

# The Information Society

## An International Journal

ISSN: 0197-2243 (Print) 1087-6537 (Online) Journal homepage: <https://www.tandfonline.com/loi/utis20>

# Putting to (information) work: A Stengersian perspective on how information technologies and people influence information practices

Isto Huvila

To cite this article: Isto Huvila (2018) Putting to (information) work: A Stengersian perspective on how information technologies and people influence information practices, The Information Society, 34:4, 229-243, DOI: [10.1080/01972243.2018.1463332](https://doi.org/10.1080/01972243.2018.1463332)

To link to this article: <https://doi.org/10.1080/01972243.2018.1463332>



© 2018 The Author. Published with license by Taylor & Francis© Isto Huvila



Published online: 07 Jun 2018.



Submit your article to this journal [↗](#)



Article views: 1197



View related articles [↗](#)



View Crossmark data [↗](#)



Citing articles: 1 View citing articles [↗](#)

## Putting to (information) work: A Stengersian perspective on how information technologies and people influence information practices

Isto Huvila

Department of Archive, Library and Information, and Museum and Cultural Heritage Studies (ALM), Uppsala University, Uppsala, Sweden

### ABSTRACT

Instead of merely subscribing to an unspecific inseparability in the co-constitution or mangle of information technologies and human-actors, there is a need for conceptual tools to describe and explicate the mechanics of how the enmeshment of technologies and human-beings is occurring in information contexts: how information technologies are both setting standards of the social conduct of information practices, and how people are using information technologies to regulate the social process. Building on an empirical study of human-technology relations in the context of archaeological information work, this article discusses how the imaginary of putting Stengers to work can make a contribution to such an end. Stengers describes an ideal system of human-actors and technology working seamlessly —World-as-Clock—that is unattainable but can serve as a benchmark and a lens for understanding frictions and discrepancies in the cohesion of the two.

### ARTICLE HISTORY



Received 3 January 2017  
Accepted 27 March 2018

### KEYWORDS

Technology; information technology; information work; archaeology; putting to work; sociomateriality

Archival scholar Anne Gilliland asks in *Conceptualizing 21st-Century Archives* (Gilliland 2014) how would archival principles look like if archivists started their work right now in the thick of the on-going information revolution. The question is perhaps more interesting than any of the possible answers in that it compels us to scrutinize work and its constituents as situated action and simultaneously the limits of its situatedness in relation to intertwined changes, stabilities, and the making of human activities and the material world. Similarly, as particular technologies are, citing Isabelle Stengers, “put to work” (Stengers 1997) in a particular social context, also social “technologies”—procedures, systems, and practices—are “put to work” in technological contexts. In both cases, there will be frictions and unexpected consequences making the whole very unlike clockwork. Instead of subscribing to classical human-centric approaches (e.g., Gunderson 2016) and the much criticized ontology of separation of the human and nonhuman (Suchman 2007), technology-centric theoretization (e.g., Wise 1998) or to assume their full equivalence, this article suggests that making an analytical (but not ontological) separation between the two can be helpful in understanding the reciprocal process of becoming of information technologies and their use. In the contemporary landscape of working and interacting with

information the deep convergence of human and non-human has become a matter of fact. Sociality is an increasingly mediated digitally. Social networks and communication services have become a part of the infrastructure of social intercourse and reciprocal trust. Knowing and decision-making are increasingly based on recommendations made by algorithms implemented in everyday technologies such as search engines (Huvila 2016a), digital personal assistants, vending machines, and home appliances (Dingli and Seychell 2015). In contrast to the modernist assumptions of the neutrality of technology, the contemporary conditions of informing and getting informed leave little doubt of the formative role of information technology (Floridi 2014) in the ticking of the social life. Technologies convey norms and people are using technology to orchestrate (or normalize) and set the pace of the doings of other people (Jasanoff 2004). Instead of merely acknowledging the inseparability of information technologies and human-actors by framing the reality as being sociotechnical (Ropohl 1999) or sociomaterial (e.g., Jones 2014; Orlikowski 2010), focusing on the impact of technology on the human sphere or vice versa, mapping the networks (Latour 2005a) or describing the mangle of material and human agencies (Pickering 1995), there is need for better conceptual tools to understand and explicate

**CONTACT** Isto Huvila  [Isto.huvila@abm.uu.se](mailto:Isto.huvila@abm.uu.se)  Department of Archive, Library and Information, and Museum and Cultural Heritage Studies (ALM), Uppsala University, Thunbergsvägen 3C, 75126, Uppsala, Sweden.

© 2018 Isto Huvila. Published with license by Taylor & Francis

This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

how sociomateriality and its performativity function in practice, *how* the interactions of humans and the material world function, and especially, *how* information technologies and human-beings are framed by each other. In the context of information scholarship, these questions are essential for explicating and understanding better the role of both digital and nondigital information technologies, information sources, and human and non-human actors in the processes of knowing, informing, and being informed.

The aim of this article is to understand how Stengers' (1997) imaginary of putting to work can function as a conceptual lens for bringing analytical clarity to our understanding of what people and information technologies do to each other when they inseparable (Ropohl 1999), co-constituted (Amir 2013), symmetrical or mangled (Pickering 1995). Putting to work gives the means to inquire into the mechanisms of: (1) how technologies are setting standards of the social conduct of information practices, and (2) how people are using technologies to regulate the ticking of the social process. Starting with Gilliland's question "what if" and building on insights from reading Stengers (1997), this article elucidates the enmeshment of digital technology, and human actors in the context of information work. The question is how the presence of "the digital" (Suchman 2014)—digital information technologies (e.g., computers, digital cameras) and other types of social or technical technologies called or attached with the attribute "digital" (e.g., digital services, digital work processes, digital archives)—affect people and are affected by what people do with them.

This article engages these issues in an empirical study of Swedish professionals working with the management of archaeological information. It focuses on information work (Huvila 2009, as an information use specific sub-work, comparable to computing work of Gasser 1986), archaeological information process (an iterative process of the production and use of archaeological information), and management of archaeological information (by stakeholders from ranging from field archaeologists to cultural heritage administrators). The ongoing "digital revolution" in archaeology (Zubrow 2006; Díaz-Andreu 2017) and the heterogeneity of norms affecting archaeological work—humanities scholarship, scientific analyses of earth samples and artefacts, land development, history education, digital documentation tools, and others—and the resulting proliferation of new types of digital information make the management and archiving of archaeological information a useful and timely setting for exploration. Information technologies that are put to work, put people to work, and influence information practices can be either technical or social, or combinations of the both. The emphasis is on scrutinizing and

elaborating the mechanics of sociomateriality, of *how* information technologies (and material artefacts) and human-actors influence each other, what is happening in practice when something is often very vaguely explained in terms, for instance, performativity (Glass and Rose-Redwood 2014) or enactment (Law 2009), and to take one small step beyond merely stating that the sociomateriality happens in a "thick of things" (cf. Pickering 1993).

## Theoretical foreground

This article draws from the theorizing of Isabelle Stengers based on her work with Didier Gille on time and representation, and more precisely on her conceptualization of technologies being *put to work* in a particular social context and also how social "technologies," procedures, systems and practices are *put to work* in technological contexts (Stengers 1997). As a scholar, Stengers is probably best known for her work on the philosophy of science with physicist Ilya Prigogine (Wilson 2000), and more recently on a volume on Alfred North Whitehead's philosophy (Stengers 2002). In information science research, Stengers has been cited somewhat sporadically, primarily as a scholar and philosopher of science (e.g., De Beer 2011, 2007; Sørensen et al. 2001; Pouloudi and Whitley 2000). With the *imaginary of putting to work*, Stengers (1997) explains the interplay of social organization and technoscientific (her term for technical/scientific) arrangements in scientific work. Her central thesis is that the reciprocal influence of technologies and human-actors can be metaphorically explained as a process of how they both make the other to adjust to their embedded norms. The usefulness of this thesis lies in that while there is a growing interest in trying to understand the very apparent complexity of information work (e.g., Bawden and Robinson 2015; Cox 2012; Huvila 2012b), there is a dearth of research directed at explicating the mechanisms of the agency of both human-actors or technologies.

In spite of the different theoretical premises of relational and processual ontologies, Stengers' perspective identifies if not commonalities, at least compatibilities, with some of the recent sociomaterial theorizing—inseparability of the social and material, ranging from Simondon (1958) to more recent work of Latour and Woolgar (1986), Pickering (1995), and others; performativity (Butler 1990); relationality (Kineman 2011); and practices (Schatzki, Knorr Cetina, and von Savigny 2001), that has begun to gain popularity in different information disciplines (e.g., Pilerot, Hammarfelt, and Moring 2017; Khazraee and Gasson 2015; Cecez-Kecmanovic et al. 2014). However, in contrast to the tenets of hermeneutics

and social constructivism, Stengers denies that the human-observer would be the principal interpreter of the world. It is the world itself that is complicated, fluctuating, open to interpretation, and limits our possibilities to provide a complete account of it (Stengers 2002). Using Stengers' work as a lens, the relation of people and technologies manifests itself as complex shifting micro- and macrolevel assemblages of objects, representations, and practices. This contrasts with the quasi-orthodoxy of technology studies to focus on political human-centered forces "deployed" (e.g., Marres 2016) or "materialized" (e.g., van Oost 2003) in technologies. Unlike many social constructivists (Latour 2005b), Stengers builds on Whitehead and refuses to see a disconnect between politics, technology, and the social sphere. She comes close, but at the same time goes beyond Hughes' idea of technological momentum (Hughes 1994). In contrast to Hughes, her interest lies in the universe at large, not in the evolution of technology. At this point Stengers' position contradicts with the social construction of technology (e.g., Hughes 1987). Similarly to Suchman (2014), for Stengers, technology, social sphere, and politics have never been separate entities and the call to see technologies as participants in social processes is a nonquestion. For Stengers, the social effort encompasses the entire universe (Stengers 2002). Her theorizing goes beyond the existence of the socio-technical assemblages and their interaction the social life to explicating *how* the social and the technological orders engage with each other (Stengers 1997). For Stengers it is evident that, as Kely puts it, technologies both "coerce us" and "interfere with our goals" (Kely 2014, 207). Her focus is to understand how this occurs.

Stengers (1997) discusses how the removal of explicit indications of time (in her example, an hourly bell everyone could hear in the central Brussels until the mid-19th century) *normalized* the social conduct of people to follow a time they had to be aware of by themselves. Stengers (1997) characterizes the example as sociotechnical (which could also be called sociomaterial even if Stengers' focus is empathetically on techniques and mechanics rather than on materiality and her thinking is first and foremost processual rather than relational) and contrasts it to technicoscientific account of how the development of time-keeping instruments and the standardization of time changed set the conditions for the development of timekeeping as a norm. Earlier timekeeping and timekeeping instruments were adjusted to follow the experienced course of time. The length of hours depended on the length of the day and varied in different times of the year. At that time, as Stengers argues, the mechanical pendulum (i.e. clocks and other timekeeping devices) was synchronized with the social pendulum, the ticking of

time as it was experienced by people. First, the standardization of navigational time with the availability of increasingly accurate chronometers, and subsequently the standardization of common time with the arrival of railway turned a clock from being a representation to become an articulation of time. Stengers also discusses heat engines and shows that here too putting to work is reciprocal (Stengers 1997).

Before drawing parallels with or making contrasts to Stengers' use of norms and normalization and earlier references to the embeddedness of norms and technologies in information scholarship (e.g. Monteiro and Hanseth 1995; Robey, Anderson and Raymond 2013), there is need for pause. In information research, there has been a tendency to externalize norms as a part of the context of information work (e.g. Huotari and Chatman 2001; Case and Given 2016) or, for instance, in the context of activity theory, as a part of rules that regulate information activities (Wilson 2008). In putting to work, they are understood in a sense that is close to the concept of normal (i.e. the settled state of affairs) in Kuhnian normal science (cf. Kuhn 1970).

### Archaeology and digital information technologies

The rapid proliferation of digital technologies in archaeological work especially from the turn of the millennium onwards makes archaeology an interesting site to investigate the reciprocal influence of information technologies and human-actors. The introduction of myriad digital field recording methods and a shift from paper-based forms to handheld devices for the input of information has disrupted both archaeological work (Zubrow 2006; Kristiansen 2014; Boast and Biehl 2011) and earlier archiving practices (Huvila 2016c).

Jeane-Claude Gardin's work from the 1960s onwards until the early 2000s (Gardin 2003) is often cited as the pioneering one in employing information technology in archeology (Dallas 2015). The focus of the early discussions on use of information technology in archeology was largely on the use of computers as a tool (e.g., Doran and Hodson 1975; Lock and Wilcock 1987; Ross, Moffett, and Henderson 1991). In this discussion links to information science and sociotechnical and sociomaterial theorization have been at the best vague if not entirely nonexistent (exceptions: Ingold 2013; Khazraee 2013). Early 1990s onwards there was more extensive discussion (e.g., Reilly 1991; Reilly and Rahtz 1992). Since then a relatively small but growing number of works (e.g., COST-ARKWORK 2016–2020; Evans and Daly 2006; Huggett 2004; Huggett 2015; Huvila 2014;

Kansa, Kansa, and Wattrall 2011) have shown ambitions of theorizing the relationship between information technologies and archaeological practices. For instance, Huggett has called for an in-depth ethnographic study of the creation of digital technologies that are being used archaeology to understand how they influence archaeological practices (Huggett 2012) and later called for a grand challenge for research on digital archeology (Huggett 2015). This shortfall with regard to information technologies is in keeping with other technologies and techniques, which are only occasionally problematized to a significant extent in the literature (e.g. Adkins and Adkins 1989; Lucas 2001; Ingold 2013). In this regard, the contrast with archaeological interest in studying technology use in the past societies (e.g. Knappett 2014; Meskell and Preucel 2007; Miller 2007) is glaring.

One could argue that archaeological information work differs significantly from other contexts and archeology has peculiarities that distinguish it from other scholarly and professional disciplines. At the same time, however, it is apparent that the relationship between technology and human-actors is similarly complex and situate in sciences (Latour and Woolgar 1986; Pickering 1995), art and architecture (Ingold 2013), and other professional disciplines (Pickering 1995). Similar to many other contexts, in archaeology, the interplay of technologies and human-actors in archaeological information work is situated, and individual technologies are a part of the enterprise with a profound impact on some aspects of the work while they do not alone change the central tenets of the field.

## Methodology

Swedish archaeology professionals with special interest in the management of archaeological information were interviewed ( $N = 16$ ), as per 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 on average 60 minutes. They focused on the interviewees' views on the current state and future prospects of archiving and managing archaeological information. An in-depth discussion of the practices of archaeological archiving in Sweden based of these interview material has been presented in (Huvila 2016c) and (Huvila 2016b). The present article focuses on explicating how insights from these interviews can help us better understand the interplay of information technologies and human-actors.

These informants represent a convenience sample of Swedish professionals with a special interest in archiving archaeology, with both genders (8+8) and

**Table 1.** Position and career stage of Interviewees.

Interviewee	Description	Career Stage
Ingmar	Information administrator at a national institution	Mid-career
Brita	Administrative director of a contract financed archaeological department at a regional museum	Mid-career
Märta	Archivist, information manager at a national institution	Early-career
Kajsa	Administrative director of a contract financed archaeological department at a regional museum	Senior
Stina	Administrator at a national institution	Senior
Gunnar	Coordinator at a private archaeology consultancy	Mid-career
Gertrud	Researcher in archaeology at a Swedish university	Early-career
Storm	Field archaeologist at a private archaeology consultancy	Early-career
Halvor	Archivist at a national institution	Early-career
Karin	Coordinator at a contract archaeology department of a regional museum	Senior
Erik	Archivist at a national institution	Mid-career
Elof	Data archivist working at a data archive	Mid-career
Eljas	Administrator at a county administrative board	Mid-career
Berger	Researcher in archaeology at a Swedish university	Mid-career
Matts	Information manager at a national institution	Early-career
Krister	Researcher in archaeology at a Swedish university, data archivist working at a data archive	Mid-career

varying lengths of professional experience represented (Table 1). The initial group was formed by contacting professionals who participated in a 2013 workshop on archaeological archiving organized by a third party in Sweden. Invitations were sent to participants the author met at the event. Further, during the interviews the interviewees were asked to provide names of persons they thought the author should interview. For reporting purposes, the interviewees were assigned pseudonyms.

The author analyzed the interview data based on a close reading (DuBois 2003) of the transcripts using an approach based on the constant comparative method (Glaser and Strauss 1967). The analysis followed an iterative process of categorizing, writing, and recategorizing the material, identifying potential expressions relating to digital technologies and change in the narratives of the interviewees. In order to control for an overexpression 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. Somewhat counterintuitively 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.

## Analysis

Interviewees' responses provide examples of how the use of digital technologies is becoming a norm of archaeological work, and how the digital technologies change the information work of archaeologists.

Because of space constraints, the present analysis focuses on explicating the aspects of contemporary archaeological field practices that are relevant for the theoretical aims of this study, to discuss the imaginary of putting to work. Useful, more in-depth, accounts of contemporary archaeological field practices (e.g., Carver, Gaydarska, and Monton-Subias 2015; Jameson and Eogan 2013; Edgeworth 2006; Lucas 2001) and archaeological information work in Sweden (e.g., Huvila 2016c; Jensen 2012) can be found in the literature.

### *Technicoscientific perspective: Digital becoming a norm*

Stengers' first perspective on how technologies and human-actors are putting each other to work focuses on the role of technologies in establishing norms for social conduct.

Almost all archaeological information produced today is digital already when it is created (Gertrud). Maps are made in field with digital total stations and GPS devices, photographs are taken using digital cameras, notes are increasingly taken on handheld devices and reports written on computers. The data is stored in field on portable devices and later at office, copied to a local server of the research group or archaeology contractor for use in analyses and reporting. Gunnar's observed that "all documentation is digital" apart from "finds [physical artefacts] we find and keep in storerooms, they [finds] are physical". Or that "we have really moved to a digital world" (Brita), and "it is not really actual to go back to using a dip pen" (Halvor). Karin, who worked as a coordinator for archaeological fieldwork, estimated that in her organization, around 80% of information was digital. Some of her colleagues worked mostly digitally even if some others were still "rather analogue" (i.e. nondigital). The same applied to some of their collaboration partners. However, in contrast to the digitality of documentation and report-writing work, the formal archiving of information is still primarily based on the preservation of printed paper-based versions of born-digital reports. In Sweden, some archives accept digital data on physical data carriers (Börjesson 2016) and there are some international examples of digital archaeological archives, for

instance, in the United Kingdom and the Netherlands (Huvila 2016c). This means that, in practice, digital documentation data is difficult to find and access, and, for instance, researchers or other potential users needing it, are required to contact the original producers of digital data and hope for the best, or to digitize print-outs (Löwenborg 2014).

Krister's account of the impact of the digital illustrates how, from his perspective, it has begun to frame archaeological information work like mechanical clock did for the life in the early 19th century. Both Gertrud and Krister stressed that "all of that [documentation material] should be digitized and made publicly available so that people can basically understand what's being done and maybe even reanalyze it and critically evaluate the publications" (Krister). According to Krister, digitization is something that "should be done" so that the different parts of documentation are linked together in a coherent manner. According to him, "the future of digital analysis lies [...] [in] the ability to do multi-site analysis, [...] that's very complicated queries over the material from multiple [archaeological] excavations" and in the "extraction of more information from the data than has been previously been achieved."

Ingmar made the most explicit case for the need to "manage [digital] information to make it usable in the future", a theme that recurs in the literature on digital archaeological practices (Evans and Daly 2006; Huggett 2015; Kansa, Kansa, and Wattrall. 2011). The digital functioning entails a need to manage and hold the chain of information intact whereas the nondigital sustains less rigorous practices, as Ingmar puts it allows for leaving "finds to a museum, here you are." While other interviewees implicitly talked about the digital as part of their work, understandings of several of them (e.g. Brita, Storm, Gunnar, Erik) seemed to be anchored on functional rather than ontological differences between the digital and other technologies. For example, Storm remarked that when archaeologists talk about digitality, they usually refer to a practical possibility of attaching a specific find or observation with geographical coordinates (i.e., to put it on the map) rather than to something that has implications for the nature of knowledge. The literature similar tendency in the use and atheoretical misuse of geographical information systems (GIS) in archaeology (e.g., Hacigüzeller 2012; Zanini and Costa 2006).

There are, however, exceptions to the preference for the digital. The interviewees noted that it can be practical to write notes in a nondigital notebook, use paper-based fill-in forms to document archaeological features in the field, or especially on smaller excavations, to use tape, pen, and paper instead of a digital measuring instrument.

However, even if the interviewees occasionally talked about the use of the nondigital and the dependability of paper-based archives (e.g., Eljas), there was no one who explicitly questioned the preference of the digital over nondigital. Kajsa would “of course” first consult the digital archive of her home institution before considering alternative sources of information. Gertrud, Storm, and Märta saw a “very big potential” (Märta) in digitization. Stina underscored her preference for the digital by emphasizing how much easier it is to access digital and digitized material even while acknowledging that she did not “simply master this digital part [of the process].” Eljas also noted that it was much faster to use a digital archive and how he and his colleagues all used digital information “very much” even though he was concerned about the sustainability of digital developments.

Ingmar made a sharp distinction between the digital and nondigital, and essentially considered the two as competing “technologies”—characterizing the paper-based archive as stable and digital archive as a “living” repository. Matts’ commented “[w]hen you talk about digital archives, often there’s an assumption that it’s just the same as analogue [i.e. nondigital] archives and they are the experts, when in practice, digital archiving is often quite different, in practice, to the way that analogue material is archived.” Erik made a similar reference to “information” as a “technology” that could put and be put to work instead of focusing on dichotomizing digital and nondigital technologies. In contrast to distinguishing between the digital and the nondigital technologies, the interviewees made very few references to contemporary archaeological theory, too few to see whether theory was informing their social conduct. Even if it might appear strange, it is not entirely unexpected in the light of the frequent remarks on the theory-practice gap between professional, and academic, theoretically oriented, archaeology (e.g., Bahn 2012; Lucas 2012).

Putting nondigital information to work with the (digital) data can also legitimize the need to accommodate for the digital, as with Berger: “[t]hat is entirely digital data. And it is actually as important to both archive [it] and make [it] available [as it is to archive and make available nondigital data]” (Berger). From an analytical point of view, the benefit of being able to observe multiple co-existing technologies and norms is that the contrast between them can divest their premises and help understand the respective symmetries and asymmetries between social conduct and specific sets of information technologies. The worries with regard to the sustainability of digital information and the difficulty of accessing nondigital collections highlight the perceived significance of both sustainability and ease of access in the context of archaeological information work. The question remains,

however, *how* these parallel, partly conflicting norms are influencing social practices. In order to shed light to the issue, we need to take a closer look at the second socio-technical perspective of Stengers: how information technologies are affecting (in Stengers terms, normalizing) the social conduct.

### ***Technoscientific perspective: How the digital is normalizing the social conduct***

In addition to examples of how the digital is emerging to function as a norm, the interviews provided examples of how the introduction of the digital is normalizing (i.e., changing) the social process for producing archaeological information. According to the interviewees, currently, almost all information is produced using digital devices and they have replaced a large number of nondigital measurement, documentation, and information processing instruments. In the past, photographs were taken sparsely, and color slides and black-and-white photographs had different documentary functions in archaeological field work. Color slides were typically used to document the excavation work whereas all “important” photographs of the excavated site were taken in black-and-white. However, now “[w]e have stopped taking black and white photographs. We don’t take such photos anymore. There are no other photographs [i.e., not even color slides] than the digital photographs” (Brita). “When we [...] write guidelines about black and white photographs or photographs or slides, it feels like, please, it is 2013 now! [i.e., it is irrelevant to write about such outdated methods]” (Karin). Archaeologists also take more photographs (e.g., Ingmar, Eljas), individual images are used to document smaller features than before, and as a whole, it seems that digital photography has become a much more prominent, if not predominant, documentary practice at an archaeological excavation, superseding earlier individualistic notetaking and sketching practices.

Another example of how digital documentation technologies are normalizing the social conduct of archaeological information work (i.e. aligning it with the standards set by digital tools) concerns preservation of documents. Along the lines of the ongoing debate in the digital preservation community (Harvey 2007; Warner 2009), the interviewees had diverging opinions on how digitalization is changing the possibilities and premises of managing all or the most important information. The interviewees were, however, unanimous about the need of centralized digital archival solutions, standardized practices, and routines that would allow access to all archaeological information from all excavations and collections, and also the inadequacy of earlier local

approaches and often ad hoc solutions for management of archaeological information—to quote Erik, “it is awfully expensive.” Gertrud acknowledged that the amount of data is increasing and saw it is a potential problem, in absence of proper methods for managing them. Storm underlined the potential usefulness of comprehensive thematic databases even though he admitted, similarly to Erik, that compiling such repositories would be an arduous undertaking.

In the experience of respondents (e.g., Märta, Ingmar), even if the digital is setting a new standard for the production and exchange of information, the inter-institutional workflows between field archaeologists, museums, and administrative bodies tend to be based on sending and receiving paper documents, scanned or paper-like digital documents (e.g., PDFs). Only Berger, Matts, and Elof worked almost exclusively with digital information because their jobs centered on the management of digital data. Most of the other interviewees acknowledged that they lacked the skills, routines, guidelines or tools (e.g., Stina, Kajsa, Gunnar, Ingmar, Storm, Halvor, Erik, Gertrud) for management and long-term preservation of digital information: “digital things are just lying there and we are just waiting to know how we could send them to the correct place to be archived” (Gunnar). There is also a lack of comprehensive digital repositories that would allow a complete overhaul of practices from nondigital and half-digital ones to fully digital workflows (e.g., Brita, Stina, Karin, Erik). Gertrud underlined that the principal problem is not technical but organizational.

Archaeological information work was conditioned by paper-based norms of working well before the advent of a large-scale digitization over the last two decades. Consequently, many informants (e.g., Erik, Karin, Eljas, Ingmar) referred to a large variation of needs and practices of different stakeholders and a continued need of local workflows rather than a complete standardization of all archaeological work.

The normalizing impact of the digital can be seen both in the accounts of how the use of digital technologies has unified documentation and documentation management practices in archaeology (e.g. Brita, Eljas, Karin on documentation and photography) and in how the interviewees describe the difficulties of following the norm (e.g. Gunnar and Gertrud). Lack of preference for whether information is produced digitally or on paper (e.g. Gunnar) shows that the social conduct had not yet settled on a new norm. Another indication of the state of flux are the occasional anxieties of the “digital side of things” and feeling that “maybe you’re treading on their turf a bit” (Matts). These concerns remind of the anxieties and hostility against the standardization of time in

the accounts of Stengers (1997). However, even if the the digital technology is indisputably putting interviewees and their colleagues to work, as Kajsa, Gunnar and Halvor noted, it is apparent that in actual practice the digital is not going to replace nondigital ones and function as the sole norm as long as there are paper-based archives and artefact collections. There are both regulatory and common-sensical reasons to manage digital and nondigital information according to their respective criteria. It is not only one technology that puts people to work but different technologies do it at the same time, imposing competing norms that interfere with each other. The incongruities of the digital and other technologies identified in the analysis suggest that the friction between different technologies functioning as norms makes it at least very difficult, if not impossible, to reach a perfect symmetry between the social conduct and the technologies. It seems that a major reason why the digital has only partially emerged as a norm and why the social conduct vacillated was that the digital had not (at least) yet been normalized on the level of social organization.

## Discussion

### *Between the ideal and an asymmetry*

A Stengersian perspective focuses on *how* archaeology professionals make the digital and nondigital technologies do things in the context of their information work, how these technologies are aligned (or not) with the social conduct of information practices, and how these technologies are putting people to work. It calls for explanation of the twofold interplay of norms (how things should be done when the reality is framed according to a particular technology) and practical agency (how people are putting the technology to work both intentionally and unintentionally). In other words, technologies are both setting and used to set the agenda. Further, as the analysis shows, the discrepancy between how the agenda of a specific information technology is understood, how it is put to work, and how the ideals and realities of multiple co-existing technologies collide with each other provide windows to understand *how* (and why) human-technology interactions take such forms as they do.

The empirical analysis shows that in the context of archaeological information work, the digital has already established itself as a normative technology and a norm of social conduct in archaeological information work largely to a similar extent we may argue it has done in the society at large. At the same time, however, we can see that it has had a major influence on local very tangible practices of information work (e.g., capturing data, compiling information) and abstract highly intangible



ideals (i.e., how things should be done in a digital world) whereas the inertia and anxieties related to how organizational routines resist the norm. The digital is doing precisely what Wilson (2001) suggests of the intellectual foundations of information organization in general. The digital is pushing us to justify why we are conforming to its limitations and why we are excited about the particular set of opportunities it provides. Instead we could first decide what are desirable outcomes and acceptable limitations, and then choose an appropriate set of technologies to achieve them. Simultaneously, archaeologists are putting the digital to work to realize their ideals of easier access to information, opportunity to use larger datasets, to meticulously document archaeological sites and to facilitate their own information work. However, similar to how the impact of digital technologies on other spheres of life has turned out to be infuriatingly multifaceted, difficult to capture, and impossible to explain in simple terms (e.g., Dourish and Bell 2011), a closer look at archaeological information work shows that the digital's impact is considerably more vague and volatile than Stengers' examples of mechanical clock and heat engine. Therefore, instead of assuming that a crystal clear norm can be found in most everyday contexts, the present study suggests that the notions of norm and normalization can be useful guides even when they enable vague characterizations of where, when, and how norms are in action.

Even if the conclusion of the analysis is that the ideals are far removed from the current practices, the wants and wishes of archaeologists provide some glimpses of what an utopian perfect symmetry of information technologies and human-actors in archaeological information work would constitute. Stengers calls this World-as-Clock, an imaginary reality in which everything circulates indefinitely as a faultless system of norms and normalized conduct (Stengers 1997). In the World-as-Clock, technologies and the norms they impose on human-beings are flawlessly aligned with how people act and vice versa. In this world everything is entirely engaged in "natural" work (i.e., without a need to put anything to work) in a cycle of a lossless circulation of energies. In a World-as-Clock technology or people do not need to put each other to work, to force one other to do things they would not do without a specific prompt. There is no need for articulation (Strauss 1985), coordination work (Gerson 2008; Peters, Kloppenburg, and Wyatt 2010) or any other type of redundant "sub-work" (Gasser 1986) to keep the system going. As a theoretically perfect, utopian perpetuum mobile, the World-as-Clock assumes that it is possible to integrate all activity in one system without leaving anything outside. As a consequence, however, as Stengers notes, as a closed and completely

integrated system, the World-as-Clock is incapable of producing anything or having an impact in its surroundings (Stengers 1997). At first, the World-as-Clock may seem as an anti-thesis of much of Stengers' theoretical thinking and its underpinnings in the process philosophy of Whitehead. Even if Stengers hints that before the introduction of normative time, the social conduct and the workings of time-keeping technology were in synchronous relation, the World-as-Clock appears primarily as a demonstration of its own impossibility and the inherent preposterity and even undesirability of such a state of affairs.

Archaeology's World-as-Clock would be a system that incorporates easy access to information, harmonized large data sets, and the capability to bring together digital and nondigital collections without information loss in digitization and standardization of the latter. In contrast to somewhat wishful expectations of the interviewees like Erik and Storm, in the light of Stengers' theorizing, this utopian system is unattainable and, arguably in the end, a paradoxical circulatory dystopia—something interviewees who value diversity of local practices indirectly emphasize. However, in its unattainability and paradoxicality, the utopian World-as-Clock imaginary can serve as a useful benchmark for comparisons with what actually transpires in reality. It is also a cautionary example of the theoretical possibility of turning archaeology into an isolated, self-containing social system that feeds itself and does not produce anything or have an impact outside of its boundaries in the society. It would appear as a nightmare for everyone who advocates for public archaeology (Richardson 2014), worries for the societal relevance of archaeological work (Thomas 2013), but also for those who care about the scholarly and scientific relevance of the discipline. It is also an anti-thesis of both archaeology and archiving, two practices with an explicit aim of bridging the distance between the past and the present by preserving, investigating, and interpreting things from the past. However, a closer look at the asymmetry between the ideal and observable systems (i.e., the contrast between how the interviewees described the digital functioning as a norm and how it was put to work) can help us understand how the politics (as in the context of performativity, cf. Barad 2003) and less wishful political and apolitical asymmetries (i.e., when specific asymmetries of technologies and their users are considered preferable for particular political or other reasons) occur (i.e., how the interviewees describe how the digital puts them to work), and see the proportions and dimensions of the complexity of a specific situation in relation to a utopian ideal (cf. Bell 2012). The lack of skills, routines, guidelines, and tools, incompleteness of digital repositories and other factors mentioned by the

interviewees are examples of places where the social conduct is not in a symmetrical relationship with sociotechnical (or -material) norms and there is need for accommodation, the work of putting to work to acquire skills, produce guidelines, and tools and, for instance, to create “complete” digital repositories.

Being able to describe a World-as-a-Clock in a specific context could be at least a partial answer to the calls for a comprehensive situated understanding of human-technology relations in information research, both in information-specific disciplines—information studies (Leckie and Buschman 2009; Allen, Karanasios, and Slavova 2011) and social informatics (Sanfilippo and Fichman 2014; Smutny 2016)—but also in other fields such as archaeology (e.g., Huggett 2012) science and technology studies (e.g., Haraway 1988; Suchman 2007). With a better understanding of what would be an ideal (information) system and consequently how to put it to work, it could be easier to choose and balance between advantages and disadvantages and to make compromises—or to deploy new information technologies or change the social conduct—in order to decrease the amount of invisible subwork (cf. Star and Strauss 1999; Gasser 1986) and, using the vocabulary of Stengers, consequent “loss of energy,” because of the misalignment of technologies and the social conduct of information work.

The imaginary of putting to work has, of course, also evident limitations. It is an imaginary and as such a non-essential concept (both good and bad) within the wider ecology of practice. Stengers seems to agree with Whitehead that a philosophical abstraction like the imaginary of putting to work limits our possibilities to discern invisible work that is not explicitly described by the abstraction (Carolan 2010). Leaning on Stengers’ own thinking, the imaginary should probably be approached from the perspective of the “truth of the relative” of Deleuze and Guattari (1994) as an instrument of escaping the fallacy that there is a “major key” (Stengers 2005), one cause that explains everything. This is also where Stengers and her approach differs from systems theorists like Luhmann (1982) who, unlike her, tend to see the concept of systems as a theoretical key for explaining the dynamics of reality rather than as (dangerous and fallacious) abstractions that themselves require explanation. In this respect, the trap of assuming that everything can be explained by norms alone (Schatzki 2001) needs to be avoided here. A natural follow-up question is how literally and to what extent the imaginary of putting to work can be useful in the context of studying information activities and technologies. The exploration of archaeological information work as an example of the real World-as-Far-from-Being-a-Clock in this study illustrates the practical impossibility and also

the undesirability of integrating and synchronizing all information technologies and social processes that simultaneously put each other to work. In contrast to the World-as-Clock, the observable systems in the context of archaeological information work and elsewhere are incomplete assemblages and even at the best, only vaguely reminiscent of the ideal system. They need to be adjusted from time to time to sync with the norm that is, similar to the information technologies, ceaselessly becoming rather than being.

### **Putting “putting to work” to work**

In addition to providing insights into technology-human actors interactions, the imaginary of putting to work provides a useful starting point to reflect upon the approach itself. Instead of seeing the friction between information technologies and the social conduct as resistance (e.g., Pickering 1995) or users’ refusal to take rational steps (from service providers perspective) and utilize useful tools (e.g., Warwick et al. 2009), databases (Talja and Maula 2003) or information management systems (e.g., Stein, Galliers, and Markus 2013), Stengers’ approach puts emphasis on accommodation. The discrepancies between an ideal system and actual ones wherein technologies and people put each other to work help us understand how and why they function as they do rather what they are not allowing each other to do. The imaginary also provides conceptual tools to explicate the reciprocity of how people and information technologies both put each other to work and the asymmetries that arise in the process.

This compares with Ribes’ notion of how people and information technologies delegate agency to each other (Ribes et al. 2013) but with a broader scope and a focus on why delegation happens. Earlier studies have frequently referred to how seemingly natural phenomena are produced, enacted or mangled (e.g. Garfinkel 1967; Latour and Woolgar 1986; Marres 2016; Pickering 1995) but these accounts tend to be rather vague in explaining what it means in practice. Even if it is apparent that the world has a tendency to kick back (Barad 1999), it is not necessarily always that clear how it happens. Here, the imaginary of putting to work provides us conceptual means to deconstruct production and enactment.

In the context of archaeological information work, explanatory power of theories of digital archaeological practices (e.g., Evans and Daly 2006) is limited when it diverges from the norm set by the digital itself. Similarly, in contrast to the often largely description-oriented enterprise of explicating the agency and inter-agency of human beings and information technologies based on the various branches of practice theory, socio-

materiality, socio-technical systems, and actor-network theory, the imaginary of putting to work can be helpful in drawing attention to the process of how people and information technologies influence each other simultaneously by putting each other to work to follow their respective ideals and norms without falling into the trap of idealizing traditional and demonizing modern information technologies (e.g., cf. Benjamin 1969).

It can bring us one step closer to understanding and explaining in more detail how human-technology interplay described in the context of information research, for instance, in terms of practices (Nicolini 2012), enactment (Weick, Sutcliffe, and Obstfeld 2005), (re)configuring (Heath and Luff 2000), interpretative flexibility and infrastructural inversion (Bowker and Star 2000) function in practice rather than merely explicating the premises and outcomes of such processes. The tendency of the conceptualizations like use, appropriation (Dourish 2003), boundary spanning (Gasson 2006), interpretative flexibility (Pinch and Bijker, 1984), and constituting (Orlikowski 2008) is to refer to an asymmetrical human engagement with information technologies. Such approaches can be criticized for not taking seriously enough the agency of technical and social information technologies such as classification systems (Bowker and Star 2000), documents (e.g., Frohmann 2004; Huvila 2012a) and information systems (Feinberg 2015). As Cecez-Kecmanovic et al. (2014) have criticized, even many empathetically sociomaterial perspectives on the agency of information technologies have left them relatively “mute” by failing to give up the precedence of the social world in contrast to the material one. In contrast, the radical forms of materiality can be criticized for overemphasizing the role of information technologies (Winthrop-Young 2011). This critique can be extended to the often inflated assumptions of information studies that information seeking can change actual human behavior and the tendency to privilege information needs over other needs (cf. Wang and Shah 2017; Case and Given 2016; Nicholas and Herman 2009). A problem with approaches like actor-network theory (Latour 2005a), practices (Barad 2003; Schatzki, Knorr Cetina, and von Savigny 2001), enactment (Boudreau and Robey 2005), and boundary objects (Star 2010) is that they are seldom very explicit about the particularities of how information technologies become part of the social process. What does it mean that technology has, for instance, a “performative effect” (Marres, 2016) or that it has a translational role (Star and Griesemer 1989)? Bell (2012) criticizes Stengers’ recent notion of the ecology of practice (Stengers 2005) for the same limitation.

In contrast, the imaginary of putting to work with its focus on norms provides a framework to make a distinction between technologies and human-beings, and their

respective forms of agency and, at the same time, to suggest how technologies are used to do what (i.e., to normalize the social), and how technology is influencing and what (i.e., the norms) in the social conduct. It can serve as a complement to the scholarship that has focused on explicating very particular techniques of how specific information technologies and artefacts influence human behavior (e.g., PowerPoint presentations: Stark and Paravel 2008, museum exhibits: Heath and Vom Lehn 2008) and vice versa (e.g., archaeological reports: Huvila 2011, medical records: Berg and Harterink 2004). Even if the imaginary might tempt a reading from the perspective of an ontology of separateness (Suchman 2007), it allows for a relational (Barad 2003) and even more so, processual reading of the pendulum. In this sense, the imaginary of putting to work comes closer to Pickering’s emphasis of the need to understand the differences and differentiate between human and nonhuman agency (Pickering and Guzik 2008) rather than to assume that agency is symmetrical, human-centered as, for example, in the social enactment of technology (Orlikowski 2008), or (relatively) techno-centered as, for instance, in the engagement theory (Shneiderman 2000) or affective computing (Picard, 1997).

Even if Stengers would probably oppose the idea, the metaphor of putting to work has similarities with the post-humanistic thinking of Haraway (1991) and Hayles (1999). The information systems out in the wild are at the best, following Haraway (1991) and Hayles (1999), cyborgs of social conduct and technological norms, similarly remote both to the notion of the World-as-Clock and the idea of the separation of the man and the machine. In the Stengersian framework, the cyborg, as a mangle of the natural and technological worlds, is an enmeshment of the two that comes into being through their engagement in putting each other to work at the point when they reach an affinity, as opposed to identity-based synchronicity of efforts of putting each other to work, disappearance of the effort through a perfect harmony of the norms of the social and technological or a (nearly) physical amalgamation of the two. In contrast to Haraway’s (1991) cyborg, Stengers’ World-as-Clock is a deeply problematic meaningless self-containing and self-serving isolate. Rather than describing the *what* of the technology-human amalgamation, Stengers’ conceptual apparatus focuses on *how* it comes into being and helps us to understand how to come close to it, to understand when and where it can come into being and, if desired, how to avoid it. In addition, the scrutiny of how the digital puts (and tries to put) people to work and how people (try to) put the digital to work goes beyond anti-dualism and provides an entry to additional levels of complexity by uncovering traces of additional

technologies and social organizations (e.g., the interplay of paper-based archive and digital information discussed earlier) that simultaneously try to put each other to work in the same situation. World-as-Clock is an anti-thesis of Haraway's cyborg and a hegemonic technology-human amalgamation, of which both Haraway (1991) and anti-totalitarian scholarship (e.g., Arendt 1951) warn us. By focusing on norms, it has space for the politics of both the social and the technological (cf. Bell 2012) without giving up their symmetrical or nearly symmetrical relationship in the context of the world.

From a more practical perspective of developing new information systems, the imaginary of putting to work can take us a couple of steps closer to a position to embrace the social (Suchman 2014) and a partial solution to the classical problem of understanding why seemingly perfect technological and nontechnological systems of organizing and managing information fail and of abstracting a part of the complex reality to a degree that a technology can be put to work to help human actors in a specific (sociotechnical) situation. Putting to work can provide at least a partial explanation to why people can be seemingly irrational in their information seeking and use (Huvila 2012b), why information technologies are appropriated for nonintended purposes (e.g., Syn and Sinn 2015) or why people are gaming information systems to get their work done (Huvila 2013).

Putting to work can also function as a theory that can help us design meaningful norms (like freedom in Kelty 2014) in information technologies. The perspective of Stengers has some potential to help us avoid becoming Ingold's single-minded "straight-line people [...] addicted to innovation and change" (Ingold 2013) and nonattentive to anything that exists beyond and besides their assumed ideal, the digital, without any attention paid to how it is put to work, how it puts us to work, and what would be a World-as-a-Clock as per the ideal of the digital. Stengers' imaginary acknowledges the intricacy of human-technology relations and takes it as a starting point but rejects description of its complexity as an acceptable outcome. Instead of merely counting and describing the general complexity of the linkages of copious human and nonhuman agents involved in a particular process, situation or practice, the imaginary of putting to work helps to explicate the mechanisms of *how* they are attempting to influence each other by, literally, putting each other to work.

## Conclusions

This article has discussed how Stengers' imaginary of putting to work can help both researchers and practitioners to explicate how information technologies are both setting standards of social conduct (Stengers technoscientific

perspective) of archaeological information work and how people are using technologies to regulate the social process (sociotechnical perspective) of information practices. Stengers' perspective to human-technology interactions provide insights into how conflicts and asymmetry between multiple norms and practices associated with specific information technologies are not necessarily a sign of a gap, discrepancy or resistance or that the unintended consequences and uses of technologies are exactly as unforeseeable as they may seem to be. The imaginary suggests that, in the absence of a perfect symmetry of the man and the machine, described by Stengers as the World-as-a-Clock, different information technologies are putting us to work and we are putting them to work to achieve a working conformity between our information work practices and the technologies that are supposed to support us in our informational undertakings.

Putting to work is an inherent aspect of both technologies and their users. Instead of merely acknowledging that information technology use stems from information practices and performativity, or that technologies frame and influence them, the imaginary of putting to work provides a conceptual tool to say something about how this is happening. It reminds of the utopian goals of technologists and the intellectual exercise of Gilliland to imagine an archive without roots in the pre-digital history, an Archive-as-a-Clock within which the social practices and the digital are perfectly aligned. In its unattainability and undesirability it is not a model for a real-world information system but it can function as a useful point of reference for understanding the limitations and potential of realizable systems, and for reducing the amount of invisible "putting-to-work"-work needed to align technologies and their users to the extent that is deemed beneficial.

## Acknowledgments

The study is a part of the project Archeological Information in the Digital Society (ARKDIS) financed by the Swedish Research Council Grant 340-2012-5751. An early version of the paper was presented at the IFIP WG8.2 Working Conference in Dublin in December 2016 as a part of a theoretical panel. Since then, it has benefited of the discussions in the context of the COST action Archaeological Practices and Knowledge Work in the Digital Environment (ARKWORK) supported by COST (European Cooperation in Science and Technology).

## Funding

European Cooperation in Science and Technology, CA15201; VetenskapsreA Vetenskaprådet, 340-2012-5751.

## References

- Adkins, L., and R. Adkins. 1989. *Archaeological illustration*. Cambridge: Cambridge University Press.
- Allen, D., S. Karanasios, and M. Slavova. 2011. Working with activity theory: Context, technology, and information behavior. *Journal of the Association for Information Science and Technology* 62 (4):776–88. doi:10.1002/asi.21441.
- Amir, S. 2013. *The technological state in Indonesia: The co-constitution of high technology and authoritarian politics*. London: Routledge.
- Arendt, H. 1951. *The origins of totalitarianism*. New York: Harcourt Brace Jovanovich.
- Bahn, P. G. 2012. *Archaeology: A very short introduction*. Oxford: Oxford University Press.
- Barad, K. 1999. Agential realism: Feminist interventions in understanding scientific practices. In *The Science Studies Reader*, ed. M. Biagioli, 1–11. New York: Routledge.
- Barad, K. 2003. Posthumanist performativity: Toward an understanding of how matter comes to matter. *Signs: Journal of Women in Culture and Society* 28 (3):801–31.
- Bawden, D., and L. Robinson. 2015. Waiting for Carnot: Information and complexity. *Journal of the Association for Information Science and Technology* 66 (11):2177–86. doi:10.1002/asi.23535.
- Bell, V. 2012. Declining performativity. *Theory, Culture & Society* 29 (2):107–23. doi:10.1177/0263276412438413.
- Benjamin, W. 1969. The work of art in the age of mechanical reproduction. In *Illuminations*, ed. W. Benjamin, 217–51. New York: Schocken Books.
- Berg, M., and P. Harterink. 2004. Embodying the patient: Records and bodies in early 20th-century US medical practice. *Body & Society* 10 (2–3):13–41. doi:10.1177/1357034X04042931.
- Boast, R., and P. Biehl. 2011. Archaeological knowledge production and dissemination in the digital age. In *Archaeology 2.0: New approaches to communication and collaboration*, eds. E. C. Kansa, S. W. Kansa, and E. Watrall, 119–55. Los Angeles, CA: Cotsen Institute of Archaeology, UCLA.
- Börjesson, L. 2016. Research outside academia? An analysis of resources in extra-academic report writing. *Proceedings of the Association for Information Science and Technology* 53 (1):1–10. doi:10.1002/pr2.2016.14505301036.
- Boudreau, M.-C., and D. Robey. 2005. Enacting integrated information technology: A human agency perspective. *Organization science* 16 (1):3–18.
- Bowker, G. C., and S. L. Star. 2000. *Sorting things out: Classification and its consequences*. Cambridge, MA: MIT Press.
- Butler, J. 1990. *Gender trouble: Feminism and the subversion of identity*. New York: Routledge.
- Carolan, M. 2010. *Decentering biotechnology: Assemblages built and assemblages masked*. Farnham, UK: Ashgate.
- Carver, M., B. Gaydarska, and S. Monton-Subias, eds. 2015. *Field archaeology from around the world: Ideas and approaches*. Berlin: Springer.
- Case, D. O., and L. M. Given. 2016. *Looking for information: A survey of research on information seeking, needs, and behavior*. Bingley, UK: Emerald.
- Cecez-Kecmanovic, D., R. D. Galliers, O. Henfridsson, S. Newell, and R. Vidgen. 2014. The sociomateriality of information systems: Current status, future directions. *Management Information Systems Quarterly* 38 (3):809–30.
- COST-ARKWORK. 2016–2020. *COST Action CA15201: Archaeological practices and knowledge work in the digital environment*. Available at: [http://www.cost.eu/COST\\_Actions/ca/CA15201](http://www.cost.eu/COST_Actions/ca/CA15201) (accessed March 30, 2018).
- Cox, A. M. 2012. An exploration of the practice approach and its place in information science. *Journal of Information Science* 38 (2):176–88. doi:10.1177/0165551511435881.
- Dallas, C. 2015. Jean-Claude Gardin on archaeological data, representation and knowledge: Implications for digital archaeology. *Journal of Archaeological Method and Theory* 23 (1):305–30. doi:10.1007/s10816-015-9241-3.
- De Beer, C. 2007. An acritical philosophy of information: general contribution. *South African Journal of Libraries and Information Science* 73 (2):180–85.
- De Beer, C. 2011. Methodology and noology: amazing prospects for library and information science. *South African Journal of Libraries and Information Science* 77 (1):85–93.
- Deleuze, G., and F. Guattari. 1994. *What is philosophy?* New York: Columbia University Press.
- Díaz-Andreu, M. 2017. Introduction to the themed section “digital heritage and the public”. *International Journal of Heritage Studies* 23 (5):404–407. doi:10.1080/13527258.2017.1286780.
- Dingli, A., and D. Seychell. 2015. *The new digital natives cutting the chord*. Berlin: Springer.
- Doran, J., and F. R. Hodson. 1975. *Mathematics and computers in archaeology*. Edinburgh, UK: Edinburgh University Press.
- Dourish, P. 2003. The appropriation of interactive technologies: Some lessons from placeless pdocuments. *Computer Supported Cooperative Work* 12 (4):465–90.
- Dourish, P., and G. Bell. 2011. *Divining a digital future: Mess and mythology in ubiquitous computing*. Cambridge, MA: MIT Press.
- DuBois, A. 2003. Close reading: an introduction. In *Close reading: A reader*, eds. F. Lentricchia and A. DuBois, 1–40. Durham, NC: Duke University Press.
- Edgeworth, M. 2006. *Ethnographies of archaeological practice: Cultural encounters, material transformations*. Lanham, MD: Altamira Press.
- Evans, T. L., and P. T. Daly. 2006. *Digital archaeology: Bridging method and theory*. London; New York: Routledge.
- Feinberg, M. 2015. Genres without writers: Information systems and distributed authorship. In *Genre theory in information studies*, ed. J. Andersen, 43–66. Bingley, UK: Emerald.
- Floridi, L. 2014. *The fourth revolution : How the infosphere is reshaping human reality*. Oxford: Oxford University Press.
- Frohmann, B. 2004. *Deflating information: From science studies to documentation*. Toronto: University of Toronto Press.
- Gardin, J.-C. 2003. Archaeological discourse, conceptual modelling and digitalisation: An interim report of the logi-cist program. In *The Digital Heritage of Archaeology, CAA 2002*, eds. M. Doerr and S. A., 5–11. Athens: GreeceL Archive of Monuments and Publications, Hellenic Ministry of Culture.
- Garfinkel, H. 1967. *Studies in ethnomethodology*. Englewood Cliffs, NJ: Prentice-Hall.
- Gasser, L. 1986. Integration of computing and routine work. *ACM Transactions on Office Information Systems* 4 (3):205–25.

- Gasson, S. 2006. A genealogical study of boundary-spanning IS design. *European Journal of Information Systems* 15 (1): 26–41.
- Gerson, E. 2008. Reach, bracket, and the limits of rationalized coordination: Some challenges for CSCW. In *Resources, co-evolution and artifacts: Computer supported cooperative work*, 193–220. London: Springer. doi:10.1007/978-1-84628-901-9\_8.
- Gilliland, A. 2014. *Conceptualizing 21st-century archives*. Chicago: Society of American Archivists.
- Glaser, B. G., and A. L. Strauss. 1967. *The discovery of grounded theory: Strategies for qualitative research*. Hawthorne, NY: Aldine.
- Glass, M. R., and R. Rose-Redwood, eds. 2014. *Performativity, politics, and the production of social space*. New York: Routledge.
- Gunderson, R. 2016. The sociology of technology before the turn to technology. *Technology in Society* 47:40–48.
- Hacigüzeller, P. 2012. GIS, critique, representation and beyond. *Journal of Social Archaeology* 12 (2):245–63. doi:10.1177/1469605312439139.
- Haraway, D. 1988. Situated knowledges: The science question in feminism and the privilege of partial perspective. *Feminist Studies* 14 (3):575–99.
- Haraway, D. J. 1991. *Simians, cyborgs, and women: The reinvention of nature*. New York: Routledge.
- Harvey, R. 2007. *Appraisal and selection in DCC Digital Curation Manual* (Technical report). Edinburgh, UK: Digital Curation Centre.
- Hayles, K. 1999. *How we became posthuman: Virtual bodies in cybernetics, literature, and informatics*. Chicago: University of Chicago Press.
- Heath, C., and P. Luff. 2000. *Technology in action*. Cambridge: Cambridge University Press. doi:10.1017/CBO9780511489839.
- Heath, C., and D. Vom Lehn. 2008. Configuring “interactivity” enhancing engagement in science centres and museums. *Social Studies of Science* 38 (1):63–91.
- Hirsjärvi, S., and H. Hurme. 1995. *Teemahaastattelu*. Helsinki: Yliopistopaino.
- Huggett, J. 2004. Archaeology and the new technological fetishism. *Archeologia e calcolatori* 15:81–92.
- Huggett, J. 2012. Lost in information? Ways of knowing and modes of representation in e-archaeology. *World Archaeology* 44 (4):538–52. doi:10.1080/00438243.2012.736274.
- Huggett, J. 2015. Challenging digital archaeology. *Open Archaeology* 1 (1):79–85. doi:10.1515/opar-2015-0003.
- Hughes, T. P. 1987. The evolution of large technical systems. In *The social construction of technological systems: New directions in the sociology and history of technology*, eds. W. E. Bijker, T. P. Hughes, and T. Pinch, 51–82. Cambridge, MA: MIT Press.
- Hughes, T. P. 1994. Technological momentum. In *Does technology drive history? The dilemma of technological determinism*, eds. M. R. Smith and L. Marx, 101–14. Cambridge, MA: MIT Press.
- Huotari, M.-L., and E. Chatman. 2001. Using everyday life information seeking to explain organizational behavior. *Library & Information Science Research* 23 (4):351–66. URL
- Huvila, I. 2009. Ecological framework of information interactions and information infrastructures. *Journal of Information Science* 35 (6):695–708. doi:10.1177/0165551509336705.
- Huvila, I. 2011. The politics of boundary objects: hegemonic interventions and the making of a document. *Journal of the Association for Information Science and Technology* 62 (12):2528–39. doi:10.1002/asi.21639.
- Huvila, I. 2012a. Authorship and documentary boundary objects. In *System Science (HICSS)*, 1636–1645. Washington, DC: IEEE Computer Society. doi:10.1109/HICSS.2012.126.
- Huvila, I. 2012b. *Information services and digital literacy: In search of the boundaries of knowing*. Oxford, UK: Chandos.
- Huvila, I. 2013. Meta-games in information work. *Information Research* 18 (3):paper C01. URL <http://informationr.net/ir/18-3/colis/paperC01.html>.
- Huvila, I. 2014. Introduction. In *Perspectives to archaeological information in the digital society*, ed. I. Huvila, 1–9. Uppsala, Sweden: Department of ALM, Uppsala University.
- Huvila, I. 2016a. Affective capitalism of knowing and the society of search engine. *Aslib Journal of Information Management* 68 (5):566–88. doi:10.1108/AJIM-11-2015-0178.
- Huvila, I. 2016b. Awkwardness of becoming a boundary object: Mangle and materialities of reports, documentation data, and the archaeological work. *The Information Society* 32 (4):280–97. doi:10.1080/01972243.2016.1177763.
- Huvila, I. 2016c. “if we just knew who should do it,” or the social organization of the archiving of archaeology in Sweden. *Information Research* 21 (2):online. URL <http://www.informationr.net/ir/21-2/paper713.html>.
- Ingold, T. 2013. *Making: Anthropology, archaeology, art and architecture*. London: Routledge.
- Jameson, J. H. and J. Eogan, eds. 2013. *Training and practice for modern day archaeologists*. Berlin: Springer.
- Jasanoff, S. 2004. The idiom of co-production. In *States of knowledge: The co-production of science and social order*, ed. S. Jasanoff, 1–12. London: Routledge.
- Jensen, O. W., ed. 2012. *Histories of archaeological practices: Reflections on methods, strategies and social organisation in past fieldwork*. Stockholm: National Historical Museum.
- Jones, M. 2014. A matter of life and death: Exploring conceptualizations of sociomateriality in the context of critical care. *Management Information Systems Quarterly* 38 (3): 895–925.
- Kansa, E. C., S. W. Kansa, and E. Watrall, eds. 2011. *Archaeology 2.0: New approaches to communication and collaboration*. Los Angeles, CA: Cotsen Institute of Archaeology, UCLA.
- Kelty, C. M. 2014. The fog of freedom. In *Media technologies: Essays on communication, materiality, and society*, eds. T. Gillespie, P. J. Boczkowski, and K. A. Foot, 195–220. Cambridge, MA: MIT Press.
- Khazraee, E. 2013. Information recording in archaeological practice: A socio-technical perspective. Paper presented at *iConference 2013*, Fort Worth, TX, February 12–15.
- Khazraee, E., and S. Gasson. 2015. Epistemic objects and embeddedness: Knowledge construction and narratives in research networks of practice. *The Information Society* 31 (2):139–59. doi:10.1080/01972243.2015.998104.
- Kineman, J. J. 2011. Relational science: A synthesis. *Axiomathes* 21 (3):393–437. doi:10.1007/s10516-011-9154-z.
- Knappett, C. 2014. Materiality in archaeological theory. In *Encyclopedia of global archaeology*, ed. C. Smith, 4700–8. Berlin: Springer.

- Kristiansen, K. 2014. Towards a new paradigm? The third science revolution and its possible consequences in archaeology. *Current Swedish Archaeology* 22:11–34.
- Kuhn, T. S. 1970. *The structure of scientific revolutions*. Chicago: University of Chicago Press.
- Latour, B. 2005a. *Reassembling the social: An introduction to actor-network-theory*. Oxford: Oxford University Press.
- Latour, B. 2005b. What is given in experience? A review of Isabelle Stengers Penser avec Whitehead. *Boundary 2* 32 (1):222–37.
- Latour, B., and S. Woolgar. 1986. *Laboratory life: The construction of scientific facts*. Princeton, NJ: Princeton University Press.
- Law, J. 2009. Actor network theory and material semiotics. In *The new Blackwell companion to social theory*, ed. B. S. Turner, 141–58. Hoboken, NJ: Blackwell.
- Leckie, G. J., and J. Buschman. 2009. *Information technology in librarianship: New critical approaches*. Westport, CT: Libraries Unlimited.
- Lincoln, Y. S., and E. G. Guba. 1985. *Naturalistic inquiry*. Beverly Hills, CA: Sage.
- Lock, G., and J. Wilcock. 1987. *Computer archaeology*. Princes Risborough, UK: Shire.
- Löwenborg, D. 2014. Recuperating GIS data from excavations: On the use, or lack of use, of digital archaeological information. In *Perspectives to archaeological information in the digital society*, ed. I. Huvila, 11–23. Uppsala, Sweden: Department of ALM, Uppsala University.
- Lucas, G. 2001. *Critical approaches to fieldwork: Contemporary and historical archaeological practice*. London: Routledge.
- Lucas, G. 2012. *Understanding the archaeological record*. Cambridge: Cambridge University Press.
- Luhmann, N. 1982. The world society as a social system. *International Journal of General Systems* 8 (3):131–38. doi:10.1080/03081078208547442.
- Marres, N. 2016. *Material participation: Technology, the environment and everyday publics*. Berlin: Springer.
- Meskel, L., and R. W. Preucel, eds. 2007. *A companion to social archaeology*. Oxford: Blackwell.
- Miller, H. M.-L. 2007. *Archaeological approaches to technology*. Boston: Academic Press.
- Monteiro, E., and O. Hanseth. 1995. Social shaping of information infrastructure: On being specific about the technology. In *Information technology and changes in organizational work*, eds. W. Orlikowski, M. J. G. Walsham, and J. DeGross, 325–43. London: Chapman & Hall.
- Nicholas, D., and E. Herman. 2009. *Assessing information needs in the age of the digital consumer*. London: Routledge.
- Nicolini, D. 2012. *Practice theory, work, and organization. An introduction*. Oxford: Oxford University Press.
- Orlikowski, W. J. 2008. Using technology and constituting structures: A practice lens for studying technology in organizations. In *Resources, co-evolution and artifacts: Computer supported cooperative work*, ed. M. S. Ackerman, 255–305. New York: Springer.
- Orlikowski, W. J. 2010. The sociomateriality of organisational life: Considering technology in management research. *Cambridge Journal of Economics* 34 (1):125–41. doi:10.1093/cje/bep058.
- Peters, P., S. Kloppenborg, and S. Wyatt. 2010. Co-ordinating passages: Understanding the resources needed for everyday mobility. *Mobilities* 5 (3):349–68.
- Picard, R. 1997. *Affective computing*. Cambridge, MA: MIT Press.
- Pickering, A. 1993. The mangle of practice: Agency and emergence in the sociology of science. *American Journal of Sociology* 99 (3):559–89. URL
- Pickering, A. 1995. *The mangle of practice: Time, agency, and science*. Chicago: University of Chicago Press.
- Pickering, A., and K. Guzik. 2008. *The mangle in practice: Science, society, and becoming*. Durham, NC: Duke University Press.
- Pilerot, O., B. Hammarfelt, and C. Moring. 2017. The many faces of practice theory in library and information studies. *Information Research* 22 (1): paper 1602. URL <http://www.informationr.net/ir/22-1/colis/colis1602.html>.
- Pinch, T. J., and W. E. Bijker. 1984. The social construction of facts and artefacts: Or how the sociology of science and the sociology of technology might benefit each other. *Social Studies of Science* 14 (3):399–441. doi:10.1177/030631284014003004.
- Pouloudi, A., and E. A. Whitley. 2000. Representing human and non-human stakeholders: on speaking with authority. In *Organizational and social perspectives on information technology*, eds. R. Baskerville, J. Stage, and J.I. DeGross, 339–54. Boston: Springer US. doi:10.1007/978-0-387-35505-4\_20.
- Reilly, P. 1991. Towards a Virtual Archaeology. In *CAA90 Proceedings*, eds. S. Rahtz and K. Lockyear, 133–39. Oxford, Tempus Reparatum.
- Reilly, P. and S. Rahtz, eds. 1992. *Archaeology and the information age*. London: Routledge.
- Ribes, D., S. Jackson, S. Geiger, M. Burton, and T. Finholt. 2013. Artifacts that organize: Delegation in the distributed organization. *Information and Organization* 23 (1):1–14.
- Richardson, L.-J. 2014. *Public archaeology in a digital age*. Doctoral dissertation, University College London.
- Robey, D., C. Anderson, and B. Raymond. 2013. Information technology, materiality, and organizational change: A professional odyssey. *Journal of the Association for Information Systems* 14 (7):379–98.
- Ropohl, G. 1999. Philosophy of socio-technical systems. *Society for Philosophy and Technology* 4 (3): online. URL [http://scholar.lib.vt.edu/ejournals/SPT/v4\\_n3html/ROPOHL.html](http://scholar.lib.vt.edu/ejournals/SPT/v4_n3html/ROPOHL.html).
- Ross, S., J. Moffett, and J. Henderson., eds. 1991. *Computing for archaeologists*. Oxford: Oxford University Committee for Archaeology.
- Sanfilippo, M., and P. Fichman. 2014. The evolution of social informatics research (1984–2013): Challenges and opportunities. In *Social informatics: Past, present, and future*, eds. P. Fichman and H. Rosenbaum, 31–54. Newcastle-upon-Tyne, UK: Cambridge Scholars Publishing.
- Schatzki, T. R. 2001. Introduction: Practice theory. In *The practice turn in contemporary theory*, eds. T. R. Schatzki, K. Knorr Cetina, and E. von Savigny, 10–23. London: Routledge.
- Schatzki, T. R., K. Knorr Cetina, and E. von Savigny, eds. 2001. *The practice turn in contemporary theory*. London: Routledge.
- Shneiderman, B. 2000. Creating creativity: user interfaces for supporting innovation. *ACM Transactions on Computer-Human Interaction* 7 (1):114–38.
- Simondon, G. 1958. *Du mode d'existence des objets techniques*. Paris: Aubier.

- Smutny, Z. 2016. Social informatics as a concept: Widening the discourse. *Journal of Information Science* 42 (5):681–710. doi:10.1177/0165551515608731.
- Sørensen, C., E. A. Whitley, S. Madon, D. Klyachko, I. Hosein, and J. Johnstone. 2001. Cultivating recalcitrance in information systems research. In *Realigning research and practice in information systems development: The social and organizational perspective*, eds. N. L. Russo, B. Fitzgerald, and J. I. DeGross, 297–316. Boston: Springer. URL [https://doi.org/10.1007/978-0-387-35489-7\\_20](https://doi.org/10.1007/978-0-387-35489-7_20).
- Star, S. L. 2010. This is not a boundary object: Reflections on the origin of a concept. *Science, Technology & Human Values* 35 (5):601–17. doi:10.1177/0162243910377624.
- Star, S. L., and J. R. Griesemer. 1989. Institutional ecology, translations and boundary objects: Amateurs and professionals in Berkeley's Museum of Vertebrate Zoology, 1907–39. *Social Studies of Science* 19 (3):387–420. doi:10.1177/030631289019003001.
- Star, S. L., and A. Strauss. 1999. Layers of silence, arenas of voice: The ecology of visible and invisible work. *Computer Supported Cooperative Work* 8 (1-2):9–30.
- Stark, D., and V. Paravel. 2008. Powerpoint in public digital technologies and the new morphology of demonstration. *Theory, Culture & Society* 25 (5):30–55.
- Stein, M.-K., R. D. Galliers, and M. L. Markus. 2013. Towards an understanding of identity and technology in the workplace. *Journal of Information Technology* 28:167–82. doi:10.1057/jit.2012.32.
- Stengers, I. 1997. *Power and invention: situating science*. Minneapolis, MN: University of Minnesota Press.
- Stengers, I. 2002. *Penser avec Whitehead: une libre et sauvage création de concepts*. Paris: Seuil.
- Stengers, I. 2005. Introductory notes on an ecology of practices. *Cultural Studies Review* 11 (1):183–96.
- Strauss, A. 1985. Work and the division of labor. *The Sociological Quarterly* 26 (1):1–19.
- Suchman, L. 2007. *Human-machine reconfigurations: Plans and situated actions*. 2nd ed. Cambridge: Cambridge University Press.
- Suchman, L. 2014. Mediations and their others. In *Media technologies: Essays on communication, materiality, and society*, eds. T. Gillespie, P. J. Boczkowski, and K. A. Foot, 129–37. Cambridge, MA: MIT Press.
- Syn, S. Y., and D. Sinn. 2015. Repurposing facebook for documenting personal history: how do people develop a secondary system use? *Information Research* 20 (4): online. URL <http://www.informationr.net/ir/20-4/paper698.html>.
- Talja, S., and H. Maula. 2003. Reasons for the use and non-use of electronic journals and databases: A domain analytic study in four scholarly disciplines. *Journal of Documentation* 59 (6):673–91.
- Thomas, S. 2013. Brian Hope-Taylor, the Council for British Archaeology, and “the need for adequate archaeological propaganda”. *Public Archaeology* 12 (2):101–16. doi:10.1179/1465518713Z.00000000034.
- van Oost, E. 2003. Materialized gender: How shavers configure the users' femininity and masculinity. In *How users matter: The co-construction of users and technologies*, eds. N. Oudshoorn and T. J. Pinch, 193–208. Cambridge, MA: MIT Press.
- Wang, Y., and C. Shah. 2017. Investigating failures in information seeking episodes. *Aslib Journal of Information Management* 69 (4):441–59. doi:10.1108/ajim-02-2017-0041.
- Warner, D. A. 2009. Libraries, archives, and digital preservation: a critical overview. In *Information technology in librarianship: New critical approaches*, eds. G. J. Leckie and J. Buschman, 261–80. Westport, CT: Libraries Unlimited.
- Warwick, C., J. Rimmer, A. Blandford, J. Gow, and G. Buchanan. 2009. Cognitive economy and satisficing in information seeking: A longitudinal study of undergraduate information behavior. *Journal of the Association for Information Science and Technology* 60 (12):2402–15. doi:10.1002/asi.21179.
- Weick, K. E., K. M. Sutcliffe, and D. Obstfeld. 2005. Organizing and the process of sensemaking. *Organization Science* 16 (4):409–21.
- Wilson, E. A. 2000. Scientific interest: Introduction to Isabelle Stengers, Another look: Relearning to laugh. *Hypatia* 15 (4):38–40. doi:10.1111/j.1527-2001.2000.tb00347.x.
- Wilson, P. 2001. Book review: The intellectual foundations of information organization (by E. Svenonius, MIT Press). *College & Research Libraries* 62 (2):203–204.
- Wilson, T. D. 2008. Activity theory and information seeking. *Annual Review of Information Science and Technology* 42 (1):119–61. doi:10.1002/aris.2008.1440420111.
- Winthrop-Young, G. 2011. *Kittler and the media*. Oxford: Polity.
- Wise, J. M. 1998. Intelligent agency. *Cultural Studies* 12 (3):410–28. doi:10.1080/095023898335483.
- Zanini, E., and S. Costa. 2006. Beyond the GIS: A place for ideas. In *Archäologie und Computer (Workshop 11: Kultur-elles Erbe und Neue Technologien)*, 1–7. Vienna, Austria: Stadtarchäologie Wien.
- Zubrow, E. B. W. 2006. Digital archaeology: A historical context. In *Digital archaeology: bridging method and theory*, eds. T. L. Evans and P. T. Daly, 8–26. London: Routledge.