Documenting information making in archaeological field reports

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Abstract

Purpose – Sharing information about work processes has proven to be difficult. This applies especially to information shared from those who participate in a process to those who remain outsiders. The purpose of this article is to increase understanding of how professionals document their work practices with a focus on information making by analysing how archaeologists document their information work in archaeological reports.

Design/methodology/approach – In total 47 Swedish archaeological reports published in 2018 were analysed using close reading and constant comparative categorisation.

Findings – Even if explicit narratives of methods and work process have particular significance as documentation of information making, the evidence of information making is spread out all over the report document in (1) procedural narratives, (2) descriptions of methods and tools, (3) actors and actants, (4) photographs, (5) information sources, (6) diagrams and drawings and (7) outcomes. The usability of reports as conveyors of information on information making depends more on how a forthcoming reader can live with it as a whole rather than how to learn of the details it recites.

Research limitations/implications – The study is based on a limited number of documents representing one country and one scholarly and professional field.

Practical implications – Increased focus on the internal coherence of documentation and the complementarity of different types of descriptions could improve information sharing. Further, descriptions of concepts that refer to work activities and the situation when information came into being could similarly improve their usability.

Originality/value – There is little earlier research on how professionals and academics document and describe their information activities.

Keywords Archaeology, Work practices, Documentation, Reports

Paper type Research paper

Introduction

A reoccurring observation in the studies of information and work has been that tasks and work as a whole are difficult to describe in high enough granularity to be comprehensible for someone who is not skilled in that particular practice (Bødker, 2009). At the same time, the proficient insiders themselves can have difficulties to explain what they do and how they know (Bouwman *et al.*, 1987; Ciborra and Lanzara, 1994). The lack of useful descriptions of information work practices, key concepts and tacit domain specific knowledge may not be a major issue for the insiders who are in the middle of things happening (e.g. Widén-Wulff and Davenport, 2007). It is, however, a major obstacle for newcomers, cross-disciplinary and professional collaborations, as well for sharing of information across diverse existing and

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potential contemporary and future stakeholder groups (Szostak *et al.*, 2016; Pardo *et al.*, 2006). From the perspective of outsiders, a better understanding of the insider descriptions and improving their usefulness would be highly welcome. Despite the extent of earlier research on information and work practices across different domains, there is a gap in the literature relating to studies on how professionals and academics document and describe their information activities.

The aim of this article is to increase understanding of how professionals document their work practices and information making by looking closer at how archaeologists describe their documentation work in archaeological field reports. As a field without rigorously standardised gold-standard workflows and where information making practices vary (e.g. Morgan and Wright, 2018; Khazraee, 2019), archaeology provides a useful context for investigating the question. The study draws on an analysis of a sample of 47 Swedish fieldwork reports from 2018. The findings suggest that archaeologists refer in diverse ways to the different elements of *information making* (Huvila, 2018) activities in their reports and that the reports convey information in terms of correspondences of different documented elements rather than as coherent procedural descriptions.

Literature review

Archaeological practices and information work

Archaeological work has been investigated from multiple disciplinary perspectives. Studies of archaeological fieldwork, for instance, in anthropology, archaeology and information science have underlined the situated, sociomaterial and tacit dimensions of archaeological practices and information work (e.g. Davidović, 2009; Edgeworth, 2003; Morgan and Wright, 2018; Khazraee, 2019). The national and sub-disciplinary variation is also considerable (Duval *et al.*, 2019; Kristiansen, 2009; Bofinger and Krausse, 2012). Much of the archaeological literature (e.g. Lucas, 2012; Chippindale, 2000) has been, as Currie (2018) remarks, pessimistic of the capability of the archaeological record to convey exhaustive information about the human past. Consequently, this has led to an epistemic pessimism of the limits of our capability to know about it. It is apparent that there are limits to what can be known and one of the central differences between archaeology and, for instance, physics is that whereas the latter can literally produce more evidence by experimenting, the first-mentioned can only capture evidence that is already there (Turner, 2007) and work with traces and surrogates (Wylie, 2019). Currie (2018, 2019a) advocates for a greater epistemic optimism in historical sciences, including archaeology, but acknowledges further that the reason to be optimistic or pessimistic depends on the epistemic situation, i.e. on when and on what premises inferences about different aspects of the past are to be made.

The shortcomings in the archaeological record and both broader epistemological, technical and small mundane limitations (Currie, 2019b; Huggett, 2020) in the capability of archaeologists and archaeological practices to capture everything, are compensated by the elaborate and multi-faceted information work archaeologists engage in (Huvila, 2018; Currie, 2019b). Archaeologists use and produce a broad variety of information sources from the physical archaeological stratum and finds to written documentation, photographs and diagrams (Huvila, 2014) and rely on multiple modalities of informing and getting informed from reading and writing, to discussing (Morgan and Wright, 2018) and engaging physically (Olsson, 2015; Hodder, 1997) or virtually (Dell'Unto *et al.*, 2017) with diverse forms of evidence. In archaeology (similarly to historical sciences in general, cf. Currie, 2019b), there is a lot of room for missing and misunderstanding of information and data (Hand, 2020; Huggett, 2020).

However, even if archaeological data are "shadowy" (i.e. fragmentary and there are different understandings of what counts as data and when, Wylie, 2017) there is a lot of explicit and implicit, intentional and unintentional "marginalia" (Huggett, 2020; McClelland,

2016; Fajkovic and Björneborn, 2014) that can help archaeologists in "taking" information someone else has made (Huvila, 2018). Archaeologists' reliance on tacit knowledge (Davidović, 2009) as a complement to explicit evidence is also helpful when working with incomplete information especially in well-known local contexts they are familiar with. As a whole, instead of being linear and frictionless, the archaeological information process is better characterised either as a discontinuum (Buchanan, 2016) or a continuum of information making and information taking (Huvila, 2018) similarly to how the archaeological chains of inference and justification are closer to being "mosaic[s] of interdependencies" rather than hierarchies (cf. Currie, 2019b). As information workers, many archaeologists are closer to being, as Lynch (1990) put it, bricoleurs than engineers.

Documentation of scholarly and professional practices

The question of sharing knowledge beyond mere information exchange has been in the focus of enquiry especially in the people-centric (Ackerman *et al.*, 2013) practice and organisational learning oriented information and knowledge management research (Huysman and De Wit, 2002). A key conclusion of that specific line of research has been that it is difficult to document what people know, i.e. to make tacit knowledge explicit (Choo, 1998) and to turn knowledge to (informative) information. Sharing procedural expertise is difficult (Hinds and Pfeffer, 2003). Because of the lack of experience in thinking of their doings in terms of documentation, even the practitioners themselves might have difficult to describe what they do (Doyle, 2009; Carr, 2005; Fook *et al.*, 1997) and it is not always prioritised (Raghu and Vinze, 2007; Stenmark, 2000). As the work of Valtonen (2007) shows, procedures do not stick to documentation if they are not explicitly enumerated, and as for instance Button and Harper (1996) note, the documentation does not necessarily correspond with what is being done in practice. Instead, practices and procedures can be easier to share by action (Hew and Hara, 2007).

In spite of the difficulties, people have developed diverse strategies to make their work visible (Suchman, 1995), for instance, by engaging in articulation work (Fjuk *et al.*, 1997), using narratives (Geiger and Schreyögg, 2012), check lists (Auvinen and Arminen, 2013; Russ *et al.*, 2013), process and sequence diagrams (Nunes *et al.*, 2009), tool applications (Jordan *et al.*, 1998; Wolf *et al.*, 2013), knowledge brokers (Meyer, 2010), formal models (e.g. Daquino *et al.*, 2020) and meta-models (Gonzalez *et al.*, 2016), or information professionals (Choo, 2000) and codifying knowledge in structured databases (Brown and Duguid, 1991; Cox, 2005). ISO 9001 quality management standard provides a three-layer scheme for documenting processes by outlining *procedures* to perform processes and using *work instructions* to describe specific tasks within processes (Abuhav, 2017). Even if the documentation of work practices is often problematic, sometimes the problem is not that such documentation does not exist but that it is not distributed to everyone who might need it (Boh, 2007).

As the work of Nuninger and colleagues on the modelling of historical activities suggests, successful documentation needs to provide not only for technical but also conceptual interoperability (Nuninger *et al.*, 2020) of sociotechnical systems. Drawing on his work on scientific visualisation, Woolgar (1990) underlines further the importance of the efforts to document the "complex socio-technical relevancies of day-to-day investigation" (Lynch and Woolgar, 1990, p. 10). For instance, relating to instruments, it is relevant to know who did what, how the equipment worked when it was used last time, what has gone wrong earlier and might go wrong in the future. Woolgar (1990) stresses also that to reach an adequate description, participants benefit from juxtaposing documents with earlier documents. Earlier research on laboratory notebooks and documentation of scientific processes point to another problem. The descriptions of work practices have a tendency to manifest intentions rather than document how work was done (Plutniak and Aguera, 2013). Some studies have led to more optimistic conclusions and, for instance, Chao (2015) suggests that a lot of methods-related metadata can be extracted from research articles.

A parallel question to the adequacy and quality of descriptions is that their primary objective might not be to provide comprehensive transparency. Often the aim of exposing methods and sources in knowledge production (Sundin, 2011) is to create trust rather than to assume that the majority of information users would be interested in the procedures *per se*. Moreover, similarly to other types of documentation work (Geiger *et al.*, 2018), the motivation to describe work procedures can be compliance rather than a sophisticated desire to provide extensive documentation (cf. Mäkinen and Henttonen, 2011). The apparent possibility to use work process data to not only improve (Jacobs, 2019) but also to measure personal performance (Brown, 1996) and a general desire to safeguard personal professional renommée (Huvila, 2006), autonomy and position can lead to a reluctance to describe work procedures in detail (Garfinkel, 1967). However, when some detail of transparency in terms of the provenance of documents is given, it has been suggested to facilitate their use across communities (Østerlund and Crowston, 2013). Donnelly (2016) makes a similar observation of how even minimal descriptions of methodological approaches help archaeologists to understand how fieldwork was conducted.

The descriptions of scholarly and professional practices come in different forms and cover a large number of documentary genres. Earlier studies have found complementaries between different types of descriptions (Holmes, 1990). Alongside research reports, laboratory (Klokmose and Zander, 2010) and field notebooks (Fowler and Givens, 1995) and diaries, data papers have emerged as a new category of documents that describe scholarly and scientific practices related to specific datasets. Li *et al.* (2020) identified 17 different types of data events (i.e. actions that were directly and purposefully imposed on data and resulted in any change to the data) described in a set of analysed data papers. The most common reported action was data collection but the papers also described, to a varying extent, if data had been, for instance, analysed, identified, modified, registered, or removed. Authors note that in 8 out of 79 papers, there was no description of data collection at all suggesting a need for caution in assuming that data papers are *a priori* reliable sources of methods related information (cf. e.g. Chao, 2015; Kratz and Strasser, 2014).

The digitalisation of research processes and increasing demands for a better interoperability of scholarly information has instigated initiatives to develop taxonomies and frameworks for formal description and modelling of scholarly activities (Reimer, 2009). In the heritage domain, CIDOC Conceptual Reference Model (Doerr *et al.*, 2020) has been extended with additional schemes including CRMdig for documenting the provenance of digital products (Doerr and Theodoridou, 2011), CRMsci for modelling scientific observation, measurements and processed data (Doerr *et al.*, 2014) and CRMinf for argumentation and inference making (Stead and Doerr, 2015). For digital humanities scholarship, related initiatives include the concept of scholarly primitives (Blanke and Hedges, 2013) and for instance, NeDiMAH Methods Ontology (Benardou *et al.*, 2010), Scholarly Ontology (Pertsas and Constantopoulos, 2017) and comparable scientific taxonomies and ontologies for describing research activities (e.g. Soldatova and King, 2006; Takeuchi, 2010). Modelling formal workflows has gained traction especially in hard sciences (Davidson and Freire, 2008) but has been applied also in the context of humanities and social sciences (e.g. Asuncion, 2013; Apollonio *et al.*, 2012).

Report writing in archaeology

Archaeological investigation process in Sweden. The archaeological report is a central document of not only the results but also of the process of fieldwork in archaeology (Gustafsson and Magnusson Staaf, 2001; Rudebeck, 2015; Hodder, 1989). The greater part of archaeological fieldwork in Sweden is conducted in the context of contracted, mostly development-related projects (Söderström, 2018). The projects involve regularly both private

and public actors. In typical cases, the key stakeholders are a developer (often state agencies, construction companies and landowners), an archaeology contractor, the local county administrative board and as a national regulatory body, the Swedish National Heritage Board (RAÄ, 2015b).

Before development projects are started, the developer is expected to file an environmental impact assessment of the planned intervention (Schibbye *et al.*, 2007). The assessment is required to include an analysis of its impact on eventual archaeological sites in the area. This is conventionally determined in a pre-study conducted by an external archaeology consultant. If the conclusion of the assessment is that the project cannot be concluded without interfering with archaeological sites and it is deemed it should nevertheless be approved, an investigation project is put out to tender for documenting and removing the sites either fully or partially. Contractors are asked to submit an investigation plan and budget for the project with a schedule and a specification of how the site will be investigated and documented (Huvila, 2016b). The tenders are processed by the local county administrative board and discussed with the developer before a final decision is made.

When the investigation is complete, the contractor is expected to file a report at the county administrative board with information indicated in the contract documents. The time for writing a report varies considerably depending on the extent of the project. The author of a report is typically the project director who is also responsible for its contents. Sometimes they are written together with two or more senior colleagues. Appendices that are describing, for instance, C14 dating results and other special analyses are written by dedicated specialists. The county administrative board reviews the report before formally closing the case. In addition to filing the report, the contractors are expected to follow designated procedures for processing any physical finds retrieved during the investigation and filing information in the national sites and monuments registry with the Swedish National Heritage Board. Even if contractors are also expected to archive other documentation material (RAÄ, 2015b), the report tends to be in practice the main outcome and document of an investigation. Even if the lack of use of archaeological reports has been widely criticised (Aitchison, 2010), they are a key source of information for research, decision-making and future investigations in the area (Börjesson, 2015; Huvila, 2014, 2016b).

Reports and report-writing. Perceiving archaeological reports as objective representations or subjective accounts has varied depending on individual epistemological views (e.g. Sinclair, 1989, cf. Tilley, 1989; Huvila, 2016a). Even if they are by no doubt more numerous than any other type of archaeological literature, reports have had a relatively poor renommée as being uninspiring to read (e.g. Hodder, 1989; Opitz, 2018, cf. Lucas, 2019) and according to critics, too often superficial, uninformative and of low scholarly value (Huvila, 2020; Aitchison, 2010; Herva, 2009). Earlier studies have investigated how reports function as boundary objects between different stakeholder groups (Huvila, 2011, 2016a), how they cite the literature (Börjesson, 2015) and how reports and report writing reflect the theoretical fluctuations in archaeology (Hodder, 1989). Similarly to how instruments (e.g. pro forma sheets Olsson, 2016), aims and standards of collecting influence what is being collected (Wylie, 2017) also implicit and explicit standards of writing affect what is being documented. Even if the contents and narrative of the reports is regulated to a varying degree in historical environment legislation and guidelines (e.g. RAÄ, 2015a; Rudebeck, 2015), reports tend to show considerable structural and content-specific variation (Börjesson, 2015; Donnelly, 2016; Lucas, 2019) and with room for improving their quality (Gustafsson and Magnusson Staaf, 2001) – even if the general standard of reporting would be satisfactory (Huvila, 2016b). This applies also to how reports describe work process, instruments and grounds for conducting the work as it is described in the report (Gustafsson and Magnusson Staaf, 2001; Faniel *et al.*, 2013). Descriptions of what was done and why can be missing, or they can be implied as something too obvious to report (Collis, 2013).

Methods and material

A systematic sample of every tenth archaeological report filed in 2018 (55 out of 555 reports) and available at the grey literature repository of the Swedish National Heritage Board SAMLA was downloaded for analysis with help of a PHP script developed for extracting URIs of PDF reports from a search results page. The corpus was cleaned of eight works that were not investigation reports leaving ($N = 47$) documents for analysis. The final list of reports is deposited in a data archive and can be found at http://urn.kb.se/resolve?urn=urn:nbn:se:uu:diva-433827. The reports were analysed using an approach based on close reading (DuBois, 2003) of reports and constant comparative categorisation to identify elements relating to information making in the reports. NVIVO 12 was used in a preliminary coding of the material. In this article all quotes and terms have been translated from Swedish to English by the first author.

The material comes with apparent limitations. The number of analysed reports is fairly small; the material represents one country and a single scholarly and professional field. At the same time, however, archaeological reports are explicitly expected to document an archaeological investigation, i.e. a highly complex information making process in such detail that it is comprehensible for other professionals not only immediately after the investigation has taken place but also in the future. Therefore the material can be expected to be useful for the present, exploratory rather than confirmatory study of how information making is documented in a professional context.

Analysis

The analysis revealed seven broad categories of elements that were identified to convey information on information making. These include (1) procedural narratives, (2) methods and tools, (3) actors and actants, (4) photographs, (5) information sources, (6) diagrams and drawings and (7) outcomes. The extent and level of detail of documentation varied a lot in the studied material similarly to what was included in the documentation. Even if most of the reports tended to follow a roughly similar structure (including background, methods, process and results) prescribed by official guidelines (RAÄ, 2015a), there was a lot of variation in details that reminds of the earlier critique (Gustafsson and Magnusson Staaf, 2001) of the diversity of how administrative information is recorded in archaeological reports. As a whole, the background information relating to the investigated site was regularly much longer than the documentation of findings (as in Gustafsson and Magnusson Staaf, 2001) and especially the documentation of the investigation process. In somewhat rough terms, as the distinction between an account of information making and the information itself is seldom clear cut, the analysis revealed that the explicit descriptions of the investigation process accounted only for a few percent of the contents of a report.

Procedural narratives

Most of the reports contained a dedicated procedural narrative of both the methods and approach used in the investigation process and of the investigation process itself. The narratives are characterised by passive voice and are best described as authoritative or business-like. To exemplify:

> No objects were deemed to be of such kind that a more complex and time-consuming method, such as the single context [method], was considered necessary. (S52)

Whereas the methods descriptions were almost always fairly short and focused on methods and approach (exceptions, e.g. S10, S15, S33), the latter tended to be longer and structured as chronological, context by context narratives of the main findings.

The narratives used a large variety of terms to describe the archaeological process and how archaeological information was made in the field. The excavation could be conducted by "excavating" (e.g. S10, S28, S29) or more specifically, for instance, as machine trenching using a hydraulic excavator (e.g. S10, S11, S33, S44) or by excavating by hand (e.g. S10, S11, S18, S33, S44). Sometimes the descriptions contained additional descriptors such as exploratory machine trenching (Swe. provschaktning). Excavation consisted also of cleaning of features and surfaces by excavator or by hand (e.g. S17, S31), roughly (e.g. S2) or more carefully (e.g. S32), of the removal of topsoil (e.g. S12, S25, S32, S40) (test) drilling (e.g. S30, S44), or sectioning with an excavator (e.g. maskinsnittning, e.g. S44). Observation could similarly be conducted by inspecting (e.g. S38, S44) surveying (e.g. S15, S26); supervising (e.g. S32, S46, S50), monitoring (e.g. S35, S41), encountering (e.g. S10, S40), seeing (e.g. S18), reviewing (e.g. S3), finding (e.g. S33, S36, S48), discovering (e.g. S40) and noticing (e.g. S45). Similar variation applies to the terms used to describe collecting, capturing and taking of samples, finds, photographs and measurements (e.g. S2, S10, S19, S25), documenting them using various tools (e.g. S4, S8, S20, S23, S33, S45), analysing, contextualising and interpreting them.

Apart from the large variation in terminology, the narratives and argumentation varied also in their level of detail. Reporting mistakes or lack of success was uncommon (exceptions S10, S25) Sometimes activities were hardly mentioned whereas others were described in detail. The use of generic terms (e.g. excavate in S10) and reflections such as a feature was "interpreted as" (S20) something, or that "several indications show" (S25) without enumerating any specific evidence point to a perceived uncontroversiality of the interpretation, or a relative unimportance of how something was excavated. For instance, while some reports make a generic remark of hand-drawing or photographing (e.g. S33, S55) during the project, in most of the cases no such mentions could be found. The same applies to the detail of describing archival work. Sometimes it is mentioned in a narrative (e.g. S12, S15, S17, S21, S29, S32) but other times, even if it is not explicitly described, for example, the list of references show that it was done (e.g. S18, S55). Somewhat rarely, the narratives include what was not done, for instance, when particular types of samples were not collected (S40) or a particular method was not used (S40), for instance, because it was considered unnecessary.

Several underlying factors can be traced behind the dissimilarities between the reports. Individual preferences of investigating archaeologists and in-house reporting conventions of different archaeology contractors explain much of the variation. Some individuals and contractors appeared to prefer shorter (e.g. S19, S14) and some others longer descriptions (e.g. S7, S35). Some of the reports very obviously made a significant effort to explain the process for non-specialists (e.g. S33, S51) whereas the large majority seems to have been written primarily with fellow archaeologists in mind. The type of investigation is another apparent factor that influences what is being reported. Reports of desk assessments tend to describe archival research in more detail (e.g. S15, S23) whereas in fieldwork reports the emphasis of documenting information making is in field methods (e.g. S3, S10). Further, if the investigation found nothing of archaeological interest, both the report and the narrative of investigation procedures tended to be shorter than when something was found (e.g. S49, S28, cf. S15, S20, S36). Finally, there were notable differences between the report text and appendices that described additional scientific (e.g. C14 dating, tree species analysis, osteology) analyses conducted by external experts. An obvious difference was that the external reports described paradigmatically scientific rather than archaeological work. Also, in comparison to archaeological reporting, the reporting of sub-contracted analysis tasks were considerably more specific and clearly defined.

Methods and tools

References to names of methods and procedures were rare, suggesting that the projects followed a "usual documentation" (S47) procedure rather than a specific method chosen

among several possible alternatives. Only a handful reports name the used fieldwork approach, for instance, as context or single-context method (S47, S51, S53).

In contrast, the reports contain a lot of references to different tools used during the investigation. Reports refer both to tools used in digging, i.e. how the documented information was made visible or available for capturing and to documentation instruments. In the first category, reports describe how the excavation was conducted using trowels (e.g. S2, S5, S10, S33, S51), shovels (e.g. S5, S7, S31, S51), pointed hoes (e.g. S2, S33), picks (e.g. S5, S7), in more generic terms using "hand tools" (e.g. S12) and in many cases at least partly using a hydraulic excavator (e.g. S10, S12, S17, S18, S31, S33). Reports could also describe if the excavated Earth was sifted dry or wet and what sieve size was used (e.g. S55).

The level of details varies considerably between individual reports. Some provide very detailed accounts of different types of tools and methods whereas others lack such references. Many report writers seem to have a clear tendency to describe complex tools in more detail than simple and mundane utensils. Describing the specific type of hydraulic excavator and bucket used at the excavation and the type of GPS (e.g. S18, S33, S55, S45) but not the exact model (exceptions S8, S51) was fairly common whereas hand tools or photographic equipment were described more seldom in similar detail. Perhaps somewhat counterintuitively, the make of metal detectors was mentioned only in S27. A plausible explanation to these tendencies is that it makes a difference to the results (retrieved information) if a site is excavated using smaller (trowel) or larger hand tools (e.g. shovel or hoe), or smaller or large excavator with smaller or larger bucket and documented with a more or less accurate GPS unit. In contrast, knowing the exact model of a GPS receiver or digital camera is not necessarily as crucial – especially because in many cases such technical information can be found in metadata embedded in the documentation data.

Actors and actants

In a report, individual human actors and other actants tend to remain fairly anonymous. The name of the field director is always written down and eventual other investigators are usually named in the reports either as members of a project group (e.g. S20, S32, S51) or by explaining their role in the project, i.e. who participated in the fieldwork or compiled the report (e.g. S11, S15, S25). Several investigations were conducted by a single archaeologist (e.g. S2, S18, S19, S23, S26). In general, individuals are mentioned usually only in relation to specific activities and analyses almost only when they are referred to as expert authorities (e.g. S10, S25, S31, S39, S51, S55 partial exceptions S32, S44). The report S10 refers to the "investigating archaeologist" without specifying which one of the three individuals she or he was.

Somewhat rarely, apart from experts who have conducted particular types of analyses, the reports could also refer to sub-contractors (e.g. S4, S20, S51, S53) and landowners (e.g. S27) as actors. In addition to individuals, many reports refer to the contractor as the principal subject of the investigation, for instance, by stating that the contractor "carried out" (e.g. S1, S21) or "performed" (e.g. S10, S20) the investigation. The reports could refer to organisations (e.g. S44, S15) rather than individuals (or both as in S52) also when acknowledging external expert work.

Apart from archaeologists and organisations, the reports assign agency to material things. The investigated site could be referred to as if it was an actor or actant. The site and its boundaries could limit what information could be retrieved or created (e.g. S33). A part of the frequent use of passive voice to describe how things were "found" (Swe. "påträffades") or how information, knowledge and interpretations "emerged" (Swe. "framkom" e.g. S7, S10, S15, S52) or "came into sight" (e.g. S33) and that "remains were documented" (S33) can be undoubtedly explained by conventions and conscious or unconscious objectivist epistemological assumptions. At the same time, however, it makes the site an actor (e.g. S7, S10, S12) and

information "maker". In addition to the site, also the wider physical environment was sometimes described in comparable terms. Sometimes the report could remark that the environment and conditions were favourable or that they had no significant effect on the investigation (e.g. S11, S27). In other cases difficult terrain, bad GPS signal (e.g. S19, S33, S46), or the potential presence of hazardous waste (e.g. S55) could hamper archaeological work and information making.

Photographs

Most of the reports contain several photographs depicting the investigated site, its surroundings and different details and phases of the investigation. Many reports show photographs of archaeologists doing fieldwork (e.g. S5, S32, S51, S53, S55). Considering that a good proportion of these images are on the covers of the reports, many of them seem to fulfil a generic illustrative rather than a specific documentary function. The relative anonymity of reporting is sometimes, albeit seldom, broken in photographs of on-going work. At times, captions mention individuals by name. Closeups are rare but sometimes an individual is identifiable in a photograph (e.g. S5, S20, S38). Even cases when the images depict a clean uncovered trench or feature, they provide cues of how and how carefully the work had been conducted (e.g. Fig. 48, cf. Fig. 52 in S51).

Sometimes when excavation and documentation tools are not described in text, they can be spotted in the photographs (e.g. Fig. 8 in S12; Fig. 11 in S20; Fig. 5 in S45; Fig. 9 in S51, Fig. 8 in S53; Fig. 12 in S55). In some cases, it seems probable that they are used to help to understand the scale of the depicted features (e.g. Fig. 79 in S51) while sometimes, it seems likely that including them in the view has not been intentional (e.g. Fig. 19 in S44). Photographs of hydraulic excavators are conspicuously popular (e.g. S11, S12, S38, S53) much similarly to how often they are described in text.

Citations

Similarly to scholarly communication in general, one of the functions of citing literature and other information sources in the reports is to contextualise and document the information conveyed in the report and to justify claims that are not based on first-hand observations. Reports described to a varying degree consultation of archival material and maps (e.g. S15, S17, S18, S21, S23, S53). Some describe the studied materials in detail and make specific references to earlier finds from the studied site, old maps, works of local history (e.g. S48) and other "material" (e.g. S33). Several reports note where information was sought (e.g. information systems and archives like FMIS, SAMLA, SHM, ATA), some contained detailed discussion of the available material (e.g. S47) whereas others explained that "relevant" material was consulted (e.g. S48). Almost all reports contain references to the literature with an emphasis on grey literature (primarily investigation reports). Some reports cited also published literature and academic theses (e.g. S8, S20, S27, S32). References to methodological literature are rare, and when present, related to non-standard and non-archaeological methods (e.g. building methods as in S10). The reports account for, also in varying detail, information given in the contract documentation and guidelines issued by the county administrative board (e.g. S10) but in general explicit references were uncommon. Here it is relevant to note that the administrative registration reference numbers (Swe. diarienummer) of the projects indicated in the reports link them together with other documentation relating to the specific case. Therefore, an explicit repetition of the guidelines may appear superfluous for a good reason. Apart from written sources, some reports also mentioned oral communication with experts or, for instance, with current or former owners or inhabitants of investigated sites (e.g. S20, S27) and examination of earlier finds from the area (e.g. S23).

Outcomes of information making

Apart from explicit references to information making and its underpinnings in the form of literature and the features of the investigated site, its outcomes (i.e. documentation materials) are indicative of the process. Similarly to how a photograph shows traces of how a site was excavated, the documentation suggests what was done. A stratigraphic matrix or a list of contexts (e.g. S47) or "archaeological objects" (e.g. S52) point to a context based excavation approach. A reference in the data tables (e.g. S20) or particular outlook of plans, section drawings and, for instance, legend of cartographic symbols (e.g. S44–45) can similarly be indicative of the use of particular analysis programs. Descriptions of retrieved finds and analysed samples evince of what was collected and analysed. Moreover, the types and size of finds could provide hints of the granularity of investigation (e.g. S36, cf. S55) and the vocabulary and interpretations of the methodological and theoretical underpinnings that guided the investigation (e.g. references to excavation and documentation method, e.g. S20, S36, cf. S51). Finally, even if the digital PDF documents are relatively clean of unintentional marginalia, the documents themselves contain metadata on what software packages (i.e. word processor or desktop publishing software and PDF converter) were used to produce the file itself.

Discussion

Documentation of information making

The analysis shows that information making is and becomes documented in multiple forms and modalities in archaeological fieldwork reports. In comparison to British reports studied by Donnelly (2016), in the analysed Swedish sample citations and direct references to guidelines and standards were rare. A glance at quantities confirm the earlier observation of Gustafsson and Magnusson-Staaf (2001) that many reports have a tendency to focus on background rather than on the investigation process and its outcomes. There are many conceivable reasons. Background information of earlier investigations, the environment and local history is used to inform the fieldwork and thus available for reporting. Many investigations are small and the new findings can be both few in number and more difficult to articulate in comparison to the accumulated knowledge available from earlier information sources.

When interpreting the findings of the study and especially their applicability outside of the context of archaeology, it is, however, necessary to take into account the limitations of the material and analysis method. The analysed reports cover only a sample of all reports published during one year in Sweden. Reporting practices change in time and differ from one country to another. Further, even if the reports were analysed by a researcher with an extensive experience of working with and on archaeological information for over two decades, it is impossible to rule out that in individual cases certain tacits forms of conveying information on information making procedures might have remained invisible for a researcher without a specific indepth experience of a particular investigation site or context. Moreover, when it comes to understanding professional documentation of information making practices, the present findings are directly applicable only to archaeological documentation even if it is likely that the identified themes and means to convey information about information making are not necessarily limited to a single domain. Both the techniques of documenting information making by developing procedural descriptions, describing tools, actors and outcomes of work, using multiple media forms and citing earlier literature, and reasons to produce particular types of documents have parallels in other contexts.

A part of the information in the reports describing work procedures was unmistakably created and included in the report as explicit documentation of information making and archaeological work in general. These passages include narratives of work processes and

descriptions of tools, i.e. similar strategies of articulation work (Fjuk *et al.*, 1997) used in other contexts of professional and scholarly work (Geiger and Schreyögg, 2012). In contrast, apart from narratives, the report writers used a limited repertoire of formal instruments such as diagrams or formal models (e.g. Nunes *et al.*, 2009; Daquino *et al.*, 2020; Soldatova and King, 2006; Bruseker *et al.*, 2017) for making their work visible. Similarly to context and finds sheets (Olsson, 2016) that are nowadays conventionally used to document information that ends up in reports, the reports themselves are oriented towards documenting objects rather than processes. Considering the variations in the descriptions of instruments and their models and, for instance, versions and names of software packages (that were often missing; similarly to Gustafsson and Magnusson Staaf, 2001) used in the investigation, it seems that the tools that were mentioned, are all to a certain extent characterisable as "exceptional technologies" (Smith, 2018). Some of the tools that warranted specific attention were probably perceived remarkable and worth mentioning in the situation-in-hand because of their epistemic implications or their cost (e.g. a part of the references to hydraulic excavators and bucket size, GPS devices, or sieve size), or that they had been institutionalised as such in guidelines, policies or conventions (e.g. RAÄ, 2015a), for instance, as in the case of C14 dating software or types of GPS units. When tools were not mentioned they were clearly not exceptional enough for the report writers – even if that information might turn out to be useful for their readers.

In addition to explicit descriptions, however, results, lists of finds, literature references, maps and choice of words mediated not only topical information but provided cues of how they probably had come into being. Much of these traces are best described as marginalia (Huggett, 2020; Goodwin *et al.*, 2017) but as such they are indicative of the mundane doings of information making. This applies perhaps especially to photographs. In comparison to the situation two decades back (Gustafsson and Magnusson Staaf, 2001), they are used generously in reporting. Similarly to tables and diagrams they revealed sometimes, for instance, what documentation tools were utilised (e.g. S20, S44–45).

As a whole, even if it was possible and to an extent meaningful to identify categories and specific elements that are telling of the archaeological process, at the same time, a report is more than a sum of these individual elements. It was apparent that sharing knowledge about work procedures is a difficult undertaking (Hinds and Pfeffer, 2003; Choo, 1998) and a report leaves many aspects of archaeological work invisible (as in Olsson, 2016) both deliberately and unintentionally. Similarly to reports as whole (Huvila, 2016a), the descriptions of information making evince how they were authored to disclose and maintain control of various aspects of the process for the benefit of the contractors, heritage administration and its other stakeholders and to help the reports to function as administrative evidence of completed projects, as boundary objects, scholarly relevant information and public documents of particular archaeological sites. Even if not necessarily always intentional, the distinct manner of describing work procedures is undoubtedly also symptomatic of the earlier documented strive in professional documentation (e.g. Heath and Luff, 1996; Huvila, 2006; Börjesson, 2016a) to maintain the status of investigating archaeologists as competent professionals.

The diversity of the means of how information making is documented in the reports suggests that rather than being a specific element or component of a report, it unfolds as an assemblage of different elements linked to each other according to a set of partly tacit, partly explicit rules, conventions and traditions that guide archaeological field documentation as a whole. Similarly to what Lucas (2019) notes of reports as a whole, information making is also documented using multiple text types, genres and registers. In addition to being explicitly a document, the assemblage as a whole acts as a strategic artefact (or resonator as for Lemonnier, 2012) that embody non-verbal communication and social conventions and relations. They provide asymmetrical redundancy by providing multiple entries to the same information and at the same time, they condensate (Lemonnier, 2012) the documentation by conveying implicit understanding of what happened between the explicitly inscribed details.

At the same time, the assemblage spreads beyond an individual report. As Woolgar (1990) suggests, deciphering a document requires juxtaposing it to other documents. Understanding the documentation of information making in a specific archaeological report requires insights not only in that particular assemblage of documentary elements but in the genre of archaeological reports as a whole. The same is plausibly applicable to other documents of professional information making as well. Instead of focussing on procedural descriptions as independent pieces of documentation, especially in complex and open-ended contexts of information making and use, the indirect and explicit documentation should be conceived as interlinked parts in a broader assemblage of documents. Apart from providing a better understanding of information and its making, a closer consideration of the assemblage as a whole can also be helpful in assessing how well the explicit procedural descriptions correspond with what was done in practice (cf. Button and Harper, 1996; Plutniak and Aguera, 2013) and to compensate for descriptions that are difficult to produce or acquire due to technical (cf. e.g. Doyle, 2009; Hew and Hara, 2007; Carr, 2005; Fook *et al.*, 1997) or motivational reasons (cf. e.g. Garfinkel, 1967; Huvila, 2006; Mäkinen and Henttonen, 2011).

Boundaries of the black box

A parallel question to how to conceptualise the traces of information making in archaeological reports is how to understand them in relation to their intended function. In contrast to the ideal of open research and processual transparency, in practice, the function of procedural descriptions and documentation of information making is only partly to open the black box of how information is made. Tendencies to black-boxing of methods, criticised by Leighton (2015) and identified by Donnelly (2016), can also be seen in the use of a large variety of methods related terms and lack of explicit descriptions of what was done. One conceivable reason is what Turkle (2007) describes as a human inclination to consider tidy and ordered "front room knowledge" as true and our consequential tendency to "mask our anxieties about the chaotic state of the little that we know" (Turkle, 2007, p. 321). It is neither implausible to assume that the lack of details can sometimes be explained by a strive to protect professional image and position (as in Huvila, 2006; Garfinkel, 1967). Others (e.g. Neerincx and de Greef, 1993) have pointed to the counter-productivity of providing non-experts with superfluous information, indicating the possibility that the same might apply to rich descriptions of information making. Similarly to other accounts of professional (e.g. Chong and Bourgoin, 2020), scholarly and scientific work (e.g. Latour, 1987) and non-academic knowledge production, for example, in Wikipedia (e.g. Sundin, 2011), a major rationale of archaeological documentation of information making is to build trust. To this end, transparency is not always the best or most economic approach. Even if transparency can be useful as a facilitator of trust, from the report authors point of view, a necessary degree of credibility can be attainable also by other means and in various levels of detail. An apparent strategy in the analysed reports (also in Lucas, 2019, p. 116) is to refer to formal authorship of documents either in technical sense of making information in practice, or assuming responsibility for it (on authorship, Huvila, 2012) as a first-hand witness (Lucas, 2019) or originator. However, formal language (Lucas, 2019) and passive anonymous voice (Huvila, 2017) can be similarly effective. Østerlund and Crowston (2013) note that some degree of transparency regarding the history of documents facilitates their use as boundary objects (Star and Griesemer, 1989; Huvila *et al.*, 2017) i.e. allows members of diverse communities to understand where they are coming from. Considering the diversity of accounts of information making in the studied corpus of archaeological reports it seems likely there are different views of how and to what extent it can and should be done. Reasoning and trust can be outsourced to external cognitive authorities (Wilson, 1983), whether they are experts in particular analysis methods, organisations (e.g. laboratories in S44, S15) or entities such as particular technical

instruments that reminds of what Sundin and Carlsson (2016) write about outsourcing trust to search engines. In such cases indicating a name and credentials can provide enough transparency but as the analysis shows, there are situations, when the report authors had chosen to provide long and detailed narratives of work procedures instead.

Correspondences

A major problem with describing the documentation in terms of an assemblage is that it provides little help to decipher it in other terms than pointing towards advantages of comprehensive domain and genre knowledge and eventually, engagement in relevant thought collectives or communities of practice. Ingold's notion of correspondences might come to help and provide insights into how to think about the assemblage. It directs attention to the relations of different types of documents in the assemblage and their links to their makers and the doings they are documenting. Alberti (2018) suggests further that correspondences can be potentially helpful for archaeologists to understand archaeological research processes. Moreover, similarly to how Ingold uses it to expose similarities between such seemingly different undertakings as arts, crafts and science (Ingold, 2017), it can help to understand why report writers have chosen to describe information making and its constituents in the terms they have chosen.

Documentation of information making does not happen *while* information is made but, paraphrasing Ingold (2017), it is done as a part of an undergoing information making. Ingold's notion of *corresponding* directs attention both to the wilful acts and what an information maker is undergoing when making information and documenting it, to the in-betweenness of agency, and how information making unfolds as a mix of intentions and of attention to the situation of the information maker. Conceiving information making as a series of correspondences rather than as a linear process initiated and performed by a human actor can help to understand why a part of it is described as intentional doing of individual and institutional actors, why some observations and doings merely happen (in passive), why certain aspects of work require more thorough description and why some others hardly warrant a mention. Following and describing these links expose top view what information professionals find necessary and relevant to share, what needs to be shared, how and perhaps most importantly, what information does not need to be explicitly shared to whom. In the world of correspondences, information making happens *with* an archaeological site or another locus of activity, tools, methods and colleagues that become worth mentioning and documenting only when their presence kicks in hard enough. When it is happening, information making is, however, not merely taking place. As the local appropriation of standards show, corresponding itself happens in correspondence with the agency and authorship of information and reality (as, e.g. in Huvila, 2019 and Olsson, 2016) and is intertwined with volitional information making, for instance, about information making itself.

As a whole, the findings suggest the presence of documentary conventions that could be argued to follow a certain diagrammatic form of aesthetics (cf. Law and Lynch, 1990). Both the etiquette of visual representation, business-like tone of reporting, use of photographs to illustrate the work, clean trenches, passive voice and relative anonymity (cf. Huvila, 2017), description of tools and the choice of words that are partly regulated in the official guidelines (e.g. RAÄ, 2015a) and partly through normative customs, evince of the existence of ideal of good, reliable and elegant description of archaeological work that parallels to the degree with the documentation practices in other fields of scholarship (cf. Turner, 2019). Interestingly enough these conventions seem to be at least partially at odds with the perceived importance of personal communication and insights of people who did the work (cf. e.g. Börjesson, 2016b; Huvila, 2014). As a whole, the differences suggest situational and individual variation in what is considered useful and meaningful. Report writing is, similarly to the scholarly work

described by Collins (1992), an exercise of piecing together a conceptual system within which the report writers are developing rather than applying rules. The conceptual interoperability (Nuninger *et al.*, 2020) of the documentation depends on the coherence of this system. In this respect a closer attention to correspondences, i.e. documenting documentation work from in-between information making and information taking and use, could be helpful in identifying what in the documentation is understandable, to whom and how. From this perspective, a prerequisite of a document that can capture "complex socio-technical relevancies of day-to-day investigation" (Lynch and Woolgar, 1990, p. 10) and is capable of informing about the work that unfolded in practice (cf. Plutniak and Aguera, 2013) is that it conveys a reasonably complete conceptual system rather than merely enumerates a set of obligatory elements. In this sense the recommendation of Gustafsson and Magnusson-Staaf (2001) to describe the choice of methods in more detail captures the essence of how professionals do not document their work practices. It is obvious through the correspondences in the situation-in-hand but might be incomprehensible when the information is shared and the documentation surfaces in another situation within or outside of the original professional or disciplinary boundaries. Even if information making would be a matter of corresponding, it unfolds as such only through the documentation as a whole. In contrast, explicit narratives take the will of an information maker as granted and do not turn the information maker, doing undergoing, or the concurrency of intentions and attention to a question requiring explicit attention.

Conclusions

The evidence of information making in archaeological reports is spread out all over the report document. Even if the explicit narrative explanation of methods and work process unfolds as a key section, it seems that documentation of information making is rather a matter embedded in correspondences than in the individual elements of documentation. Its usability is a question of how a forthcoming reader can live or correspond *with* it as a whole rather than how to learn of the details it recites. Even if the archaeological literature sometimes refers to the ideal of field documentation as means to redo an earlier excavation, it is unlikely that this is the intention of report writers and obvious that it is not what the documentation achieves. This might reflect the fact that, not least because of the influence of excavation as the archetypal approach of doing archaeology, the reproducibility of investigations has not turned to become a key concern of documentation. In the present study, the contrast between the focus on meticulous procedural descriptions in the attached scientific analysis reports and the lack of similar accounts in the fieldwork reports themselves, could not make this more apparent.

Even if it is undoubtedly difficult, there are different possibilities to make documentation of information making both in archaeology and in other contexts of professional information making and information sharing more accessible to both insiders and outsiders. Rather than assuming that a report is supposed to unfold the information making in detail, acknowledging its limitations is a necessary starting point. In parallel, instead of attempting a complete overhaul of documentation, it seems plausible to suggest that putting more focus on the internal coherence of documentation and that different aspects of work are explained in some means (either in narrative, diagrams, or for instance, through describing tools or outcoming information). Further, it would undoubtedly be helpful if key descriptive (and not only official) concepts such as different terms used to refer to work (in archaeology, e.g. excavation) and its documentation are explained in adequate detail. Finally, it would be beneficial if correspondences in the documentation were made visible through the explaining of the situation through which information came into being, rather than trying to develop a coherent narrative of a process that was in reality messy and disjointed.

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