

Towards Mixed Methods Digital Curation: Facing specific adaptation in the artistic domain

Abstract

In this paper, we propose an epistemological framework based on mixed methods research to support specific adaptation of digital preservation models (such as the Open Archival Information System) in relation to digital curation models (such as the Digital Curation Centre curation lifecycle). Specifically, in the artistic domain, this framework is targeting production processes involving work-specific digital technologies, where the goal is to preserve the ways of re-performing the works rather than the preservation of a recording of the performance. This framework is based on four previous studies and their ontological and epistemological assumptions. The paper builds on these studies to elaborate a model for mixed methods digital curation, which accounts for multiple views of the relation between information and representation, and presents the impact on both digital curation research and practice.

Keywords: digital curation lifecycle; mixed methods; epistemological framework; information and representation; domain-specific adaptation; artistic domain.

1 Introduction

The design of domain-specific digital preservation and curation frameworks is challenging. It involves producers (see the Producer–Archive Interface Methodology Abstract Standard 2006, for methodological considerations about required actions during the early steps of the ingest process), as well as lifecycle management in relation to multiple stakeholders (see Pennock 2007; Higgins 2008, for discussions about the Digital Curation Centre curation lifecycle and Yakei et al. 2013, for the relations between stakeholders and trust in digital repositories). The context of the artistic domain is especially challenging because of the idiosyncrasies of the production of works involving digital components. Whether in the domain of installation art (see Heydenreich 2011; Coleman 2011), net art (see Laforet 2009), video games (see McDonough, 2013)¹, or musical works (see Wetzel 2004; Berweck 2012), the issues concerning the preservation of work-specific technology are critical and involve, notably, numerous stakeholders, tacit knowledge, and transmission of know-how (see Franklin, 2001, for a discussion about creativity and tacit knowledge). Visual arts as well as musical works involve issues of interaction and praxis (see Abbott 2012, Richard and Boutard 2013), complex socio-technical frameworks (see Born 1997; Konstantelos 2012), and distributions of creative agencies (see Born 2005; Fourmentraux 2006; Lovejoy 2011).

The idiosyncrasies of artistic projects advocate for original solutions regarding their preservation, while still benefitting from the tools and models developed and theorised in digital preservation and digital curation. The case of musical works using digital technology is specifically telling because the current frameworks for constructing work-specific software have been originally developed in this domain (e.g. development frameworks such as Max/MSP, PD, etc., which are now commonly used in visual arts, dance, and theatre) and the issue of their preservation has long been acknowledged (e.g. Menger and Cullinane 1989, Canazza and Vidolin, 2001). The preservation of these works entails the preservation of the ways of re-performing the works rather than the preservation of a recording of the performance (similarly, for a discussion about installation art as performance, see for example, Laurenson 2006).

¹ For the record, MOMA in New York City recently added video games to its permanent collection, Antonelli (2012).

In this paper, we propose an epistemological framework specifically aimed at addressing these issues, building on four recent converging studies on the preservation and dissemination of work-specific digital material in the context of contemporary music using digital technologies (i.e. Boutard and Guastavino 2012a, 2012b; Boutard et al. 2013, Boutard and Marandola, 2013b). This framework investigates the potential use of mixed methods at the design level for the preservation and curation of artistic works involving work-specific digital components. The necessity to design such a framework based on mixed methods of investigation will be discussed in this paper. According to Innocenti (2012), “so far, the theoretical aspects of the problem of digital art preservation and curation have been examined without much grounding particularly in experimentation [...]” (p. 73). The four studies grounding this framework are completed, and their results have been disseminated in various publications, except for the fourth that is in the final dissemination phase. However, the research methods and preliminary outcomes from this fourth study have been published (Boutard and Marandola 2013a, 2013b). The framework we propose, grounded in these four studies, is not limited to the context of research but rather fundamentally impacts upon the practice of digital preservation and curation and thus provides the basis for developing what we refer to as mixed methods digital curation (MMDC) that is the curation of digital material on the basis of multiple interplaying methodologies involving different ontological and epistemological grounds.

2 Epistemological and ontological grounds

2.1 Background

The consideration of mixed methods in the context of research and practice is far from being trivial; several authors have brought attention to mixed methods research (MMR) in the context of information studies (e.g. Fidel 2008) and the related issues for ontological and epistemological grounds (e.g. Greene 2006, 2008). As Ma (2012b) puts it, ‘information’ may refer to different ontological types and that may be dealt with by different epistemologies and methods. It is imperative to understand the ontological referent of the term ‘information’ in order to determine the appropriate epistemology and method for the study” (p. 1865). Generally speaking, “theoretical/methodological shortcomings need sustained attention in all areas of information science” (Cibangu 2013, p. 199). In particular, in MMR, this point has been questioned: “‘mixed methods’ sometimes being taken as an antidote to inappropriately chosen topics in regard to the methods used and epistemological confusions regarding methods, thus compounding confusion upon confusion” (Day 2010).

From this point of view, and for any ‘stage of mixing’ (see Fidel 2008), using mixed methods requires specifying the ontological and epistemological perspectives that will form our ‘epistemological framework’ (see Ma 2012b, p. 1859: “the mixing of research methods requires an epistemological framework that embraces the ‘reality’ uncovered by different research methods”). The following sections present the four studies that inform our model for MMDC. The outcomes of these studies have been disseminated and will not be presented in this paper (see Boutard and Guastavino 2012a, 2012b; Boutard et al. 2013; Boutard and Marandola 2013b). These paragraphs will focus on our analysis of the unpublished ontological and epistemological grounds for each study and their potential relations, how they informed our framework, and what they lead to. They will be presented following a chronological order that reflects best the relation that we trace between the four studies. We will then present the MMDC framework.

2.2 Considerations about information and knowledge

The first study (Boutard and Guastavino 2012a) that informs our model was conducted from 2010 to 2011. It investigated the relevance of tacit knowledge in artistic productions. Boutard and Guastavino selected a knowledge management model according to several criteria fitting the artistic context (descriptive rather than prescriptive models, operationalisability) with a focus on tacit knowledge. Specifically, the model that they selected is Boisot’s (1995) information space model². The model, based on three dimensions (abstraction, codification, diffusion) is presented in Boutard and Guastavino (2012a); the practical description of this model is irrelevant to this paper.

² Boutard and Guastavino reviewed other knowledge management models, some of which have been used in the

Developed during the same knowledge management era (see McAdam and McCreedy 1999) as Nonaka and Takeuchi's (1995) famous Socialisation-Externalisation-Combination-Internalisation (SECI) model, it differentiates on several points. The assumption of a possible segregation of knowledge into categories in the SECI model has been criticised (see McAdam and McCreedy 1999). Boisot states that the information space model tries to be more generic towards knowledge: "in contrast to most models in knowledge management that start from what managers and workers in an organisation actually do (Nonaka and Takeuchi 1995), the I-Space adopts a more abstract point of departure, namely, the nature of information and knowledge flows in any system. Recasting Polanyi's well-known distinction (1958) between tacit and explicit knowledge in information theoretic terms, the I-Space exploits the idea that knowledge that can be articulated will diffuse more speedily and extensively within a given population of agents than knowledge that cannot be so articulated" (Boisot et al. 2007, p. 6-7).

Boisot's model is grounded in Shannon's information theory. Boisot and Canals' (2004) theorisation starts from a criticism of the position on data, information, and knowledge fostered by what they refer to as 'methodological individualism' (according to which human activity relies on the individual characteristics of the agents, Theureau, 2010), a position they posit as influenced, notably, by Locke. Their primary axis of criticism of the data, information, knowledge, and wisdom (DIKW) model is the restriction of the unit of analysis to the human being (Boisot and Canals' criticism is presented in opposition to neoclassical economics, the goal being to link economics to organisation theory. Their criticism is not presented in relation to the environment like Bateson's, 1987, cybernetic epistemology, or technology like Hutchins', 1995, situated cognition), while their position is that of a 'fundamental openness of the systems' under scrutiny.

In this context, Boisot provides us with a theoretical framework that builds on Shannon's information concept with an extended focus on representation (that is to say, including the question of semantics) in relation to theories stemming from cognitive sciences (for an overview of the historical construction of cognitive sciences in relation to semantics (see, for example, Rastier 2010). Meunier (2002) refers to this as the representational hypothesis, which posits that the true nature of information is representational, that is to say symbolic: "[...] before we are in a position to extract information from a symbol, we first need to extract the information that it is indeed a symbol [...]" (Boisot and Canals 2004, p. 51). Boisot and Canals are thus primarily theorising the relation between information and representation. As they put it in a very broad statement, "if economists of different stripes have tended to conflate knowledge and information, sociologists, by contrast, have been more concerned with knowledge alone" (Boisot and Canals 2004, p. 49). Their theorisation is deeply rooted in cognitivism and as such doesn't try to specify the underlying gnoseology (see Rastier 2010, p. 35). It is thus enlightening that when discussing the nature of knowledge they refer to Popper whom Meunier (2002) associates with a naturalistic thesis on culture (from this perspective, culture is just another step in the increasing complexity of nature, specifically in relation to the adaption to the environment, Meunier 2002, p. 138). Obviously, reducing their take on knowledge to a citation of Popper is preposterous, but the point is that, following Rastier's argument about the 'gnoseologic postulate', it is outside their scope in this cognitivist framework. On the other hand, while they reject the essentialist position of neoclassical economics on data-information-knowledge, there are still traces of a realist ontology in their framework, a position where, "data, then, and the regularities that reside within the data, are properties of events and things 'out there' in the world [...]" (Boisot and Canals 2004, p. 52). We will come back to the things 'out there' in the following sections. As Lorino et al. (2011) put it, "representational epistemologies are realist: objects are presumed to exist and be governed by laws independently from observation by subjects" (p. 771).

In terms of the study of Boutard and Guastavino (2012a), and as a basis for discussion in the following sections, the use of Boisot's model in the context of digital preservation provided us with the conceptualisation of *significant knowledge* (see Boutard and Guastavino, 2012a), an extension of the well-established notion of *significant properties* (see Hedstrom and Lee, 2002, Hockx-Yu and Knight, 2008, Knight and Pennock, 2009) with a focus on the management of tacit knowledge. While conducted in a specific artistic context (i.e. contemporary music involving work-specific technological components), the outcomes of the study showed potential use of the conceptual framework and its operationalisation in other artistic production contexts, advocating for the relevance of *significant knowledge* for broader digital preservation contexts.

context of information studies, such as Snowden's Cynefin model in Childs and McLeod's (2013) research in record management.

2.3 A conceptual framework grounded in data

Guy, Donnelly and Molloy (2013) observe that, during the interviews of researchers that they conducted in the context of creative arts institutions, “[...] the expressions ‘documenting the research process’ and ‘visualisation and documentation’ were offered as alternatives to ‘research data’” (p. 103). Whether in installation arts (e.g. Heydenreich 2011), performance arts (e.g. Abbott 2012), or music (e.g. Donin 2012), within the context of research or preservation, the relevance of the production and the creative processes of artistic works in relation to their intelligibility has received attention. Abbott and Beer’s (2006) survey of 147 academics and practitioners in the general context of performing arts (including theatre, dance and music) established that ‘materials documenting the process of creating the performance or product’ have as much importance as the ‘materials documenting the final performance or product’ (p. 31). The second study, we refer to (Boutard and Guastavino 2012b), was conducted in 2011 and aimed at providing a framework for the conceptualisation of these processes, including both human and non-human agents in the context of contemporary musical works involving digital technologies.

This focus on the context of production and use of new technologies converges with theorisations in the sociology of science and technology. Latour (2005) emphasised the need to “study innovations in the artisan’s workshop, the engineer’s design department, the scientist’s laboratory, the marketer’s trial panels, the user’s home, and the many socio-technical controversies. In these sites objects live a clearly multiple and complex life through meetings, plans, sketches, regulations, and trials. Here, they appear fully mixed with other more traditional social agencies. It is only once in place that they disappear from view” (p. 80). Latour refutes the notion of social inertia, and, with some influences stemming from interactionism and ethnomethodology (Coenen-Huther 2002), reconsiders the object of research: “social aggregates are not the object of an ostensive definition [...] but only of a performative definition” (Latour 2005, p. 34). While his position induced accusations of a return to the position of Merton (Bloor, 1999) and of relativism (e.g. Gingras 1995), Latour answered in elaborating his theory: “‘constructivism’ should not be confused with ‘social constructivism’. When we say that a fact is constructed, we simply mean that we account for the solid objective reality by mobilising various entities whose assemblage could fail; ‘social constructivism’ means, on the other hand, that we replace what this reality is made of with some other stuff, the social in which it is ‘really’ built. [...] Since it was obvious to us that ‘social construction’ meant a renewed attention to the number of heterogeneous realities entering into the fabrication of some state of affairs, it took years for us to react in a balanced way to the absurd theories with which we appeared to be associated” (Latour 2005, p. 91-92). While this paper does not intend to present an historical account of the sociology of science and technology, Latour’s position impacted the methodological design of Boutard and Guastavino’s (2012b) study and thus, as we will discuss later, the epistemological framework presented in this paper.

This second study by Boutard and Guastavino (2012b) relied on grounded theory (Glaser and Strauss 1967) for the analysis of secondary data (see Boutard and Guastavino, 2012b, for a discussion about grounded theory applied to secondary data). Maintaining a qualitative approach, grounded theory enables one to “generate a rich, deep and well integrated conceptual system, organised at various levels of theoretical abstraction all of which in some way articulate with the data” (Henwood and Pidgeon 1992, p. 104). As Strauss and Corbin (1998) put it, “if our concepts are abstract enough, then they are likely to occur in similar or variant forms [...]” (p. 284). Thus, there is a direct relationship between the level of abstraction of the concepts generated and their transferability (according to Guba’s, 1981, specification of the relation between quantitative and qualitative criteria) to similar situations, which determines the relevance of this ‘rich conceptual system’ to multiple contexts, that is to say, from our perspective, to other artistic contexts. We will further discuss this point in relation to non-representational epistemologies in the following sections.

Grounded theory relates to several ontological and epistemological positions. According to Georgiou (2001), Glaser and Strauss’ (1967) grounded theory relies on a contextualist epistemology that presupposes that the data collected is part of an organised social interaction structure. The process of conceptualisation using the grounded theory requires studying actions/interactions in context. Nevertheless, grounded theory is not limited to ethnographic data collection. Glaser (1978) reminds us that, “though uniquely suited to field work and qualitative data, [grounded theory] can be easily used as a general method of analysis with any form of data collection: survey experiment, case study. [...] It transcends specific data collection methods” (p. 6). Georgiou (2001) declares that grounded theory is grounded in symbolic interactionism (see Blumer 1969). We may measure this statement against the later divergence of both authors

on the ontological and epistemological basis for the theory. Glaser will head towards what Henwood and Pidgeon (1992) call 'inductivist positivism'. Heath and Cowley (2004) state that, for Glaser, "induction is viewed as the key process, with the researcher moving from the data to empirical generalisation and on to theory (Bulmer 1979)" (p. 144). Following Glaser, Charmaz (2006, p. 48) emphasises the need to keep initial coding open-ended but still she acknowledges that researchers hold prior ideas and skills. In this way, Charmaz converges with Strauss' position. While Glaser does not deny prior ideas, he considers that, "learning not to know is crucial to maintaining sensitivity to data" (Heath and Cowley 2004, p. 143). Strauss and Corbin (1998) acknowledge these elements: "we recognise the human element in analysis and the potential for possible distortion of meaning. That is why we feel it is important that analyst validate his or her interpretations through constantly comparing one piece of data to another" (p. 137). But they also claim them as an integral part of grounded theory (Goulding 2002) through the inductive as well as the deductive process of theory construction: "we are deducing what is going on based on data but also based on our reading of that data along with our assumptions about the nature of life, the literature that we carry in our heads, and the discussions that we have with colleagues" (Strauss and Corbin 1998, p. 136-137). The specification of the role of previous literature is critical in the difference of position between Glaser and Strauss. Heath and Cowley (2004) acknowledge that for Strauss, "both use of self and the literature are early influences and, while diffuse understandings provide sensitivity, both specific understandings from past experience and literature may be used to stimulate theoretical sensitivity and generate hypotheses" (p. 143). Mills, Bonner, and Francis (2006, p. 27) remind us that Strauss and Corbin (1994) clearly do not believe in the existence of a "pre-existing reality 'out there.' To think otherwise is to take a positivistic position that [...] we reject [...]. Our position is that truth is enacted" (p. 279). Strauss diverges from the realist ontological position. He states that "the nature or essence of an object does not reside mysteriously within the object itself but is dependent upon how it is defined" (Strauss, 1969, p. 20). Bryant (2009) reminds us that, since its inception, grounded theory has avoided acknowledging the theory's epistemological position. Still, Bryant traces back Strauss' relationship, as a member of the school of Chicago, to pragmatism and symbolic interactionism. This relationship to pragmatism is Bryant's ground for a constructivist understanding of grounded theory. Consequently, it should be noted that some extensions of grounded theory modified its epistemological background. Clarke's (2005) situational analysis proposes a post-modern turn; Georgiou (2001) identifies in Costain Schou and Hewison's (1998) work a shift from a contextualist epistemology to a constructivist epistemology, providing a ground for post-structuralist approaches; and Mills, Bonner and Francis (2006) stress that Charmaz was first to present her research as constructivist grounded theory. In this context, Bryant highlights the critical role of abduction in regard to Glaser and Strauss' positions on induction and deduction.

Boutard and Guastavino (2012b) acknowledge the use of the literature for the generation of the theory, especially the impact of the notion of technological mediation (Latour 1994) on the consideration of agencies, a notion that has also received research interest in the context of artistic production (see Hennion and Latour 1993, for a discussion about the link between sociology of science and sociology of art) as well as in library and information science (LIS) (e.g. Hedstrom 1991). In light of Latour's position on constructivism which influenced the work of Boutard and Guastavino (2012b) and the different ontological positions of Glaser and Strauss, it is specifically relevant that this second study we refer to was grounded in a contextualist epistemological background, that is to say, Strauss and Corbin's (1998) take on grounded theory. Consequently, the reference to grounded theory in our epistemological framework will always refer to the point of view of Strauss and Corbin.

Practically speaking, this second study provides us with a conceptual framework relating to creative processes in contemporary musical works with digital components relevant to the preservation of idiosyncratic software production in the artistic context. We presented in detail our position on grounded theory in relation to the epistemological framework that we propose because it has a direct relation to the notion of generalisability and transferability and thus impacts the curation process in terms of the relevance of the conceptual framework we use. We will further elaborate on this specific aspect of the framework and its usefulness as mediation when discussing the idiosyncrasies of the production processes.

2.4 Data, information, and the OAIS

The third study (Boutard et al. 2013) is critical in many ways. It aimed at integrating the outcomes of both previous studies in terms of impact on digital preservation models and specifically on the Open Archival Information System—OAIS (2012). The integration addressed the relevance of tacit knowledge (i.e. the first study) and production processes (i.e. the second study), as discussed previously, in the context of the OAIS. On the one hand, we will not present the technicalities of this integration that Boutard et al. (2013) proposed; suffice it to say that both previous studies impacted the design of the model: the knowledge management model advocated for an open design at the level of the association between the Information Object and Representation Information (allowing for the addition of *Significant Knowledge* and *Significant properties* alongside *Representation Information*); the grounded theory conceptualisation induced the proposition for an explicit reference to the submission agreement in the model. On the other hand, we will discuss the epistemological grounds for such integration, following on from the thread of this paper.

The OAIS relies on the Data Information Knowledge (DIK) model (usually supplemented with a W standing for wisdom). In this system, according to Davenport and Prusak (1998), data is, “a set of discrete, objective facts about events”, information is, “a message, usually in the form of a document or an audible or visible communication”, and knowledge, “a fluid mix of framed experiences, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information”. Balmisse (2002) proposes a simpler definition: information is data in context and knowledge is information in use. Specifically in the OAIS (2012), information is, “any type of knowledge that can be exchanged” (p. 1-12) adding that, “in an exchange, it is represented by data” (p. 1-10). This view of the DIK is expressed in the ‘representation information’, that is, “the information that maps a Data Object into more meaningful concepts” (p. 1-13); “data interpreted using its Representation Information yields Information” (p. 2-4).

According to Frické (2008, p. 134), the intellectual background for the DIKW model is, in particular, positivism. Boisot and Canals’ position as detailed previously is explicitly a criticism of the DIKW model: “although few people will argue that knowledge can ever be reduced to data, the two terms are unwittingly brought into a forced marriage by having the term information act as an informal go-between” (Boisot and Canals 2004, p. 44). In fact, critics of the DIKW model have been numerous, mainly on the same terms as Boisot. For example, Day (2010) stigmatises LIS for “the poverty of foundational theories, particularly as they are built upon incoherent and inaptly applied metaphors (for example, [...] the DIKW (data–information–knowledge–wisdom) hierarchy, which is built upon a Lockean naïve empiricist theory of knowledge [...])”. In a more measured manner, we endorse Ma’s (2012a) statement: “the DIKW model, while useful for thinking about data flow in information processing machines, depicts a limited view of human learning” (p. 720), that is to say, the cognitive processes. In parallel, Boisot and Canals remind us that while Shannon distinguished 3 levels in communication (the first level or the technical problem, the second level or the semantic problem, and the third level or the effectiveness problem), he focussed on the first one, that is to say the level of the technical problem: “was the message received the same as the message sent?” (Boisot and Canals 2004, p. 53) and they address the second (building on the first). The OAIS does not address the cognitive models of information processing depicted by Meunier.

Lorino et al. (2011), referring to Goodman (1993), define representational epistemology as “an epistemology which assumes that the human mind can reproduce reality in a way that corresponds to the real world” (p. 771). Boisot’s model extends the usefulness of the OAIS model (following Ma’s argument) with a cognitivist approach, providing a focus on the management of tacit knowledge, while its realist ontological basis and its representational epistemological grounds are well suited for integration within the OAIS for the management of digital material.

On the other hand, the conceptual frameworks generated by the application of the grounded theory depart from this position and relate to the adaptation of preservation policies according to specific domains. Still, on epistemological grounds, the conceptual frameworks impact the management of digital objects at the level of digital preservation models. This impact relates to the need to account for the production processes and, notably, the constant creation of new agencies between human and non-human agents (the rendering of production processes proposed by Boutard et al., 2013, relevant at the OAIS level in relation to the submission agreement is outside of the scope of the present discussion). As Latour (2005) puts it, “[...] the object of a performative definition [of social aggregates] vanishes when it is no longer performed—or if it stays, then it means that other actors have taken over the relay” (p. 37-38). The use of

grounded theory in relation to the consideration of agencies during production processes and its relation to representation is well suited for the integration of domain-specific conceptual frameworks for the management of digital objects on non-realist ontological grounds. In this context, we may consider that this use of grounded theory as a management conceptual framework relates to Meunier's description of the 'phenomenological hypothesis' (which Meunier opposes to the previous so-called symbolic hypothesis of representation that we previously related to Boisot's position, both being part of the representational hypothesis), which still relates to the question of representation but in which information becomes 'idiosyncratic' and 'phenomenologic'. In this paradigm, interpretative agents use technologies (Meunier is interested in information processing systems) as an extension of their own representational structure (Meunier 2002, p. 140-141). From this perspective, the conceptual framework emerging from grounded theory is a structure for digital material collection (we will see in the following sections where this statement leads to) as well as the link to the preservation management levels provided by the OAIS and Boisot's model.

2.5 Non-representational epistemologies and the idiosyncrasies of production

If we posit that the conceptual frameworks emerging from grounded theory still have a representational relation to information, and as Lorino et al. (2011) put it, "if the purpose of models is not replication but mediation for inquiring, representations should be objects of critique and discussion, whereas descriptive complexity makes them black boxes for users (Morel and Ramanujam 1999). If complexity is interpretive, then we need theories and methods for the complex interpretation of systems rather than the observation of complex systems" (p. 773). Grounded theory is thus the pivotal level for the mediation of the inquiries (i.e. in the context of research, and for framing the digital material collection in the context of practice). The next step is then to fully endorse non-representational epistemologies to support the idiosyncrasies of production contexts in the artistic domain (see, for example, Benghozi 1995, for a discussion about the specificities of the production context in the artistic domain) and to design adequate collection methods for the curation of complex digital material (for re-performance purposes, as previously stated in the introduction of this paper). This was precisely the goal of the fourth study (Boutard and Marandola 2013b) that we refer to, that is to say, designing collection methods for artistic production processes, notably on the basis of the research of Clot in work psychology (see Clot 2008) and its application to multi-expertise situations in the context of organisation studies (see Lorino et al. 2011). The relation between the notion of transferability Guba (1981) and Strauss and Corbin's (1998) take on grounded theory is critical for relating to the work of Clot and Lorino et al. because "[...] research can produce mediating artefacts which are usable in a generic class of situations, 'cognitive trails' (Cussins 1992) relevant to a limited territory whose boundaries cannot be determined ex ante. This subsequently requires permanent watchfulness for signs of a possible loss of relevance in any future situation" (Lorino et al. 2011, p. 775).

As Latour (2005) puts it, "if you mention an agency, you have to provide the account of its action, and to do so you need to make more or less explicit which trials have produced which observable traces—which does not mean, of course, that you have to speak about it, speech being only one of the many behaviors able to generate an account and far from the most frequent" (p. 53). Hennion's sociology of music, influenced by Latour (see Hennion 1993, p. 263) and working on converging epistemological grounds (see Hennion and Latour 1993), emphasises the need to acknowledge the expertise of agents of the creative processes and their ability for critical thinking. Similarly, the work of Clot is also based on the ability of agents to comment on their activity, but also on the critical argument that the 'reality' of the activity is not only what is done but also what is not done, what we would like to do, what should be done, what could have been done, and what is done without wanting it to be done (Clot 2008, p. 89). Clot's method of crossed self-confrontation and its counterpart in the domain of organisation studies (i.e. Lorino et al.'s, 2011, method of the 'dialogical mediated inquiry'), enable the capture of this context of work activity among multiple agents, both human and technological, and the oral tradition among the multiple agents of the production process that supports it in the artistic domain (see Boutard and Marandola 2013b). These methods designed in the fields of work psychology and organisation studies use traces of activity, that is to say, "[...] forms of confrontations equipped with traces of past activities, including folders of documents, audio or video recordings, and visualisations in real-time of certain behavioural indicators of subjects" (Cahour and Licoppe 2010, p. a). According to Cahour and Licoppe, "such traces

[individual traces related to the agent's own activity] can also be supplemented with traces relating to behaviours of other persons in order to produce dynamic maps that render visible collective behaviours, or else modes of living together in a territory [...]. Such visualisations give rise to a second type of confrontation with traces of activity, that go beyond discussion or interview situations in order to integrate themselves into the very fabric of everyday life as continually available reflexive resources" (p. b). Boutard and Marandola (2013b) presented video excerpts of the work process (as well as related documents) to the agents of the production (i.e. composers, instrumentists, sound engineers, and computer music designers) in the aim of collecting additional verbalisation according to the methodological specifications. As suggested at the beginning of this paragraph, the domain-specific conceptual framework developed by Boutard and Guastavino (2012b) on the basis of grounded theory, provided their inquiries in the idiosyncratic production processes with a relevant mediating framework grounded in a non-realist ontological perspective. Specifically, it supported the segmentation and validation of the ethnographical video material as well as the selection of additional material for the conduction of the confrontations. Subsequently, it provided the framework for the segmentation and selection of the material collected during confrontations (see Boutard and Marandola 2013b).

The research question of Meunier (2002) was to define whether or not cultural phenomena could be related to information processing systems. His mitigated conclusion was affirmative but he stressed the difficulty and emphasised the issue of non-compositionality of core elements within culture. This statement converges with the perspective of Lorino et al. (2011), in the context of organisation studies, who state that, "the type of complexity generally faced by organization studies is not the predominantly syntactic complexity with which complexity theories have been mostly concerned. Organization studies must deal with predominantly semantic and pragmatic forms of complexity, which require different concepts and methods" (p. 770). This type of collection and inquiry method they advocate for, holistic in nature (see Clot and Leplat 2005), provides us with a non-representational view of the production processes of complex digital objects especially relevant in the artistic domain.

Following Boutard and Marandola's (2013b) research project, if we are interested in the work of Lorino et al. (2011), rather than other non-representational methodologies (we will briefly discuss other frameworks related to ergonomics, psychology, and linguistics in the following sections), it is also because it explicitly relates to the relation between information and representation which informs the direction of this paper and the primary axis of our MMDC framework.

3 The design of an MMDC framework

The selection of models and theories discussed in the previous sections follow different but related issues and perspectives related to digital preservation and curation in the artistic domain. The MMDC, which we conceptualise in the current section, primarily emerged from the need to articulate these different perspectives on the preservation and curation of work-specific digital technologies in the artistic domain, rather than the selection of models and theories to fit an *a priori* concept of MMDC.

Our goal is similar to the one of Strauss and Corbin (1998) in the context of grounded theory, when they state: "although most researchers tend to use qualitative and quantitative methods in supplementary or complementary forms, what we are advocating is a true interplay between the two. The qualitative should direct the quantitative and the quantitative feedback into the qualitative in a circular, but at the same time evolving, process with each method contributing to the theory in ways that only each can" (p. 34). On the one hand, the four levels we described picture a vertical model (represented in Fig. 1), that is to say, an 'epistemological framework' with multiple takes on representation and information grounded in multiple ontological and epistemological grounds. This relation between representation and information is the basis for the representational axis in Fig. 1. This axis illustrates the different takes on information across multiple epistemological and ontological grounds which we described previously. Following Meunier (2002), the higher levels correspond to a converging perspective on information and representation; in this context, information is representational, that is to say symbolic. Another way to put it is that the higher level on this axis is the closest to Lorino et al's (2011) definition of representational epistemologies. From this perspective, we may say there is a stronger gap between the third level (information space) and the second (grounded theory) because of the different ontological assumptions on both sides of this division. The upper levels (3 and 4) lean towards realist positions

and less domain-specific,³ idiosyncratic, situated aspects of curation (and thus less engaged in the lifecycle aspects that curation advocates for—see Pennock 2007—and more in the preservation aspects). On the other hand, the four studies showed the interplay between levels that are not strictly to be considered as hierarchical or the independent building blocks of a theory. The interplay between levels discussed primarily during the third study (see Boutard et al. 2013) showed a ‘non-linear’ influence between levels. For example, as discussed previously, both the grounded theory level and the information space level may influence the design strategies for the OAIS. This point is critical for the conception of adequate domain-specific policies (see Boutard et al. 2013).

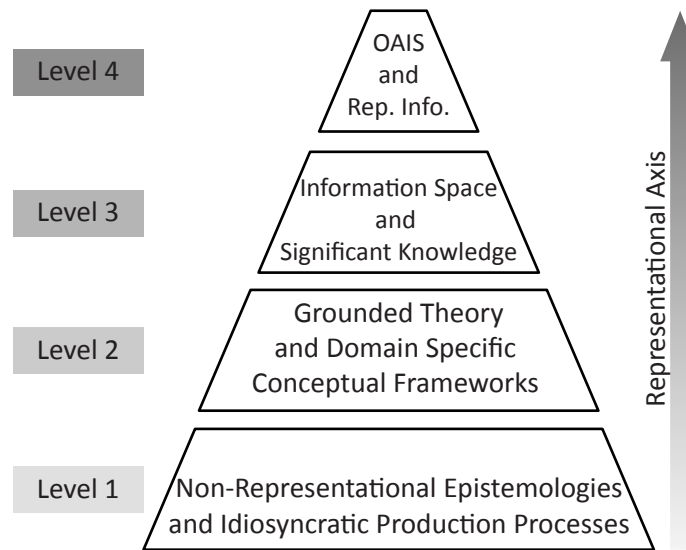


Fig. 1 The MMDC framework

Further discussion about the influence of the domain-specific conceptual framework level (i.e. the grounded theory level) in relation to digital curation models is required. The grounded theory level, in relation to non-representational approaches (level 1), rather than providing a classification scheme, provides curation policies with a conceptual framework to guide capture and ingest policies in relation to digital material production processes (as presented previously). According to Lorino et al. (2011), “the critique of their [i.e. representational epistemologies] shortcomings can follow two different tracks. It can question the notion of representation ontologically, or it can question the epistemological status of representations as true reproductions of the world and re-conceptualize them as signs mediating situated interpretations” (p. 774). While the information space level provides the first move in the direction of the first part of this statement, the grounded theory level fully supports the second proposition, that is to say it supports the last level (i.e. non-representational epistemologies level), which in our specific implementation relates to Lorino et al.’s (2011) method of dialogical mediated inquiry and Clot’s (2008) related crossed self-confrontation method.

The necessity to develop an MMDC framework doesn’t imply that we provided the only possible model. Specifically, at the first level, some convergent methods of inquiry are available with, nevertheless, some different epistemological assumptions (see Cahour and Licoppe 2010 and Theureau 2010, for a review of the goals and assumptions of several methods, including the work of Clot) such as the explicitation interview developed by Vermersch (2011, 2009), and the course of action (Theureau 2010, influenced notably by Suchman, 1987 and Hutchins,

³ From this perspective, “the model can and should be made as independent of singular contexts as possible” (Lorino et al. 2011, p. 771).

1995) which has been applied to music research (Donin and Theureau 2007). The think-aloud method (see Someren et al. 1994), for example, has also already been used in the context of music research (Collins 2007), as well as specific research in cognitive linguistics (see Cance et al. 2013). They are all valuable scientific instruments, still, all should be measured according to their assumptions (but also their goals; for example the level of intrusion fostered by the think-aloud method may impact other aspects of curation) and how they may fit into a specifically designed epistemological framework for research and/or practice adapted to a specific domain.

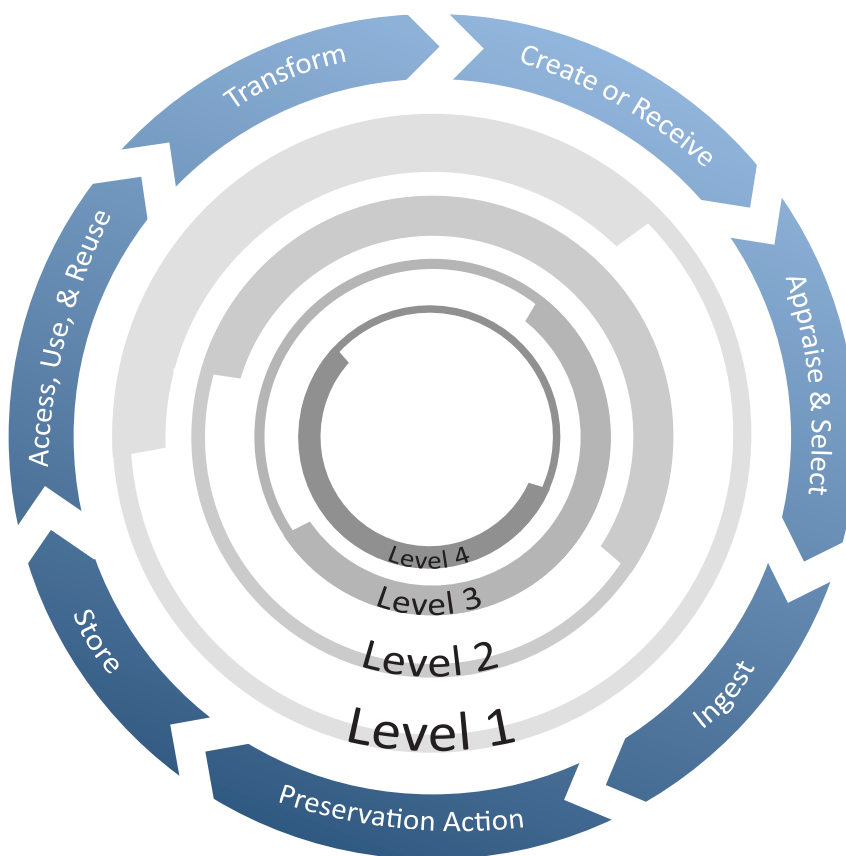


Fig. 2 Schematic view of the relation between the MMDC framework and the DCC curation lifecycle

According to Abbott (2012), “(...) the development of holistic, high-level curation strategies in recent years, such as the Digital Curation Centre’s curation lifecycle model (Higgins 2008), offer a structured approach which is more appropriate to open-ended works such as performance and interactive artworks. The explicit acknowledgement of an ongoing cycle of curation which includes elements of transformation is particularly useful for addressing the challenges of work in this domain” (p. 69). However, a digital curation model such as the Digital Curation Centre (DCC) curation lifecycle is primarily horizontal, that is to say time-based (which is consistent with the notion of lifecycle). Higgins (2008) acknowledges the need to connect their model to the OAIS: “workflow design, management issues, identification of processes and use of best practice can all be enhanced through the application of standards such as OAIS (...)” (p.135), the next stage of the project being, “(...) the development of domain-specific variations to help

further contextualise training and resources, while providing more tailored advice" (p. 136). An MMDC framework such as the one we presented supports the connection of a digital curation model such as the DCC curation lifecycle model to the OAIS, framing processes on a vertical as well as horizontal basis.

A consequence of this view on curation policies is that it fosters different kinds of evaluation methods according to the level. Following Lorino et al., cognitive purposes (that is to say, related to representational epistemologies) involve "the measurement of a variance between a target and a real situation" (p. 775), while in the context of existential purposes, "evaluation can then be defined as an ongoing judgement of the existential direction of the process. Cognitive purposes are simply heuristics in the pursuit of existential purposes, and can be changed at any moment" (p.775). The MMDC framework provides the structure for establishing the discourse between the curation model and the preservation model and the view that no unwanted discontinuities have been generated at some level; e.g. a failure to transmit know-how and praxis in the context of work-specific digital material in relation to the first level, a failure to question continuously the boundaries of the conceptual framework at the second level according to new situations, a failure to provide quantitatively more tacit knowledge related assets at the third level in a production context notorious for the impact of this specific knowledge, or a failure to match a specific property (a significant property or a transformational information property, OAIS 2012) at the fourth level during migration.

In Fig. 2, we present a very schematic, simplified view of such a relation with no empirical evidence. The thickness of the ring for each level represents the level of interaction between the MMDC framework and the DCC curation lifecycle. This kind of representation may help the specification of risk management policies (or instance, a gap in management during a specific phase of the curation lifecycle) and the validation of any MMDC design. Such a relation between the MMDC framework and curation lifecycles should be investigated in detail (this should be a primary goal of MMDC research), not forgetting about the potential non-sequential aspects of curation. The value of this figure is to point at the simultaneous movement horizontally and vertically and what they imply for curation: how can we maintain continuity at each level (where the line grows thin in the representation in Fig. 2) by carefully designing the interplay between levels (which we have provided a relevant ground for in this paper) while still enabling and fostering vertical movements? Feeding on the OAIS notion of 'designated community' we may argue that different designated communities will be involved at different levels for maintaining this continuity. This last argument requires stretching the definition of designated community outside of its original scope of consumer profiles (according to the OAIS, 2012, the designated community is "an identified group of potential Consumers who should be able understand a particular set of information") to include producers, which may be also consumers in specific contexts such as the artistic domain (more generally speaking, it relates to the notion of lifecycle in the context of curation but also of stakeholders (see Dappert and Farquhar, 2009, and Boutard and Guastavino, 2013, for a discussion about stakeholders from the point of view of digital preservation), and curators. Similarly, in the context of research data curation, Nielsen and Hjørland (2014) suggest "that information specialists who are also domain specialists could be important partners in providing information about research and data needs in different domains. Information specialists should help researchers articulate their research infrastructures and data curating needs" (p. 237), which requires educated professionals (see Palmer et al., 2013).

In terms of evaluation, in relation to our previous point, it means that some communities will be involved in more 'cognitive purposes' oriented evaluations (primarily related to level 3 and 4) while others will focus on 'existential purposes' oriented evaluations (primarily related to level 1 and 2). As mentioned in the Disciplinary Approaches to Sharing, Curation, Reuse and Preservation (SCARP) project's synthesis report (2010), "[...] the quality of datasets themselves and the likelihood of them being viable for the longer term is related to the disciplinary and data-related expertise of the people charged with responsibility for those datasets. [...] These data professionals may need domain-specific, task-specific and cross-cutting, general data curation training and support" (p. 27). We build on this statement to argue that producers may also need to be more involved in the curation process, especially at levels 1 and 2.

4 Conclusion

In this paper, we have proposed an approach to digital curation grounded in mixed methods. The epistemological framework of MMDC provides a 'vertical' complement to 'horizontal' digital curation lifecycle models as well as a

relevant relationship between the more abstract notions of digital curation, provided in models such as the DCC curation lifecycle, and the more concrete specifications of digital preservation models such as the OAIS.

Building on the notion of representation in relation to information across different epistemologies, we described the potential interplays between the levels fostered by such a framework, while specifying the ontological and epistemological assumptions they imply—from the positivist epistemologies of digital preservation models to the non-representational epistemologies proposed, notably, in work psychology and organisational studies. We related this epistemological framework to the notions of generalisability and transferability, as well as to the question of evaluation at multiple levels.

Following notably on this last point, we have argued that while the MMDC framework is based on research, its impact is primarily one of practice. The use of such a framework may impact upon practice at different levels (according to the levels we defined and in relation between them) and ground the specification of curation policies in relation to each phase of the DCC curation lifecycle (not only appraisal and ingest).

Further theoretical and empirical research should be conducted regarding the connection between the MMDC and digital curation models. We posit that we laid the groundwork for these future directions. Other domains of inquiry also come to mind, for example, the relation to models of organisation at a broader level, that is to say, specifically in relation to library, archive, and museum (LAM) and the notion of collaboration (see, Zorich et al. 2008; Waibel and Erway 2009).

We have argued that the artistic domain provides us with specific challenges for digital curation. In this context, the preservation of work-specific, idiosyncratic software meets the need for continuous re-performance and transformation. As Abbott (2012) puts it, “both performance and interactive art never reach a state of completion, both are open-ended creative endeavours, experienced uniquely, and continually being re-formed as part of an ongoing creative process” (p. 66). Numerous publications echo this statement (e.g. Yong 2006, Wetzel 2006, Tilly 2009). The potential opposition between a focus on transmission for the sake of preservation, which echoes the conceptualisation of the lifecycle in digital curation, and a focus on preservation for the sake of transmission, which echoes the strategies in digital preservation can be solved with the integration of both views interplaying along the curation lifecycle, the strategies potentially working in parallel at multiple levels. The specificities of the horizontal integration proposed in Fig. 2 should be investigated thoroughly according to domain specificities. This task may involve the systematic comparison of specifications of digital curation phases and methodological practices (such as the one described in the previous sections of this paper). Focus groups and survey research involving designated communities (including producers/consumers and curators) may complement a literature review approach. Furthermore, the implementation of an experimental curation platform would provide MMDC research with a high potential for development.

The MMDC framework described in this paper is one specific instantiation of the general mixed methods approach to digital curation that we propose. However, this approach can provide the digital curation community with a potential for extending over multiple domains of application.

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