Awkwardness of becoming a boundary object: mangle and materialities of reports, documentation data and the archaeological work

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Abstract

Information about an archaeological investigation is documented in an archaeological report, which makes it the boundary object par excellence for archaeological information work across stakeholder communities such as field archaeologists, heritage managers, and land developers. The quality of reports has been a subject of debate, and recently it has been argued that more emphasis should be placed on making primary research data at least similarly available. This study explores the changing materialities and reciprocal formation of documents and their users with the advent of digitization, and how documents form and lose their status as boundary objects in these processes. The study posits that in order to be functional, a boundary object needs to provide a disclosure that makes it accessible to cognate communities. Further, it shows how assumptions about the functioning of the human and nonhuman (material artifacts) influence the ways in which archaeologists conceptualize the preservation and archiving of archaeological information and the role and potential of different types of digital and paper-based documents. This article is based on an interview study of Swedish archaeology professionals (N = 16) with theoretical underpinnings in the notions of boundary objects, mangle of practice, and disclosure.
Keywords: boundary objects, reports, data, archaeology, documents

1 Introduction

Documents frame how people do things. They mediate views and can function as naves of social practices by providing common ground between communities and function as constitutive artefacts of documentary practices (Frohmann, 2004). The interplay of practices and documents can be described as a *mangle*, according to Pickering a "thick of things" that is "a symmetric, decentred process of the becoming of the human and the non-human" (Pickering, 2008). Understanding their interplay is a key to understanding how documents can work as enablers of cooperation and cohesion. A considerable body of literature has analysed this particular role of documents as

boundary objects (BO), a concept coined by Star and Griesemer (1989) to describe a category of artefacts capable of facilitating understanding between different communities. Doolin and McLeod (2012) have used sociomaterial perspective to elaborate the notion and to articulate the emergent and performative aspects of BOs. But even if BOs in general and documents in particular have a capability to bridge gaps and provide common ground, a single piece of document does not necessarily function as a BO. A relevant question is when and how in the mangle a document becomes and ceases to function as a BO.

The aim of this study is to dig deeper into the changing materialities and formation of documents and their users in the advent of digitisation, and how documents become and lose their status of BOs in these processes. The discussion is based on an interview study of professionals (N=16) working on the archiving of archaeology in Sweden, and the analysis of how the interviewees describe the struggle of coping with emerging and legacy forms of digital and non-digital materialities of archaeological information. The study posits that in order to be functional, a boundary object needs to provide a disclosure, means to access reality for adjacent communities. Further, it shows how the assumptions of the functioning of the becoming of the human and non-human (material artefacts) influence the ways how the interviewees conceptualise the preservation of archaeological information and the role of digital and paper-based documents.

2 Documentary practices

Frohmann posits that the "informativeness of documents [..] refers us to the properties of documentary practices" (Frohmann, 2004). The documentary practices make the documents to be what they are and how they can be embedded to be a part of other practices. According to Frohmann's classification, documentary practices are characterised by their materiality, the institutional sites where they are situated, the ways of how they are socially disciplined and historically contingent. Their material form influences the work with documents. Frohmann (2004) refers to the problems of working in a group with hard copies of web pages printed with different computers and printers, and consequently, with different paginations. Another example of the influence of the materiality of documents is discussed by Sellen and Harper (2002) in their description of the affordances and resilience of paper-based documents amidst of the discourse of the coming of the "paperless office". As they note, the material properties of paper-based documents have affordances to support workplace activities from authoring to collaboration and communication. Digital documents have other affordances that support linking, searching, editing and updating their contents (Sellen and Harper, 2002). Other researchers (e.g. Østerlund, 2008a; Piper and Hollan, 2009) have made similar remarks in other contexts.

The second aspect of documentary practices relates to the institutional settings of their production. Frohmann (2004) uses the institutional setting of early science as an example of an emerging institutional context in which documents were produced. Unlike today, it was not given for early scientists what aspects of their observations

should be documented or that it is possible to prove something by conducting and describing an experiment. In contrast, many of our contemporary practices are conducted in established institutional settings: how a medical record should be written (Berg and Bowker, 1997), what information a written receipt should contain (Levy, 2001), how public service work should be conducted (Finn et al., 2010), and how scholarly communication (Fry and Talja, 2007) and publications should be structured (Francke, 2008).

Further, documentary practices are influenced by social disciplining: training, teaching, controlling and correction. Both technology and management can enforce new documentary practices by letting or making people to learn new ways of working. Similarly, both social and technical systems can force people to assume certain practices of working with documents. At the best, social disciplining helps to establish uniform workflows that benefit all stakeholders (Jonsson, 2007). In the worst cases, the various forms of social disciplining produced by social and technological systems have generated different levels of problematic outcomes from spectacular organisation-level failures to unclear benefits of the attempts to control information flows in an organisation (e.g. Heath and Luff, 2000; Akhavan and Pezeshkan, 2014).

Finally, according to Frohmann (2004), the documentary practices depend on their historical roots and development in course of time. Often, the historical developments are documented in the organisational change processes as a source of inertia (Flinn, 2010), but the anchoring of the contemporary practices in the past has also a capability to provide stability and continuity (Sundin, 2011; Craven, 2008).

A significant aspect of Frohmann's concept of documentary practices is that documents are not merely an outcome of information activities. This facet has been to discussed somewhat implicitly in a large corpus of document related work on medical (e.g. Berg, 1996; Østerlund et al., 2010; Juven, 2013) and legal contexts (e.g. Riles, 2011), science (e.g. Biagioli, 2006) and archaeology (e.g. Pavel, 2010; Newman, 2011), but it has been somewhat less common to pursue explicit discussions of the interface of the information and documentary practices outside the field of documentation theory (Lund, 2009). Documents have an active role in the process that lead to informational inputs and outcomes.

3 Boundary objects

Frohmann (2004) takes *boundary objects* (BO) and their capability to coordinate the work of people residing in different social worlds as an example of the diversity of documentary practices and how informativeness is not the only significant property of documents and their related practices. According to the original definition of Star and Griesemer (1989), a BO is an artefact that resides in the interface between communities and is capable of bridging perceptual and practical differences. BOs have a tendency to be weakly structured on the level of common understanding and more rigidly defined within communities. The origins of the notion lie in the sociology of Strauss and Callon's concept of translation and Star's and Griesemer's interests in knowledge infrastructures and conceptual

foundations of sciences (Trompette and Vinck, 2009).

Earlier research has demonstrated the diversity of BOs and their uses in different contexts (e.g. Harvey and Chrisman, 1998; Kuhn, 2002; Frost et al., 2002; Lee, 2007; Østerlund, 2008b; Carroll, 2012; Shepherd and Sampalli, 2012) and fields of research (Trompette and Vinck, 2009), and how BOs change when they are moved between communities. Similarly to the making and changing of technologies and artefacts in general (Winner, 1980; Kling, 1994), Boland and Tenkasi (1995) note that (re)shaping BOs incorporates the element of power. The process can be collaborative or one-sided and accordingly, BOs are not necessarily neutral or consensual, but outcomes of a reflexive process of making one's own and assimilating perspectives of others. Martin and Wall describe the biassed nature of an often cited documentary BO, a medical record, and note that they can be problematic in administrative tasks and require work-arounds to compensate for the lack of common ground (Martin and Wall, 2011), or neutrality.

Gasson (2006) and Fleischmann (2006) build on actor-network theory and elaborate further the discussion of the complex power relations in boundary activities. In general, the actor-network analysis of BOs and actors (Czarniawska, 2004) has proven useful in contesting the earlier Foucauldian theorising of power and hegemony (Sage et al., 2010). At the same time, however, the actor network theory has mostly omitted the question of the generic nature of the juxtapositions outside the scope of individual organisations or networks. Huvila has discussed the authorship of documentary BOs and their political implications. Instead of being neutral translators, Huvila has shown that the BOs are both purposefully authored (Huvila, 2012) and that they incorporate an agenda when they build bridges between communities (Huvila, 2011).

These earlier observations are useful, but similarly to actor-network analyses of BOs, they focus on relationships and remain vague on the role of BOs as tangible objects. Østerlund (2008b) suggests that Star and Griesemer chose to discuss "objects" to avoid making claims of the physical or intangible properties of boundary things. In her last text on BOs, Star (2010) extends the discussion on materiality and remarks both that materiality is a significant aspect of things in different contexts from domestic contexts to museums, and that the materiality of objects derives from action (i.e. a theory can be a powerful object even if it is not as physical as e.g. a car). Østerlund (2008b) and several other authors (e.g. Doolin and McLeod, 2012; Trompette and Vinck, 2009) have developed the material trajectory of BO literature. Using the model of Hanks (1996), Østerlund (2008b) suggests that as material objects BOs can be part of communicative practices 1) as objects of evaluation, 2) as an expressive medium, and 3) as part of the field of action within which practices takes place.

Doolin and McLeod (2012) have developed further the theorising of the materiality of BOs by exploring the interface of sociomaterial theory and the notion of BOs. The authors use sociomateriality as a lens to explicate the practices, temporal emergence, sociomaterial agency, performativity and multiplicity of BOs. BOs emerge in the practices of intersecting communities, they are in a constant process of becoming (as Pickering's sociomaterial assemblages, cf. Pickering, 1995) rather than being static or stable entities. BOs are *performative artefacts* (Suchman et al., 2002) and their affordances are outcomes of sociomaterial agency of the object (understood as assemblages

rather than physical artefacts) and its users. Finally, Doolin and McLeod use the notion of multiplicity (of the performativity of BOs) to explain how different communities can use and interpret an artefact in different ways.

4 Towards the making of boundary objects

To further explicate the emergence of BOs in the nexus of documentary practices, this article builds on Pickering's (1995) theory of the mangle of practice (also used by Doolin & McLeod, 2012) as a (new-)materialist lens to shed light on the premises of the making of BOs. According to a Pickeringian reading of information work (Huvila, 2013), documentary (informational) practices and documents (information objects) form a *mangle*. It is a "thick of things" that is "a symmetric, decentred process of the becoming of the human and the non-human" (Pickering, 2008). A central element of Pickering's theory is the notion of resistance, that the nature sometimes "punches back" and resists our pursuits. The capacity of documents to function as hubs is dependent on their place in the dance of agency of the mangle. Documents lose their potential as bridges if they are detached from the mangle and drift or are forced into dualism and becoming manifest instruments of dominance and control. The process of *counter-hegemonic formation*, described by Pickering (2008) as the decentred becoming of human and non-human, is a key to how documents can work in the mangle of practice as enablers of cooperation and cohesion. The mangling comprises intentional structures and *1) social contours* (scale of social actors and their relations to other social actors) *of human-agency and disciplinary agency*, the cemented socially enduring routines relating to both conceptual structures and technologies). Instead of conceptualising the interplay of human and non-human synchronic reciprocation of interests and constraints, Pickering (1995) sees them as a diachronic mangle of 2) *resistance* (of how material objects hold out against human endeavours) *and accommodation* (how humans adapt to the resistance) in time.

In contrast to Doolin & McLeod (2012) who anchor BOs to a broader sociomaterial framework for understanding the dynamics or *how*s of the (Pickeringian) becoming of BOs, this article continues the parallel effort of explicating the mechanisms of *why* certain BOs are a part of particular sociomaterial associations and *what* makes BOs to 'become' in the process of counter-hegemonic formation. Huvila (2012) has argued earlier that the BO'ness is not (necessarily) emergent, but rather an intentionally (or sometimes unintentionally) authored property that is independent of the making of the object that functions (or does not function) as a BO. The emphasis of authorship is a significant step away from the earlier implicit assumptions that BOs emerge in the process of making the things that function as BOs. However, what remains to be explained is the influence of the agency of the reception and of the object itself.

The proposition of the authored nature (in sociomaterial terms, emergence with agency) of BOs can be expanded by using Hekman's (2010) notion of *disclosure*. Hekman discusses the notion originally coined by Rouse (2002) as a critique of the complete denial of reality within certain extreme forms of social constructivism. According to

Hekman (2010), the basis of disclosure is that perspectives, concepts and theories make a difference as the means of accessing reality. Hekman does not suggest that the reality would be constituted by the concepts, but rather portray it. Disclosures have also agency and material consequences, which can be argued for, even if it is, by definition, impossible to convince everyone of their usefulness (Hekman, 2010).

The theoretical lens of this article combines Pickering's notion of mangle with Hekman's concept of disclosure to explicate the material constituents of the making of BOs. In contrast to the earlier discussion on BOs, the approach broadens the perspective to the functioning of the BOs to comprise the whys and whens of the dance of agency between the BOs, their authors and users. Similarly to how Hekman (2010) argues for her preference for the notion of mangle instead of Latourian actor-networks, this text posits that the messier notion of mangle is useful in explicating the becoming of a BO similarly to how it has helped Pickering to explain the emergence of scientific discoveries or Hekman to discuss the female body. As Hekman (2010) underlines, mangle (verb and noun) does not attempt to renounce the insights of the linguistic turn (in the case of BOs, the concepts are constitutive if only as a part of the mangle) or dichotomise human and non-human, but includes the social and political context of practice and focuses on the mangle of the constitutive elements of mangle. In a sense, the objective of this attempt can be described quoting Denis and Pontille (2012) as of an investigation of the "invisibilities" of work. In contrast to the study of invisibilities in the sense of infrastructure studies (Edwards et al., 2009), this study delves deeper into explicating the becoming of BOs, an infrastructure behind infrastructures.

5 Material and method

The empirical material consists of qualitative interviews (N=16) of Swedish archaeology professionals with special interest in issues pertaining to the archiving and preservation of archaeology. In accordance with the aim of the study to focus on interviewees' accounts (in contrast to ethnomethodological approach of observing the actual procedures of work), the interview approach was chosen to let them articulate their narratives of the struggle of changing materialities.

The interviews were based on the semi-structured thematic interview approach of Hirsjärvi and Hurme (1995). All interviews were conducted by the author, taped and transcribed by a professional transcriber. The interviews lasted in average 60 minutes. The interviews focussed on the interviewees' professional work, their views on the current state and future prospects of archaeological archiving i.e. the management and use of both recognised and traditional (Huvila, 2011) and potential new documentary BOs in archaeology. After a small number of initial questions about education and work experience, the informants were asked to describe their current work (daily routines, positive and negative challenges, organisation) and to articulate an outline of the mangle of the daily work. Next the interviewees were asked about the current state and future prospects of preservation, archiving and keeping of 'archaeology' to let them explicate the extents of documentary practices and evolving boundaries of their

work. The questions about archiving (i.e. what artefacts and what types of documentary practices and agency they considered to be central to their work in the long run and which ones of these could be analytically labelled as BOs) were left open to allow interviewees to define the priorities of keeping various types of assets, documents and objects and to choose their preferred term for archiving (or e.g. keeping, preserving, saving) archaeology. Interviewees were also asked to describe their own use of archaeological archives and their information work in general terms in order to understand how they themselves positioned in the mangle they described. Finally, the informants were asked to describe an ideal archaeological archive and from their perspective, how it would differ from the present situation. This was done to contrast the experienced and an ideal mangle. The overall aim of the interviews was to collect rich narratives relating to the production, management and use of archaeological documentation (i.e. BOs and potential BOs) tied into the objectives of the present study of investigating the mangle of becoming and unbecoming of BOs.

The group of informants represents a convenience sample of Swedish professionals with a special interest in archiving archaeology, both genders and varying length of professional experience. The initial group was formed by contacting professionals who participated in a workshop on archaeological archiving organised by a third party in 2013 in Sweden. Invitations were sent to participants met by the author at the event. In addition, during the interviews the interviewees were asked to provide names of persons they considered the author should interview. New informants were interviewed until the interviewees did not indicate new relevant informants and the interviews had become substantially repetitive in terms of information (Rubin and Rubin, 2005). Participants came from county administrative boards, regional museums, two national institutions (the National Heritage Board, NHB, and Swedish History Museum, SHM), archaeology departments and laboratories at Swedish universities, data archives and private archaeology contractors. The roles of these actors is discussed in more detail in Section 6 below. Considering the sampling approach, the group of interviewees is not representative of a larger population, but is still useful considering the conceptual and exploratory rather confirmatory aims of the present study. For reporting purposes, the interviewees were assigned false names (Table 1).

The author analysed the interviews using a method drawing from the constant comparative method (Glaser and Strauss, 1967) and close reading (DuBois, 2003) of the transcripts. The analysis followed an iterative process of categorising, writing and recategorising the material, identifying potential BOs, their role, constituents and perimeters in the narratives of the interviewees. In order to control for an over-expression of individual opinions, the analysis places a special emphasis on views expressed by multiple interviewees. Similarly, a special emphasis was placed on controlling apparent bias related to the age and professional experience of the interviewees. Perhaps somewhat unintuitively they did not seem to have a noticeable impact on the expressed views. The results were revisited after one month of the initial analysis using negative case analysis (Lincoln and Guba, 1985) with a specific purpose of finding contradictory evidence that would decrease the reliability of the drawn conclusions.

Interviewee	Description
Orlando	Finds information administrator at a national institution
Traiano	Administrative director of a contract financed archaeological department a regional museum
Marsilio	Archivist, information manager at a national institution
Agramante	Administrative director of a contract financed archaeological department a regional museum
Rodomonte	Finds administrator at a national institution
Angelica	Coordinator at a private archaeology consultancy
Namo	Researcher in archaeology at a Swedish university
Medoro	Field archaeologist at a private archaeology consultancy
Astolfo	Archivist at a national institution
Brandimart	Coordinator at a contract archaeology department at a regional museum
Oliver	Archivist at a national institution
Sobrino	Data archivist working at a data archive
Gradasso	Administrator at a county administrative board
Bradamante	Researcher in archaeology at a Swedish university
Ruggiero	Information manager at a national institution
Alcina	Researcher in archaeology at a Swedish university, data archivist working at a data archive

Table 1: Interviewees.

6 Working with reports and documentation material in Swedish archaeology

A typical archaeological field project in Sweden is development-led and starts with an Environmental Impact Assessment (MKB) whenever a public body, private company or an individual citizen will proceed with land development. The development-led archaeological process is organised as a commercial quasi-market with a certain degree of central and regional control (Kristiansen, 2009; Börjesson et al., 2015). It involves several private and public actors (communities in BO sense cf. Star and Griesemer, 1989) including developers (e.g. building company or the national traffic authority), county administrative boards (CAB) in 21 Swedish counties, the NHB, archaeological contractors, the SHM and regional museums. Archaeologists working in administration and field units have similar educational background with graduate or post-graduate level university degrees (Jennbert, 2008). According the Swedish Cultural Environment Act (KML, 1988:950) CABs have the practical responsibility for administering archaeological work in the country. The NHB has a national level supervisory role, responsibility for developing cooperation between actors in archaeology and cultural environment sector and an authority to issue directives on the implementation of the Cultural Heritage Act i.e. to set norms on how archaeological fieldwork should be practiced in Sweden (Riksantikvarieämbetet, 2015-). According to KML, archaeological work is expected to be conducted according to a "good scientific quality" (KML 1988:950, 2 kap. 13 §). Research-led projects initiated, for instance, by museums and universities are subjected to the same general legislation (Riksantikvarieämbetet, 2007; Hegardt and Källén, 2011).

On the basis of an initial MKB (Schibbye et al., 2007), the local CAB produces a statement and if necessary, starts negotiations for an eventual investigation. If an archaeological site needs to be either fully or partially removed,

the CAB puts an investigation project out to tender. Contractors (including private companies, foundations, archaeological units of regional museums and by the time of the study, the field archaeology unit of the NHB which was moved in 2015 to be a division of the SHM instead Amréus and Jansén, 2015) are asked to submit an investigation plan and a budget. The tenders are processed by the CAB (which is also responsible for judging the qualifications of the contractors) and discussed with the developer before a final decision is made (Riksantikvarieämbetet, 2012).

After the chosen contractor conducts an archaeological investigation on the site, the contractor is expected to file a report with the CAB, developer, a regional museum concerned with the project and NHB (one digital and two archive quality paper copies), and submit basic data on the project to the national sites and monuments record (FMIS) held by the NHB (RAÄ, 2015). A report consists of a textual narrative of the investigation process and findings, a small selection of illustrations and maps administrative details (incl. information on the investigated site and its location) and appendices (e.g. separate on reports conservation of finds and osteological analyses) (Riksantikvarieämbetet, 2012). Even if NHB has provided relatively extensive guidelines for writing reports (RAÄ, 2015) and all Swedish reports have common elements, they differ considerably from each other (Gustafsson and Magnusson Staaf, 2001). As Gustafsson and Magnusson Staaf (2001) note, the quality of a report is better defined as a question of matching certain content related and communicative expectations than as that of absolute goodness or badness. NHB stores digital copies of reports (as PDF-files) in an open online repository SAMLA (http://samla.raa.se). Also many contractors provide access to their reports on their corporate websites. Information on archaeological finds is submitted to the NHB, which is responsible for making a decision on where are to be deposited. With some exceptions, the finds are usually allocated to a local regional or municipal museum. If not, they are deposited to the SHM, which also has a general responsibility for providing support for local and regional museums and managing archaeological finds in the country (Amréus and Jansén, 2015; RAÄ, 2015).

In addition to archiving the report, CAB is responsible for making a decision about the archiving of other documentation material not included in the report commonly refered to as data (or sometimes "documentation material", e.g. Riksantikvarieämbetet, 2012, including digital and non-digital maps, drawings, handwritten field notes, measurement data, photographs and other documentation data not included in the report) and selecting an archival institution responsible for keeping the archive (RAÄ, 2015). In general, both documentation data and physical finds are kept at regional museums with certain exceptions (e.g. specific find types or projects). At the time of this writing (in 2014) none of the archival institutions accepted digital data as data files i.e., not deposited as material artefacts on CDs or USB memory sticks (Brandimart, Ruggiero). In contrast, a small albeit growing number of digital datasets have been made available by specialised research data archives, for instance, the Swedish National Data Service (SNDS) (http://snd.gu.se/sv/catalogue/advanced-search?subject=arkeologi) and the Strategic Environmental Archaeological Database (SEAD) (http://sead.se).

Information flow in a typical contract archaeology process is serpentine (Riksantikvarieämbetet, 2012). All public bodies involved in the process are required to archive all related administrative documents. The private actors have

no similar general requirement to keep archives. Even if the guidelines emphasise the importance of all documentation material (RAÄ, 2015), the interviews confirmed earlier observations that report is both *the* central document (e.g. Gustafsson and Magnusson Staaf, 2001) and BO (Huvila, 2011) in the archaeological information process. Even if the availability and accessibility of reports might not always be optimal (e.g. Gustafsson and Magnusson Staaf, 2001; McManus, 2012), they are capable of traversing boundaries between communities and organisations and function as an information source *par excellence* about a particular archaeological site and investigation.

7 Findings

Both reports (e.g. Drewett, 1999; Seymour, 2009; RAÄ, 2015) and data (e.g. Faniel et al., 2013; Niccolucci et al., 2009; Riksantikvarieämbetet, 2012) are referred to as distinct entities of archaeological documentation in the literature even if they both are essentially compilations of multiple types of data. What turned out to be the most significant outcome of the analysis of the interview record was the explication of the fundamentally very different functions and roles of *reports* and *data* in the mangle of the documentary practices described by the interviewees.

7.1 Reports as BOs

The apparent success of archaeological report as BO in the studied context can be traced back to several factors. Partly, their perceived usefulness can be explained by their embeddedness in the social contours of archaeological community and a widespread trust in the functioning of the disciplinary agency in archaeology. Brandimart told that "I read all reports. But I don't check [..] if everything was [done] in a way it stated" but on the other hand was critical about his colleagues when he had learned for many "[i]t is enough with that we have in the report". A report is turned to a BO by the (relative) trust in them, their timeliness, comprehensiveness and the merits of the process of their becoming. During the last couple of decades reports have improved as mediators because they are generally written faster than before (Agramante), but there are still problems if they are poorly structured (Namo), they are difficult to access (e.g., Namo, Agramante, Angelica, Rodomonte) or there is a lack of oversight in the investigation and reporting process (e.g. Rodomonte, Namo, Medoro).

Even if the producing and filing a report with a CAB is a legal obligation, the interviews show that the reliance goes well beyond a mere juridical responsibility. The way how, for instance, Bradamante and Gradasso describe the reporting procedure demonstrates that the obligation to produce the specific BO is intertwined in both the work practices and the general ethos of archaeologists. Traiano moderated the coercion of writing reports by pointing that for him writing a report, especially smaller ones, is "great fun". Gradasso who is working as an administrator of contract archaeology work at a CAB, confesses that he does not have time to read all submitted reports, but that the high level of professionality of the contractors, his oversight of their work and reporting processes, and the requirement of contractors to process finds and submit documentation in time ensures the high quality of the results

(i.e. documentation and BO). Medoro, a field archaeologist, shared Gradasso's trust on the (counter-hegemonic formation) process of a 'good' report-as-BO. In contrast to Gradasso, he assumed that there is always a colleague reading his texts at the CAB and controlling that he has not missed anything while compiling the report. According to Brandimart, there is a similar, partly unfounded, general confidence on the quality of report-BOs that all earlier investigations have been properly reported.

Both Gradasso and Brandimart have observed that the timeliness of producing report has improved over time especially after the introduction of the market-based contract archaeology model in Sweden in the 1990s. Before, reports were often not written in time or were produced at all. Now, according to Brandimart, "there is much better control" and reports are generally handed over on time. The major gaps are found in older archives (Brandimart).

However, even if the marketisation has improved reporting practices, it has also risen new disputes about who should have what information i.e. which communities are a part of the disclosure (using the concept of Hekman, 2010) of archaeological work both in conceptual and in practical terms. For instance, even if the NHB guidelines indicate that regional museum (RAÄ, 2015) should be entitled to a copy of the report, in practice, the museums are often not considered as stakeholders enough and do not always get their copies even if they would be the designated archival institution for research materials. As Traiano notes, the contractors may not always feel obliged to inform others than they commissioners. Brandimart suggests that there "should be a system to make sure that decisions are followed up" and excavating archaeologists are actually delivering their reports to all involved parties. This would also open up the mangle of the making of report as a document and BO for a broader range of stakeholder communities.

Apart from their embeddedness in the social contours and disciplinary agency of archaeology, the sucess of reports is contingent on their capability to accommodate to a broad range of uses. Similarly to earlier observations (Huvila, 2011), reports function as BOs between a large number of stakeholder communities according to the interviewees. They act as tokens of completed investigation projects for field archaeologists and administrators (e.g. Gradasso) and even as embodiments or epitomes of archaeological field research towards adjacent communities. "Most often, at least if it's a larger investigation, much is there, you can say, of the investigation, it is" (Oliver). They are BOs between earlier and current investigators of previously investigated areas (Medoro). They are easy to use: "I haven't found that it would be problematic [to access reports in an archive]" (Gradasso). Finds administrators (responsible for managing physical archaeological artefacts) at the SHM and NHB accommodate reports as BOs when they make decisions about the deposition of finds in different museums (e.g., Rodomonte). Academic researchers (e.g., Bradamante, Namo, Oliver) use reports as BOs when they are pursuing a broader understanding of the observations made during a specific field project.

Even if there is a relative consensus that the major improvement of reporting practices relates to the increased

timeliness of reports, Oliver and Rodomonte consider that the reports have become more comprehensive as well: "reports, today, are quite comprehensive" (Oliver). The resistance of reports and need for accommodation have reduced. At the same time, however, Traiano emphasised that even an old "report is a report even if their outlook has changed" considerably over the years. Even if the reports from the 1930s begin with "Dear brother" and were signed "respectfully" (Traiano) they function as information carriers and bridges between the communities of their origin and use. Interestingly, Rodomonte remarks that a report can be also too good. He noted that especially with the newer reports he misses the excitement of research and detective work: "with them [newer reports] it is not, kind of, that much searching for things". When this isolated remark is contextualised to how the interviewees described the general appeal of their work in terms of research and excitement of learning and discovering new things, it seems a document can be too perfect to be an optimal BO. A BO can be 'overmade' to lose of its necessary flexibility, and to begin to resist and require more accommodation.

Even if archaeologists have learned to accommodate, the use of reports have resistances that hold against particular types of translations and transformations. Reports function as sources of "facts" about a site for a person who is visiting or knows a particular site from the past (Traiano) and can be an enjoyable source for learning about different types of sites and periods of the past but their technical language (Oliver) stands as a resistance that fights back attempts to use them as a BO between excavating archaeologists and people who have never visited the site.

The remark of Brandimart that reports are not popular literature makes obvious the fact that they also stand against boundary crossings between archaeologists and non-archaeologists (even if, at least in theory, reports are expected to contribute to these boundary crossings as well cf. Gustafsson and Magnusson Staaf, 2001). Namo notes that information is not always well-structured and, as Traiano remarks, in general, it is probably true that "nobody becomes glad of reading archaeological reports". The difficulty of understanding reports depends on multiple factors. As Oliver notes, "archaeologists don't have time to do all kinds of reports". Writing "one for the general public and one for the archaeological research" would be too much. He considers that "it's a pity that [..] the reports are written in a far too academic manner that the general public could find them useful". At the same time, he thinks, however, that the archaeological reports should keep a certain scientific and scholarly standard. Otherwise, as he notes, it would be impossible to use the report as a basis for (academic) research.

To understand how the reports have become a part of the mangle of archaeological practices it is necessary to understand how they are used. The long history of reporting means that reports are the principal and often the only available source of archaeological first-hand (or as near as it gets) information on archaeological investigations. For this particular reason, for instance, Bradamante and Namo have relied extensively on reports in their work on building digital datasets of legacy data. Angelica describes the role of reports by explaining that "an investigation is that one takes a way a site, information, and then transforms it to information that will remain in a report, or the

documentation material we have left, both in analogue and digital forms". The idea of report as a manifestation (in practice, a BO between the 'community' of archaeologists who investigated the site and others) of an archaeological investigation was articulated also by other interviewees (e.g. Gradasso, Rodomonte). Rodomonte told about the problems of making decisions about where finds from specific excavation should be deposited fast enough to keep in pace with new incoming requests and mentioned specifically a project, which aimed at processing a back-file of non-allocated "reports" (sic!), not investigations or projects.

The actual frequency of using reports depends on work duties. Brandimart notes that he needs legacy reports often when he works with new investigation projects. Some of the interviewees (e.g. Medoro, Namo) used almost exclusively reports for information on sites and projects whereas some others (e.g., Agramante) used them more sporadically. But even for the occasional users, the report tended to be *the* authoritative first-hand source of information. Medoro's observation that "most often people just want the report, not to talk about it" is indicative of the use reports as authoritative reference and BOs rather than as a source of raw data.

Another example of how reports have been mangled as institutionalised BOs and accommodated as a part of archaeological work practices is how Brandimart describe his double role as contract archaeologist and doctoral researcher.

> "If we have a contract archaeology job, it needs to be reported and archived according to the regulations. If you want to do research on it [report], you do it in a totally different way so to say. You are doing that in a project or [university] department, you get to use the material just like other researchers. That's how I did. [..] I got to be nice and go to the SHM and ask for the finds. So, you get to keep your two roles apart." (Brandimart)

Brandimart's making of an explicit difference between his two roles deviates from the tradition of how field directors have claimed a quasi-ownership of their data. Brandimart's reading falls in the current legislation and is explicit about the role of reports as BOs between field archaeologists and researchers, and the authoring of reports as a (boundary) activity that produces that particular type of artefact.

In addition to being a BO that translates between contemporary and past material practices of archaeologists and (pre-)historic human-beings, a report is also a material object in the mangle of archaeological documentary practices. According to the interviews the materiality was problematic. The fact that accessing paper reports is difficult resists their usefulness as BOs. In contrast, the cost of keeping paper documents was seldom criticised. The most of the interviewees tended to consider that physical things were less problematic because there are well-

established (albeit not always dependable) procedures for managing and archiving them. The "natural" material form of reports imply their perpetuity ("[t]he report is naturally an archive quality paper [document]", Angelica) and actuality for their users. A pile of reports on a desk reminds of what "should have been written or should be written" (Traiano). It is a mnemonic of a work to be done and a document that literally travels from one desk and community to another.

Even if the materiality may become a problem when a report or finds are difficult to access or when they are needed simultaneously in two places, it gives the BO a definite location where different users can find it. As Traiano describes, when a physical copy of a record is kept at an archive it is unquestionably there for the readers to consult. Additional physical copies of documentation are similarly physically present at other locations and can solve eventual "fight[s] for reports in the organisation" (Traiano). The materiality of the BOs can be meaningful even if they would not exist or they cannot be found. As Traiano notes of reports, the lack of the (physical) BO can function as a prompt to phone the field director and ask whether something interesting was found or not: "If there is no report, you call [a specific person you know] and say 'Hey you, what did you find?"'.

Even if the materiality was mostly considered as an asset, the interviewees with archival duties observed that it was common to blackbox (printed) documents and other material objects. For instance, Oliver criticised that at the archives of the NHB, all materials sent by the contract archaeological units were kept as is without considering whether the data should be kept or asking if something had been or should be discarded. The black-boxing undoubtedly contributes to the capacity of the materials to function as BOs but omitting a discussion of the relevance of the materials from the archival perspective may reduce their usefulness in translations and transformations to and from that particular community.

Even if report-writing has changed in time throughout the history of archaeology (Lucas, 2012), the interviewees were unanimous of the significance of the digital shift. Digitisation of archaeological reports has changed the configuration of the communities and their boundaries, and altered the practical (even if not the legal) ownership of the BOs. Oliver emphasised that "professionally I don't think that there is a difference between digital and non-digital information. Everything is equally valuable". The strongest advocates of digitisation and its beneficiality were Sobrino, Alcina and Ruggiero who worked in information management and data archiving. The sceptics were found among contractors and archivists (e.g. Oliver, Angelica, Rodomonte, Marsilio). They described the problems related to the lack of regulations of who is responsible for accepting digital material and maintaining digital archives, and a lack of an established digital (vs. the paper-based) workflow. Oliver remarked that he knows that "an archive quality printout endures many, many years" whereas the preservation of digital material "requires more effort" even if "it is not impossible". "There are others who manage to do it" like the Swedish Tax Agency or the Swedish Social Insurance Agency (Oliver). Marsilio suggests "there is a lack of administrative knowledge, I think, a bit. And then

it is felt like an obstacle if something should be preserved. You either think that it not worth preserving or that it is already 'preserved' in citation marks. [To preserve digital things should be relatively easy] but the problem is that people do not realise that it should be preserved".

The main reasons to consult web sites for reports instead of visiting an archive are easiness and faster access to materials (e.g. Rodomonte, Sobrino, Ruggiero, Namo). "It is a lot of easier to me to send a datafile somewhere in the world than to copy a book and send it in an envelope" (Sobrino). The availability of reports from the early 2000s and, for instance, decisions of find deposits from 1994 onwards in digital format make them easy to access (Agramante, Angelica, Rodomonte). Getting older reports and documents tends to require more work: "We can't kind of self retrieve them. We have to order them from the staff at the archive" (Rodomonte). Sometimes accessing a printed report can be so difficult that it makes more sense to ask a colleague for information than to try to find the document (Agramante).

Several contractors publish reports on their websites as PDF-files (as explained by Angelica, Traiano and Brandimart). Because of their easy availability, many staff members at CABs and NHB routinely visit contractors' websites to find PDF-versions of reports even when the paper copies are kept in their own archives (Angelica, Rodomonte). Traiano recalled also that he had serendipitously discovered a useful report from another part of Sweden when he was searching the web for information on a particular type of archaeological site. Brandimart assumed, however, that the easy access to the reports on the web could also mean that people may have began to rely more on the easily accessible material instead of conducting proper research in the archives. He emphasises that it has always been possible to access archival material, but at the moment, when it is far more easier to access reports, they might have become more popular than other sources of information.

According to Rodomonte, another common reason of the popularity of the web searching is that, as discussed earlier, the reports are not always submitted to all stakeholders. Finally, contractors' web sites are often the most accessible repositories of the reports of eventual pre-studies (which, in practice, become BOs first when they are made available as digital PDFs) conducted at an excavation site. Contractors do not necessarily submit these documents (and are generally not required to do so) even if they may contain crucial information from the administrators' perspective. Both Rodomonte and Traiano criticised sharply that pre-studies are not systematically archived at public archives. Occasional availability of some reports on the web can help administrators in their daily work, but as Angelica notes, it does guarantee long-term access to the material. The same applies to the publishing of the PDF-versions of full reports on the web.

The digitisation of reports does not, however, always and for everyone mean better access or alleviation of their resistances as BOs. Even if Rodomonte was positive to the digitisation of information, he noted that current information systems and the efforts to standardise descriptions can lead to problematic loss of information. Oliver added that today, without any existing solutions for digital archiving of archaeological data, a lot of data is inevitably lost. From the usage perspective, Gradasso felt that the old suspension files were faster to use than the digital archive

used at his organisation. Brandimart remarked that he uses paper reports relatively often when an administrator at the CAB has contracted his organisation to conduct an investigation, mentioned that "yes, but there is an old [non-digitised] report" and provided a paper copy of the document. He also remarked that it can be easier to make a photocopy of a paper report than to scan and send it. Another perspective that can be sensed in Brandimart's comment is that the physical nature of BO can make the boundary crossing more tangible. Namo linked the preference of paper to habits: "people keep to the traditional system that paper documents are archives and so on. It feels awfully safe and secure, because you know that things are preserved on the level they are".

From the boundary perspective, the digitisation and publishing of reports and other information on the web might have opened BOs for a larger number of communities and in case of pre-study reports, turned new documents into BOs. At the same time, however, the less dependable availability has reduced their temporal persistence and, as it seems, the status of individual documents as official and somewhat difficult to access artefacts.

7.2 Data as a (non-)boundary object

In contrast to reports and how they were tightly intertwined in the *longue durée* of the mangle of documentary practices in archaeology, a close reading of the interview record showed that the data is a completely different beast in the disciplinary dance of agency of archaeology. Even if the interviewees were more inclined to believe in the persistence of the reports than of the data, they were very explicit about the importance of keeping not just the reports but also both digital and non-digital data. Traiano commented that "it [data] has to be preserved somehow", otherwise there is just the report, or as Bradamante noted that it is crucial that "someone really has the duty to see that the digital [data] is stored in a way that it becomes available for, well, perhaps especially to the researchers". Namo criticised the discrepancy between the huge investments in contract archaeology, the enormous research potential of the produced data and difficulty to access and use it (this critique is not specific to Sweden, e.g. McManus, 2012; Faniel et al., 2013; Kriesberg et al., 2013). In practice, most of the data is hardly used at all after the initial reporting of the fieldwork project. "There needs to be a possibility to study the material afterwards. And right there of course the documentation material can play a significant role" (Oliver). Also Brandimart was highly critical to the idea that reports would be enough. He stressed that ideally all data should be there in a way that it could be possible to recreate the whole excavation.

Even if the interviewees emphasised that data is important, it was apparent that the digital and non-digital

'data' did not function as BOs for them. If available, specific parts of the data could assume this function (e.g. measurement data could clearly traverse communities if it was marked out) but on the level of the mangle of archaeological practice and as conceptualised by the interviewees, data as a whole seemed to lack this function. It did not have an equal status with the report as a universal source of information or hub between different stakeholder communities. As an archaeological thing, it has an inferior position to physical objects, too. Bradamante expressed a wish that in the future, "it can have an equally high value than finds and other things people are obliged to manage in a correct manner".

It seems that firstly, a significant reason for inferior status of the data is the *predominant position of report as the accredited outcome of an archaeological investigation* and its consequent status of an 'official BO' in the archaeological information process. Brandimart had experienced that CABs have a tendency to cut on the time budgeted for the processing and preservation of data. According to Gradasso's (administrator) view, the CABs have a legal obligation to archive reports, but nothing else (including photographs or other information) that is not included in that specific document. Further, he pointed that from his administrative point of view, the report is the final record of an investigation and as such a sufficient outcome of the investigation process. At Bradamante's organisation, the data is in principle considered to be an attachment of the report (cf. Marsilio) and is archived "via the report" (Angelica). Agramante elaborated the same issue:

> "[the data] is often a bit unfairly treated, and by choice after the report is finished you begin to think that ok, this needs to be archived, too. To make it work well, it has to be thought already from the beginning, and managed accordingly".

"The data lies on the server and there are no routines to access it" (Traiano) like there is to access reports. Brandimart was very critical to the present state of affairs when no one knows how much and what archival material exist and where. Not even the archivists at archaeology related archives know what they have. The primacy of report has been well internalised by the contractors as well (e.g. Marsilio). Archaeologists tend to focus on meeting the obligations of the CAB by writing an instructive report instead of putting effort to keeping and organising the data for forthcoming use (Marsilio). Even if the data itself would not resist its use as a BO, its place in the mangle is resisted by the solid materiality (in terms of being more tangible for most, if not all, of the adjacent communities) of the report and its role as a central BO in the disciplinary agency of archaeological work.

A second factor that explains the inferior status of the data can be traced back to the *lack of definition of what is data and established technical procedures of how to archive and make it accessible.* It lacks an established position

in the disciplinary agency of how archaeological information work should be conducted. Traiano and Angelica emphasised that the heterogeneity of the data and diversity of data carriers make the data difficult to preserve. Bradamante underlined also that unlike with reports, a particular piece of data from a specific excavation might not exist. There are no specific minimum requirements of what data should consist of and what a user of the data could expect to find. It is difficult to accommodate to data and its resistances when they are poorly defined. Traiano explained that it is "easier to feel motivated when I come with a bunch of hand-drawn plans and say: these need to be archived. But if I come with a CD-ROM or whatever, and say that this needs to be archived [..] and it should be usable in 50 years or 20 years or so, it is almost hopeless". Even if there was a relative consensus that there are (technical) questions that should be solved and agreed upon, the different interviewees framed the problem from diagonally different perspectives. Archivists saw it primarily as a technical problem and a question of resources (e.g. Oliver, Astolfo, Marsilio), administrators, researchers and contractors as an administrative question of someone (else) taking the responsibility for solving the issue (e.g. Brandimart, Namo), and information managers as a non-issue they could solved right away if they would have the authority to do so.

Thirdly, the contrast between the status of reports and data can be explained by that the *data has not a specific stakeholder* that would be explicit about requirements and priorities like the CABs are with the reports. Data (as a whole) has no self-evident position in the social contours of human-agency and disciplinary routines of archaeological work even if all of the individual pieces of it would, if accessible and available for specialists, play a crucial role in the making of archaeological knowledge. Both Namo and Brandimart call for CABs to take more responsibility and would like to see "printed instructions how things are expected to be done" (Brandimart). There is a large number of different actors without a clear idea who is in charge of deciding what should be documented and preserved and why. Orlando notes that, for instance, museums do not play a major role in deciding what is being investigated, what is retrieved and documented and what is preserved. He criticises that it is common to note that "ok, now we have excavated. We have discarded 80% but these 20% have we kept and reported" without discussing the non-documented aspects of a site. Orlando expressed his concerns that archaeologists have a tendency to focus on the information CABs perceived as important and to forget that the documentation should be able to give answers to all conceivable questions at the present and in the future.

According to the regulations, the CAB is expected to make a decision on an archival institution with a responsibility to preserve the data (Riksantikvarieämbetet, 2012). According to Brandimart, explicit decisions about the archival deposits were made only sporadically by the CABs. These decisions applied to the non-digital data, because at the time of this writing, not a single archive was accepting digital archaeological data if not deposited as a material artefact on a physical data carrier, or as Brandimart put it, "data is something archival institutions do not want to have". The lack of standardised procedures, explicit responsibilities and follow-up meant that the

practical responsibility to see that the data (whether analogue or digital) were preserved is still largely with the investigators (Brandimart, Marsilio, Gradasso). Several informants (e.g. Traiano and Brandimart) underlined that the finds are administered consistently but no one has really an idea what is archived or not. Brandimart who works at contractor admitted that he reads all reports written by his subordinates before they are submitted to the commissioner, but that he does not check the data. Agramante considered that it would be appropriate that the responsibility would lie at a regional organisation that would take care of all material related to a specific investigation and site, but emphasised that the major concern is after all the present lack of a clear consensus on who should take the responsibility. From the perspective of the contractors, an additional problem of disclosing primary data is that in the absence of clear regulations and obligation to hand over that information, one-sided sharing of this information could potentially provide an unfair advantage for competitors in the forthcoming tenders (Brandimart). As a result, the practices of managing archaeological information remain highly heterogeneous and a lot of data stays with private and public contractors outside formal archives.

Finally, the fourth reason for the dysfunctionality of the data as a BO is that in comparison to reports, *the demand for data* is low. According to Bradamante's observation, in practice, everyone who expresses interest in an investigation tends to ask for the report, not for the data. Marsilio shared his view and noted that the most of the people who came to his organisation to find information were interested in reports: "archaeologists want to get an overview and to see what have been before". Besides researchers, Agramante (administrator) was the only interviewee who told that he consulted relatively often the digital data resources available within his own organisation. He stressed that reports are not complete and contain only a "report" of data. At the same time, however, the archived (or stored) data tends to be so complex and difficult to access that it is common to content oneself with the reports or asking a colleague instead of accessing the data itself (Agramante). The lack of time to consult other documentation material than reports was "frustrating" also according to Marsilio. He (as an archivist) considered that is it disappointing that "there are no more possibilities, time or resources [for archaeologists] to come here and consult that part [data, archival material] of information". The lack of time and difficulty to access data was also an issue for Brandimart who dreamt of a possibility to have an online access to an archive and a possibility to download complete datasets of older excavations to the archaeological information management software package he used in his work.

On the basis of the reflections of Marsilio and Orlando, it seems, however, that the fundamental problem can be traced back to a combination of disbelief that someone would need and use the data in the future (based on the interviewees' own information practices), (largely unarticulated) reluctance to let others to make critical remarks on one's own work, the lack of an explicit disciplinary agency that would regulate data practices and an aspiration to see the contribution of one's own archaeological work as something that pertains to the general public instead of

merely being of interest to colleagues and researchers. Even if there are many obstacles, the proliferation of digital data seems to have had an impact on the attitudes on the perceived significance of primary research data. The ease of accessing and exploiting digital resources are potentially a significant driver of change as the interviews of Namo, Ruggiero, Angelica, Alcina and Sobrino suggest. Sobrino underlined the ease of sharing digital information and the possibility to in a completely different way to "add information around it and still link them together" to an extent that he would advocate for a large-scale digitisation of non-digital information.

8 Discussion

We posit that the findings have two central implications from the perspective of the aims of this study. They help us to understand (the mangle of) archaeological documentary practices, why reports are a central and data a peripheral instrument for traversing boundaries between archaeological communities. At the same time, the findings provide us a starting point for beginning to understand why certain BOs are a part of particular sociomaterial associations and what makes BOs to become in the process of counter-hegemonic formation.

8.1 Why a particular BO is part of a specific sociomaterial association

The affordances and constrains of archaeological reports and data can be seen in the light of a dialectic of resistance and accommodation (Pickering, 1995). Similarly to how Shanks (2007) argue in general that the archaeological methods determine how the past looks like, the methods of making archaeological BOs are a part of the same process of making archaeology and the past. They are instruments of Hekmanian (2010) disclosures similarly to perspectives, concepts and theories. For instance, the observation "we are doing it [archiving in general] pretty well here in Sweden" (Oliver) show that the contemporary procedures of work are reasonably well aligned to the currently dominant (paper-)based documents and there is little need for accommodation whereas the anxieties of not knowing how to deal with the digital data shows that it is resisting present-day archaeological practices. The multi-faceted, layered and consequently flexible and somewhat vague nature (which Gustafsson and Magnusson Staaf (2001) elaborately describe) of reports facilitate their accommodation in their different stakeholder communities even if, at the same time, they would prove to be sub-optimal sources of information for specific information needs. As the analysis shows, the digitisation (and digital publication) of reports changed certain aspects of their material *form* (cf. Frohmann, 2004) and their affordances as BOs. To a degree, it has also reduced the need for accommodation but it has not radically changed their *materiality* and consequently how they function and how they *are* BOs. As it also summons new resistances, similarly to how Evans and Moore (2014) note, the cost-benefit ratio of digitisation

of paper reports has its sides; digitisation may or may not be as beneficial as could be expected and it certainly is not enough to radically (re)mangle the mangle.

In contrast to the resilience of the materiality of reports, data may take diverse material forms but it clearly lacks materiality (i.e. how data is not a thing and tangible entity in and for its different stakeholder communities). Without a reasonably clear explicit (and/or implicit) understanding of the materiality, it is unlikely that data would become a BO in the mangle of archaeological information practice. This might happen when the counter-hegemonic formation reaches a point of when the mangle of archaeological practices and data (an object with its inherent materiality) reaches a point when the mangle is capable of disclosing something of importance not only for the principal stakeholders of the data but when the disclosure and its significance becomes apparent for a critical number of adjacent stakeholder communities. Currently, individuals like Namo, Sobrino and Ruggiero are developing (and in practice advocating for) their own solutions and standard formats for using data as an instrument of disclosure but the large majority of the interviewees do not yet have a clear idea of the role of data in this mangle. The prerequisite of making data a BO is to find a simultaneously rigid and flexible material forms for and a conceptual understanding of data that would make data similarly tolerable and as capable of facilitating disclosures as reports for different types of users and uses. The current problem is that data is framed in the context of archaeological information work as a similar "noble substance" (Nunberg, 1996, 107) than 'content' (and information) in the writings of Nunberg. It is detached of its carriers, which makes it too vague. Simultaneously it is difficult to see how it could contribute to a disclosure. The contemporary framings of data can be accused of a similar disconnect to archaeological social practices of which Hart and Chilton (2015) criticise archaeology and its tendency to regard collecting of artefacts as lacking value in the contemporary society.

In addition to the (non-)existence of the materiality of objects, the mangle of archaeological documentary practice depends on people and institutions. The social contours at different archaeological actors, their relative organisatory and intellectual independence of each other and their consequently diverging disclosures (as in Hekman, 2010) buttresses the usefulness of self-contained (but flexible-to-interpret) BOs rather than vaguely framed intermedial resources, which would require diligent negotiation between bordering communities in the mangle. This reminds of the findings of Curry et al. (2014) of how in the IT sector, the diverging perceptions of the (essentially an assemblage called) IT (as an) artefact is a major hindrance of collaboration even if there would be a reasonable consensus how the more specific artefacts within the IT domain should be defined. Because of the dominance of the report as the BO *par excellence*, there is a noticeable lack of interest and apparent need to work towards a crafting a new BO and disclosure. The disciplinary agency of archaeological information work (the practices of working with information) is oriented towards processing of enclosed 'lumps' (reports) rather than, in practice, highly diffuse assemblages (i.e. data). The fact that there seemed to be a relative consensus that certain (technical) questions of the management of archaeological data should be solved and agreed upon, but that the different interviewees framed the problem from diagonally different perspectives illustrates the issue. Archivists saw it as a primarily technical problem of

reliable long-term preservation and adequacy of resources. Administrators, researchers and contractors framed it as an administrative question of someone (else) taking responsibility for solving the issue, and information managers as a non-issue they could solve right away if they would have the authority to do so.

At this stage, considering the discussion so far, an obvious albeit partial answer to the question of why certain BOs are a part of particular sociomaterial associations is that they are aligned with the social contours in a particular mangle and become embedded (routinised) as a part of the disciplinary agency in a particular context. On the basis of the elements that make reports BOs and data a non-BO, a central premise of those to happen is reaching a disclosure, a moment when proto-BO turns from being a concept that only portrays multiple parallel realities for different communities (as data does) to also become a means of accessing a particular reality together (as for reports).

8.2 What makes a BO to become

The second implication, an obvious follow-up question to the why certain BOs are a part of particular sociomaterial associations, is what makes them to become. Apart from social contours and disciplinary agency, the mangling comprises intentional structures (Pickering, 1995) but to successfully turn data into a BO (following the framework of the authorship of BOs proposed by Huvila, 2012) would require a relative high-level consensus of how data is understood between different communities of the users and producers of archaeological data and that archaeological work would (slowly) accommodate to its peculiarities and thus reduce the resistances. Data needs to become an instrument of disclosure. It needs to provide access to 'archaeology' not only to individual archeologists or smaller communities but to them all. Efforts to study archaeological work (e.g. Edgeworth, 2006; Jensen, 2012; ARKDIS, 2013-2017) and to standardise and document documentation and meta-data practices (e.g. projects like ARIADNE www.ariadne-infrastructure.eu or DAP www.raa.se/dap) contribute to the first aim. The efforts to reject the hegemonic BO'ness of the report and/or to rearticulate data as the new essence of archaeology (e.g. Signore, 2009; Kansa et al., 2010, 2011; Tudhope et al., 2011) contribute to the second aim. In the interview data, Namo's cooperation with a stakeholder organisation to develop a data repository that would be beneficial for both parties is a practical step towards this direction.

Both approaches incorporate elements of collective authorship of BOs by heavy-weight peer-production (Huvila, 2012) and articulation work (Suchman, 1996) i.e. explicit voicing of the central aspects of work (or documentary practices) in the adjacent communities in order to operationalise and emphasise the affordances of digital data. Unsurprisingly these affordances are similar to those already discussed in the literature (e.g. Sellen and Harper, 2002; Frohmann, 2004; Østerlund, 2008a; Piper and Hollan, 2009). But instead of being only instances of articulation by words, any attempts to promote archaeological data are unavoidably situated in the mangle of archaeological practice. Within this practice not only human actors but also data and reports themselves have agency as well as the

existing disclosures, the ways in which concepts and theories are currently used to access the reality of archaeology as it is respectively represented by data and reports.

It was apparent in the present interview data that the inherent preference of material objects within archaeology and its related disclosure could still explain a part of the perpetuation of the liking of the physical rather than digital forms of preservation (especially Traiano, Angelica). In contrast, the accounts of the highly data oriented interviewees (including Namo, Bradamante, Sobrino) and the general inclination to agree upon the significance of data could indicate an on-going paradigm shift. From the perspective of data, it would be tempting to suggest that those who advocate for the primacy of reports as the principal form of archaeological information and implicitly as the BO *par excellence* should let go and give leave to new data-oriented documentation procedures to emerge, similarly to how Pickering suggests in his study of the Mississippi flood-banks that the Corps of Engineers should stop fighting against time and let Mississippi to take New Orleans (Pickering, 2008, 8). Different types of BOs could emerge in the process. Geographical information systems (GIS) data has already become a new BO not only between different communities of GIS-literate archaeologists but also between archaeology, environmental science and, for instance, land management.

In spite of its appeal, a *laissez faire* approach has its own problems. As the interviewees noted, the reports have been highly resilient over time. The disclosure persists and works against other disclosures. As with BOs in general, their plasticity can be traced back to the fact that both formulations and documentation practices have been allowed to evolve over time. Adequate tolerance of the unavoidable obsolescence that affects all documentation (cf. Buckland, 2012) is necessary for the longevity of BOs. A radical departure from an established practices could endanger the continuum of recording (and because of their intimate relation, of archaeological work in general) especially if recorders are not careful about capturing and taking into consideration central aspects of mangle (physical objects i.e. documents, but also social contours and disciplinary agency) in all bordering communities.

In addition to documenting what, the management of archaeological documentation is (or should be) about "engineering obsolescence" (Cohn, 2014), about understanding of how things have been done before and how this understanding can help us to do similar things now and in the future. Essentially, it is a process of making and unmaking of BOs with a capability to bridge communities and their endeavours over time. As Linde has noted in the context of space exploration research, the current mission of NASA is not to reproduce Apollo (spacecraft) but to "return to the Moon on the way to Mars" (Linde, 2006b). Similarly, the mission of reusing archaeological information could be defined as an information retrieval task (or like Hekman 2010 suggests, as a disclosure) rather as a literal reproduction of an excavation as a physical exercise. In parallel, the task of the documenting archaeologist is to produce a BO that allows the future users to bridge the gap between them and to produce a disclosure, to perform a particular information retrieval task they find relevant. In this exercise, capturing the 'design' rationale of archaeological documentation and focusing on information life cycle management rather than merely on the keeping of documents is as invaluable as in managing engineering knowledge in the context of space flights. In contrast to

the knowledge management perspective of Linde (2006a), however, the BO perspective underlines the keeping of document as a similarly legitimate (and from a long-term perspective, significantly sustainable) stakeholder priority as the management of 'information'.

9 Conclusions

A closer look at archaeological documentary practices of archaeologists provide insights into why particular types of BOs are a part of particular social associations and what makes them (and other objects not) to become BOs in the mangle of archaeological documentary practices and other bungles of sociomaterial existence. Instead of merely residing in a sociomaterial context, certain objects are authored (in the sense authoring is understood in Huvila, 2012) to become BOs. To function as a BO, a thing needs to be a material (i.e. a thing and tangible entity in and for its different stakeholder communities, not necessarily physical) object with a built-in communicative intention (cf. Pickering, 1995, 20). However, in addition to a mere intention to make one, in order to become a BO that bridges perceptual and practical differences, the object needs to be capable of providing a disclosure (borrowing the concept of Hekman 2010), a means shared by adjacent communities to access a particular reality.

Whereas a report arguably is a BO that provides a disclosure and means to access reality (in case of reports, 'archaeology') for adjacent communities within and in the margins of archaeological work, it is equally apparent that data is not a BO even if individual pieces of data can function as BOs for specific communities and contexts. Data types, metadata and to a certain degree disciplinary agency can be argued to function as BO rather than the data itself. From the perspective of its users, a non-BO like archaeological data lacks comparable materiality to its rival BOs, there is not need or interest for a replacement for an existing BO, it does not (yet) facilitate the emergence of a meaningful disclosure for accessing aspects of reality for a significant number of adjacent stakeholder communities, it resists dominating practices of archaeological work and the social contours of its context. With archaeological data, there are indications of an on-going process (or attempts) of a counter-hegemonic formation of turning it (or a derivative) to a BO but the process is incomplete and the majority of stakeholder communities have yet to accommodate to its resistances. Whether these attempts will be successful in making a new BO remains to be seen. The documentalist critique of 'information' (Frohmann, 2004; Lund, 2009) and, for instance, the recent remarks on the unclarity of what is meant with data and what it is supposed to imply (Borgman, 2015) could serve as serious warnings of discernible problems even if it might be too hasty to suggest that new BOs could not emerge in the mangle.

From the practical archaeological perspective, even if it is obvious that archaeological data is not at the moment a feasible BO, it is equally clear that the current information management process (the process of the reception of the BOs) can be criticised for being too much focused on moving (physical) documents from one place to another to

be compliant with the emerging and already established digital information practices. What would be needed is a counter-hegemonic (re)formation of the information practices that would realign the patterns of how archaeologists engage with material objects (reports and data) and vice versa. A possible outcome of this reformation could be a new BO similar to the current report (which might obviously be, and be called a report) but which would be better inline with the material characteristics of the digital world. The interdisciplinary open data movement (Gurstein, 2011) and the experiences of data reuse and data intensive research in archaeology (e.g. Beck and Neylon, 2012; Faniel et al., 2013; Löwenborg, 2014) have both made a convincing case of the potential benefits opening new disclosures. The emerging mangle of practice with digital documents, information and data is indicative of possible ways to proceed. Instead of being a physical document, the BO could be a permanent identifier of a particular investigation and site. Similarly, the tracing of the compliance of the activities to the incumbent legal requirements does not have to rely on a literal paper trail. But what is still needed, is that especially in the daily administrative work, there are instruments like BOs and other (material) artefacts, which present opportunities for "human passivity", periods "in which material agency manifests itself" (Pickering, 1995, 21-22), takes care of the routine both within and between communities and provides shortcuts to avoid arduous banalities and allows humans time to focus on matters that require their active intellectual attention.

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