initial training, recognition of expertise, and the consolidation of common professional practices and methods around these tools. In this context, several respondents advocate for the implementation of continuing education, experience-sharing networks, and certification modules in order to harmonize skills and provide a framework for their transmission. Resource pooling and open-source teaching materials are also cited as potential levers.

8. Outlook and developments

The last part of the questionnaire focuses on how professionals perceive the future of 3D digitization in archaeology. The responses reveal a relative consensus on the need to better integrate these methods into all stages of archaeological research, but also a clear understanding of the persistent barriers to their widespread use.

8.1 *Towards a systematization of 3D digitization uses?*

Lexicometric analysis of the prospective question (How do you see the evolution of your 3D practices?) reveals three dominant priorities in professionals' discourse. The term 'drone' appears 39 times, 'skills' 26 times, and '3D printing' 18 times. The most significant semantic relationships are 'development'; 'skills' (14 occurrences) and 'flight'; 'drone' (13 occurrences), reflecting a dual expectation: acquiring new skills and systematizing aerial surveys.

The systematization of drone surveys is accompanied by pressing demand for more flexible remote piloting regulations. Currently, administrative and legal constraints are perceived as a major obstacle to the development of this practice. Simultaneously, many respondents express their need for continuing education in the 3D field, with particular attention to emerging technologies such as virtual reality and augmented reality, deemed promising for heritage mediation. 3D printing also generates reflections, particularly regarding communication needs, promotion, and collection accessibility (for example, for visually impaired audiences). Although mentioned less frequently than drones or training, it emerges as a development avenue identified by the most forward-looking professionals.

8.2 *Persistent obstacles*

Respondents emphasize the need for change in procurement policies to obtain suitable equipment that would optimize data processing and exploitation time, if not in real-time, at least during the post-excavation phase. The mismatch between technical needs and allocated resources remains a major obstacle. Beyond material aspects, professionals highlight the urgency of institutional recognition. Several respondents call for the creation of positions specifically dedicated to 3D acquisition, which should be distinguished from the surveyor profession. This professional distinction would prevent surveyor overload and guarantee sustainable specialized expertise.

Respondents also emphasize the need to raise awareness among decision-makers of the scientific and heritage value of 3D, so that it is not confined to an illustrative or decorative function. Applied research programs, led by consortia such as the 3D Heritage Network (3DHN, https://www.3d-heritage.eu/en/about/), working on the uses, preservation, and dissemination of 3D digitization data, are identified as levers to support this transformation. Regarding Regional Archaeology Services (SRA) and the technical and scientific archaeological referents (Conseillers Techniques et scientifiques Régionaux en Archéologie, CTRA) respondents wish for 3D digitization to find its place not only in prescriptions but also in final operation report formats.

However, some voices are raised to warn against excessive systematization of 3D digitization. These respondents fear that institutions might see it only as a return on investment in terms of time and money, to the detriment of interpretive analysis and direct field observation. They suggest that acquisition should be used judiciously, according to the actual scientific needs of each operation, rather than applied systematically.

8.3 *Concrete recommendations*

Respondents made a series of recommendations to support the development of 3D in archaeology:

– Strengthening continuing education, tailored to different skill levels (beginner, advanced, expert).
– Explicitly including 3D skills in job descriptions, since institutions do not plan to create positions specifically dedicated to 3D.
– More integrated real-time 3D tools.
– Creating shared platforms for storing and exchanging 3D data, tutorials, and best practices.
– Establishment of a professional network dedicated to 3D in archaeology, facilitating knowledge sharing and practice monitoring.
– Support for the acquisition of equipment, training, and recruitment of dedicated staff in order to ensure the long-term use of these methods.

These expectations converge towards a single ambition: to make 3D no longer an individual and marginal skill, but a structuring and shared tool, fully integrated into the scientific, heritage, and institutional logic of the discipline.

9. Different perspectives on digital practices in archaeology and heritage

The results presented can be put into perspective with other recent surveys which, thanks to their complementary samples, provide a nuanced overview of digital practices in the fields of archaeology and heritage sciences. Our survey: 175 respondents, 2021-2022 (Delamare 2024); that of the 3D Consortium: 51 respondents, 2023 (Sorin-Mazouni *et al.* 2024) and that of the H2IOSC project on digital infrastructures in heritage sciences (Mancuso *et al.* 2025): 161 respondents until 2025 reveal similar findings while highlighting distinct dynamics depending on professional and institutional contexts.

9.1 *Shared obstacles*

The three surveys agree on the identification of obstacles that hinder the development and sustainability of digital practices. The lack of training appears to be a constant across the board: a significant proportion of respondents to our survey say they are self-taught, the 3D Consortium survey highlights the recurring lack of skills, and H2IOSC notes the absence of clear trends in the needs expressed. The issue of hardware and software is a second similar point. Our lexicometric analysis reveals that the terms 'problem', 'hardware' and 'software' occur significantly together. The 3D Consortium confirms this observation of the cost of equipment and software as the main obstacle, while H2IOSC documents the chronic difficulties in accessing sufficiently powerful computers and proprietary software licences. This mismatch between technical needs and allocated resources creates significant inequalities between institutions depending on their internal policies and financial capacities.

The third shared obstacle concerns the management, storage and archiving of digital data. Our survey reveals that a significant proportion of respondents have no satisfactory storage solution, and that makeshift systems dominate, with the French national repository for 3D data (https://3d.humanities.science/) remaining marginal. The Consortium 3D survey confirms this fragility: despite the existence of the national repository for 3D data (Conservatoire national des données 3D, CND 3D, https://3d.humanities.science/) in France, few projects use it, and data management plans are not systematically established. H2IOSC generalises this observation beyond 3D: the bulkiness of data, transfer difficulties and the absence of standardised protocols are recurring obstacles.

9.2 *Imbalance between production, exploitation and publication*

A paradox emerges from the three surveys: massive production of digital data coexists with marginal publication and reuse. H2IOSC documents that, despite widespread commitment to Open Access for textual publications, very few researchers actually publish datasets or software. This reluctance to share raw data can be explained in part by the lack of academic recognition: a significant proportion of H2IOSC respondents, mainly those at the beginning and middle of their careers, point out that datasets carry little weight in academic evaluation compared to traditional articles and monographs. Our survey reveals a similar paradox: while 3D digitization is widely practiced, most outputs are converted into 2D documents, primarily orthophotographs and digital terrain models. Native 3D models remain in the minority in scientific exploitation. This 'reduction' from 3D to 2D reflects technical, institutional and cultural constraints linked to working habits rooted in 2D representation.

9.3 *Individual initiatives*

The three surveys document a 'bottom-up' dissemination dynamic, driven by individual initiatives rather than by structured institutional frameworks. H2IOSC notes that individual initiative plays a central role and that practices remain dependent on personal trajectories. Our survey confirms this observation: the majority of 3D digitization skills are provided internally by multi-skilled staff, and decision on applying 3D acquisition methods is often made solely by the operations manager. This fragmentation is compounded by a lack of standard formats. H2IOSC reveals that a significant proportion of respondents are unaware of metadata file standards. Our survey confirms this: despite the proliferation of 3D productions, no common protocol has emerged regarding formats, resolution levels, naming conventions, or associated metadata. This lack of standardisation compromises the interoperability and reuse of data in the medium and long term.

9.4 *Distinct motivations*

In our sample, which mainly consists of preventive archaeology practitioners and local authorities, saving operational time is overwhelmingly the dominant theme. 3D is primarily seen as an effective tool for speeding up field recording and quickly producing working documents. This pragmatic concern reflects the constraints of preventive archaeology. Conversely, the Consortium 3D survey, which mainly covers research establishments, places data analysis in first position, explicitly highlighting the heuristic value of 3D and the hope of obtaining results that could not have been achieved without these tools. Conservation and mediation occupy secondary positions. H2I-OSC, covering the entire spectrum of heritage sciences, reveals a third logic centred on data management and circulation. The dominant concerns relate to interoperability, sustainability, and the aggregation of heterogeneous resources, as evidenced by the creation of dedicated platforms.

9.5 *Funding: a revealing blind spot*

The Consortium 3D survey sheds unique light on the financial dimension, which is absent from our own survey and that of H2IOSC. It reveals a wide disparity in access to resources: a significant proportion of projects receive substantial funding, while others operate without dedicated funding. It also sheds light on priority investments: half of the budgets are devoted to photographic equipment for photogrammetry, a significant portion to processing software, and only a small portion to computer equipment, revealing an imbalance between data acquisition and exploitation.

9.6 *Prospects for change: consensus and differences*

Regarding future prospects, a consensus is emerging on the need for better institutional structuring and greater access to continuing education. However, the priorities expressed differ significantly depending on the profile. Our survey emphasises the systematisation of drones and the development of practical skills, reflecting immediate operational needs. The 3D Consortium favours the development of software specifically dedicated to the humanities and social sciences, as well as improved data sharing and interoperability, reflecting methodological concerns. H2IOSC, for its part, calls for institutional recognition of digital skills in job descriptions and evaluation criteria, the creation of dedicated professional networks, and the development of shared platforms. Significantly, both our survey and that of the Consortium 3D reveal minority but persistent voices warning against excessive systematisation, fearing that institutions will value performance at the expense of interpretative analysis.

The three surveys converge on one essential point: the urgent need for institutional structuring that goes beyond individual initiatives, guarantees the sustainability of skills, and recognises the production of digital data as a scientific contribution in its own right.

10. Conclusion

The survey of 175 archaeology professionals provides an overview of 3D digitization uses for 2021 and 2022 (Delamare 2024, 98-219), as well as expectations and perceptions related to the integration of 3D acquisition into archaeological practices. It highlights the growing spread of these tools since the 2010s, especially in France, driven primarily by internal team dynamics and individual initiatives rather than formalized institutional frameworks.

The professionals surveyed recognize clear benefits associated with the use of 3D digitization: time savings, accuracy of surveys, the possibility of returning to raw data, and diversity of restoration and interpretation media. Today, 3D is perceived as an effective methodological tool, a vehicle for scientific restoration, and a lever for promoting heritage.

However, this evolution remains uneven and fragile. The identified obstacles, technical, human, and institutional, still limit the spread of these practices. Time, a cross-cutting theme of the survey, crystallizes this ambivalence: both a resource to be saved and a constraint to be managed, it strongly influences methodological choices. Nevertheless, the views expressed are clear: those working in the field want to see better integration of 3D digitization, not as a gadget or a secondary promotional tool, but as a genuine scientific tool in its own right. This development requires concerted action: investment in training, structuring of professional networks, recognition of skills in job descriptions, and development of tools adapted to the humanities and social sciences.

Beyond the technical aspects alone, 3D raises broader questions about contemporary changes in archaeological work. It redefines the timing of actions, the distribution of tasks among agents trained in 3D, the forms of restitution, and the methods of communicating results. In this sense, it bears witness to the evolution of digital practices in heritage professions.

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ABSTRACT

This article presents the results of a survey conducted between 2021 and 2022 among 175 archaeology professionals, mostly in France (88%). The aim was to analyze the uses, impacts, and future perspectives of 3D digitization tools in archaeological practice. The data, collected through a 24-question online form, were processed using statistical and lexicometric methods. The findings reveal a growing but uneven integration of 3D digitization methods, driven by practical needs and individual initiatives rather than institutional mandates. Key motivations include time-saving, accuracy, and data visualization, while main obstacles relate to equipment, training, and official recognition. The article concludes by calling for structured training programs, institutional support, and the development of shared standards to foster a sustainable and professionalized use of 3D digitization in archaeology.