

Model–Database–Interface:

A study of the redesign of the ArtBase, and the role of user agency in born-digital archives

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Abstract

This thesis critically examines the researcher's embedded practice of redesigning the ArtBase archive of net art in collaboration with digital arts organization Rhizome.

Net art challenges the notion of artworks as single, self-contained objects. To be performed and experienced, net art depends upon alignments between hardware and software environments, network protocols, as well as user interactions. Therefore, the archive of net art operates as a network of relations between users—including staff, artists, programmers, academics—and digital infrastructure. This networked condition complicates a redesign of the archive's interface, but also opens opportunities to rethink the agency of users within opaque, digital institutional environments.

To explore and expand the potential for informed user interaction and intervention, this research develops an original framework for the design of born-digital archives: Model-Database-Interface (MDI). MDI traces and makes visible the links between data model, database software, and user interface, reflecting processes of institutional and community-based classification, use, and maintenance.

This thesis demonstrates how MDI applies design prototypes, data visualizations, and user workshops to open up underlying data structures and processes to inspection and intervention. Further, it discusses how the ArtBase redesign adopts a linked open data (LOD) model to support ongoing user engagement and collaboration. Thereby MDI is positioned as a conceptual and methodological framework that centers user participation and critical meaning-making beyond the redesign's completion.

The development of MDI as well as its application in LOD environments, make distinctive contributions to interface design theory and practice. This study also contributes to the field of digital archiving by reimagining the ArtBase interface as a site for infrastructural inversion and user collaboration. Reaching beyond the particular case of net art, the strategies discussed in this thesis are applicable to a variety of digital interface contexts that place value on the role of user agency.

Author's declaration

I declare that this thesis has been composed solely by myself and that it has not been submitted, in whole or in part, in any previous application for a degree. Except where states otherwise by reference or acknowledgment, the work presented is entirely my own.

Lozana Rossenova Mehandzhiyska 1 February 2021

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NB This thesis is intended to be read alongside an interactive PhD Portfolio accessible at: <u>https://sites.rhizome.org/artbase-re-design/index.html</u> For more details, see also p.29 of this thesis.

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Introduction

Computers and networks have become transparent¹, and ubiquitous, delivery systems for text-, image-, or video-based media, which they are able to fully represent and contain. At the same time, it remains the case that the rapid pace of change in the fields of both hardware and software engineering has resulted in obsolete environments and devices. Furthermore, the development of new patterns of interaction between users and computers, continuously complicates the long-term provision of access to any digital artifacts of cultural value (Stevenson, 2008; Munro et al., 2019). Cultural heritage institutions with collections consisting of artifacts that fall within containable formats such as texts or images (whether born-digital or digitized analog media) have worked towards established policies and procedures for long-term storage and representation in online archives and repositories (Duranti and Schaffer, 2012). However, these policies, procedures and attendant digital infrastructures are not yet able to fully address the needs of complex, non-linear digital cultural expressions, such as multi-player online video games, user interactions via social media platforms, or indeed the object of study of this thesis—net art.² Existing research has outlined "significant properties" relating to the conservation of softwarebased art (Laurenson, 2014; Ensom, 2018); documentation practices for the purposes of preservation of net art (Dekker, 2013), and technical approaches to the preservation of network-based objects (Espenschied and Rechert, 2018) and video games (de Vos,

¹ In this thesis, the term transparent is used to signal the "window" metaphor in interface design and human-computer interaction. In this sense transparency means to reduce visual complexity in the interest of a user-friendly interaction experience, wherein the interface becomes a transparent "window" to deliver content (Bolter and Gromala, 2003). See also Chapter 3.

² The term net art is contentious. This thesis discusses several different terms to talk about varieties of born-digital art. Born-digital art generally refers to artworks which rely on computers and networks for their production and performativity. The term new media art is also used on occasion to refer to works which may also use computational media, but could also encompass various forms of installations, as well as physical components. Net art is the term used most often in the literature referenced in this thesis to describe works in the ArtBase archive. It is broader than the earlier net.art, which focused on a specific group of mostly European artists during the mid-to-late-1990s. Net art, as described by Michael Connor in the publication supplementing the Net Art Anthology online exhibition (Connor, 2019), is not just about the creative use of the net, but also about examining the conditions of participation in it. In that sense, it can involve performative or participatory elements outside a browser window. In the case archive examined here—the ArtBase, the primary experiential context for the artworks is the internet.

2018), to name just a few examples from the current literature. However, questions relating to how these research findings are integrated into the user-facing interface of an archival system designed to present and make such works accessible (in various preserved states) remain open. The main research question this thesis seeks to address is how can new possibilities for informed user interaction and intervention be developed in such contexts?

Moreover, I position this question as a *design* question, which can be addressed through a design practice. This PhD project was conceived as a Collaborative Doctoral Partnership³ between a research institution (London South Bank University's Center for the Study of the Networked Image) and an archival institution (Rhizome) with the intention that a practice-based research project could produce new insights around the so far under-researched and underdeveloped area of archival interfaces for interactive, networked media. My embedded role as a designer-researcher within Rhizome offered the opportunity to observe, as well as intervene in, the interdependent relations between institutional policies and user practices, and between interface and infrastructure, by redesigning their archive. The outcomes of the redesign process included visual design prototypes and data models for the information architecture of the archive. Meanwhile, my research role within the university offered the opportunity to reflect on the practice and the broader applicability (or lack thereof) to other institutional contexts facing related challenges of digital preservation and access provision. The outcomes of this research process are this thesis and a set of reflective reports produced alongside each phase of the redesign. These outcomes jointly articulate a new conceptual and methodological framework: Model–Database–Interface (MDI). This framework moves design theory and practice outside the silo of human-computer interaction (HCI) and user experience design (UX).

³ A Collaborative Doctoral Partnership, as supported by the AHRC (Arts and Humanities Research Council) in the UK, is a scheme for collaboration between an organization and a higher education institution "to support a student to deliver a specific area of postgraduate research" (Hill and Meek, 2019, p.5). Furthermore, "the topic of the student's research has to support the work of the partner organization" (*ibid.*).

Research problems

In order to begin unpacking the question of access and user agency, and formulate a set of specific research problems, I focus on the case of Rhizome's online archive of net art—the ArtBase. Rhizome is a grassroots digital arts organization founded in 1996 as an online mailing list, which then grew into an online platform dedicated to engaging with, promoting and critiquing born-digital art generally, and net art more specifically. In 1999, Rhizome's founder, artist Mark Tribe initiated the ArtBase archive project. The ArtBase invited artists to submit their net art work to the archive and offered various options for data (and metadata) submission and preservation. This case study offers opportunities to work with a wealth of material (over 2000 works) spanning more than 20 years of networked artistic practices and various ideas of what constitutes a net art archive, its preservation, and how users interact with it.

The evolution of these practices and ideas is closely associated with identifying what constitutes the net art work itself. Unlike plain text documents or static digital images, net art works are not single digital artifacts, but rather assemblages (Dekker, 2018),⁴ dependent on alignments between hardware and software environments to be executed and rendered. Additionally, they change over time and require specific user input in order to be performed (Paul, 2009). Capturing multiple layers of dependencies on specific operating systems, browser software and network protocols, as well as various user interaction models, poses technical as well as social challenges when preserving and presenting net art online. Technical aspects related to the documentation of metadata and use of interface design elements to indicate unsupported browser plug-ins, changes in web languages or syntax, interaction models which develop over time and/or over various platforms, among others, remain to be fully resolved (McKeehan, 2016). In addition, clear parameters for identifying and representing the social context of net art, including spatial, temporal, aesthetic and behavioral context (Konstantelos, 2014), continue to be underdefined in academic

⁴ The processual behavior of net art works, their propensity for change and variability occurring in nonlinear ways, is why Dekker proposes the concept of the assemblage as a useful way of thinking through the problems of conserving net art (2018). Using the concept as originally developed by Deleuze and Guattari (2004[1988]), and later simplified by DeLanda (2006), Dekker proposes that net art assemblages do not simply hold heterogeneous components together by means of particular relational patterns (2018). Assemblages help to "diversify and clarify" these relations because different components of the assemblage can retain autonomy, disconnect and become parts of other assemblages (*ibid*.).

and professional cultural heritage literature. The relative clarity or ambiguity regarding such parameters—with the provision that ambiguity may in some instances be intentional—impact how such artworks may be represented in a user interface, and also the architecture that may organize and describe them in a backend database. What is more, as net art combines many of the interactive, networked and non-linear digital media properties that can be seen in games, websites, or software applications, the findings of this thesis are relevant to a range of interactive media that is increasingly becoming the object of institutional collecting (Dekker, 2018; de Wild, 2019; Haidvogl and White, 2020).

To further specify the scope and relevance of the design practice discussed in this thesis, I focus on three specific areas which open up distinct, yet interconnected problems for the ArtBase redesign. These are: a) backend infrastructure for digital preservation; b) frontend interface design for born-digital archives; and lastly c) the role of user communities in the archive's socio-technical infrastructure.

a) Backend infrastructure for digital preservation

The first set of problems for the ArtBase redesign is determining what backend infrastructure is required to meet the needs of net art preservation and how that infrastructure impacts presentation in the frontend interface. The embedded position within Rhizome revealed that the current archival framework of the ArtBase is no longer able to provide adequate access to a large number of the historic artworks. Increasingly, the focus of preservation efforts at Rhizome has been on developing new approaches and building tools to support the presentation of complex artworks with multiple dependencies (Connor, 2016; McKeehan, 2016). Recent developments in browser-based emulation and web archiving tools have been instrumental in facilitating the restoration and reperformance of complex internet art works as part of Rhizome's major curatorial project launched in late 2016—the Net Art Anthology.⁵ The emulation of browsers or entire operating systems within a user's own browser, as well as web archiving techniques which aim to preserve network traffic between a server

⁵ The Net Art Anthology is a two-year-long curatorial project developed by Rhizome, which presents works from the history of net art online each week. Works are typically contextualized with new research and reperformed via emulated browsers or system environments (Net Art Anthology, 2017).

and a specific user's client application, as opposed to collecting folders of static HTML and CSS files, represent an attempt at "fencing apparently infinite objects" (Espenschied and Rechert, 2018) in a way that preserves key user interactions with said objects. But these new tools and approaches severely challenge existing collection management infrastructures—not only within Rhizome, but within the larger cultural heritage field as well. Applying such approaches in one-off instances, usually for exhibition-related activities has proven successful (for example, in many instances of the Net Art Anthology at Rhizome). Nevertheless, database infrastructures, metadata descriptions, and graphical user interfaces, which can present such approaches in an integrated and coherent way, are yet to be developed.

Curators, conservators and researchers who work with net art collections have already noted that existing collection management systems have no provisions to account for the processual, performative and variable properties of these artworks neither in their classification schemas, nor in their interface designs (Barok et al., 2019a, b; Rossenova et al., 2019). Studies of alternative software tools which could begin to address these challenges, have focused on documentation and file management (Engel and Wharton, 2017; Barok et al., 2019a,b; Barok et al., 2020), but less so on how new ontologies can be organized in flexible backend systems, and what their visual representation via a graphical user interface might look like. Despite the fact that in recent years there has been a renewed interest in curating and exhibiting net art in established art world institutions,⁶ as well as discussing its preservation,⁷ problems regarding metadata classification, backend database structures—and the respective connection to frontend user interfaces providing access to these works—remain largely unexplored.

⁶ Several such exhibitions include: 'Electronic Superhighway (2016-1966)', Jan 29-May 15 2016, Whitechapel Gallery, London, and 'I was raised on the Internet', Jun 23-Oct 14, 2018, Museum of Contemporary Art Chicago, both curated by Omar Kholeif; 'Art in the Age of the Internet, 1989 to Today', Feb 7-May 20, 2018, The Institute of Contemporary Art/Boston, curated by Eva Respini and Jeffrey De Blois; and 'The Art Happens Here: Net Art Archival Poetics' Jan 22-May 26, 2019, New Museum, curated by Michael Connor and Aria Dean.

⁷ For example, a two-day event dedicated to discussing the preservation challenges of net art was hosted at Tate Modern on Apr 3–4, 2019, as part of the research program within Tate's conservation department titled 'Reshaping the Collectible: When Artworks Live in the Museum' (duration: 2018–2021). The event brought together academics, researchers and specialists from major art institutions to focus on ongoing issues related to "the changing relationship between internet art and the museum" (Lives of Net Art, 2020).

b) Interface design for born-digital archives

The entanglements between backend and frontend in born-digital archives both decouple⁸ and connect⁹ various processes and agents. But these entanglements are necessary for meaning-making in the user-interface encounter and pose an interesting set of problems for the redesign. Existing design metaphors in archival interfaces cannot account for the processes involved in the preservation and presentation of the networked and interactive properties of net art, and so new interaction design paradigms need to be developed for the ArtBase interface.

In the fields of human-computer interaction (HCI) and user experience (UX) design, there has been substantial research done around issues of discoverability, accessibility and usability in digital archives, but existing studies have focused primarily on archives with text- or image-based documents (Wray et al., 2013; Whitelaw, 2015; Kräutli, 2018; Windhager et al., 2018; Vane, 2019). The research and design practices emerging from these studies have worked with digital object "surrogates" (usually image thumbnails and a small selection of visible metadata) in order to provide new ways of browsing through digital archival interfaces via narrative- (Wray et al., 2013) or data-visualization-based approaches (Whitelaw, 2015). As a result, these approaches have proven influential in moving interface design beyond a purely search-box-based paradigm, towards a more "generous" (ibid.) one-allowing users to interact with archival materials without the explicit need for specialized prior knowledge. Important research has also been carried out with regards to the design of data visualization tools and strategies for temporal representations of objects in cultural collections and their relative ordering, even in complex circumstances where precise dates may be missing from the historical record (Kräutli, 2016; Vane, 2019). While all of these developments in the design of digital archival interfaces are significant precedents for the practical work carried out as part of this PhD project, many of these approaches are premised on the properties of physical objects such as

⁸ For example, in the case of the ArtBase, emulation and browser containerization decouple an artwork's reperformance in the user's browser from its source-code environment which may be obsolete. This preservation strategy privileges fidelity to user experience over technical fidelity (see Chapter 2).
⁹ For example, metadata schemas can be used to connect preservation actions, or other interventions in the artwork's lifecycle, to specific agents and timeframes, providing additional context to users accessing the artwork's record in the archive (see Chapters 2 and 7).

paintings or book covers, which can be captured and represented via a single digital image, and whose temporal dimensions conform to the idea of a single point in time corresponding to a date of creation.

Complex digital artifacts, such as net art works, on the other hand, can prove impossible to summarize, or to extract parameters for meaningful interpretation from (color palette, for example, which is an ordering principle common in the visualization of collections of digitized visual arts), based on a single JPEG or PNG screenshot alone. Additionally, a date of creation for such works may be an unstable, constantly moving/multiplying concept, as new instantiations or variations of the works are initiated by their creators or conservators. What is more, the new software tools and preservation approaches developed by Rhizome with the goal of providing ongoing access to the works in the ArtBase, utilize a variety of non-standardized modalities for user interaction—from cloud-based emulation, wherein a user interacts with a functional legacy browser inside an iframe¹⁰ on a webpage, to web archived artworks with partially missing or temporally-mismatched resources. Such modalities will also need to be integrated within the overall interface of the ArtBase archive and made intelligible to users, alongside a range of new categorizations and classifications in the metadata schema representing the artworks.

Lastly, media studies scholarship frequently cites net art works as examples of critical explorations of the "formal languages and new aesthetics of the computer [interface]," wherein "transparency and seamless functionality [are] not the goal." (Andersen and Pold, 2011, p.7). Within the field of HCI, transparency has traditionally been framed as a necessary condition of a good interface, one that reduces visual complexity in the interest of a user-friendly interaction experience (Emerson, 2014). However, the more 'transparent' an interface appears to its users, the more opaque the underlying infrastructure is rendered (Bolter and Gromala, 2003). This is precisely the opposite of the goal of many net art works (Andersen and Pold, 2011, 2018; Lialina, 2016), which

¹⁰ An iframe is a shorthand for an inline frame, specified with the <iframe> tag in HTML. An inline frame is typically used to embed another .html source within the current HTML webpage the user is browsing. With cloud-based emulation, an entire emulated operating system can be embedded via an iframe, as it is accessible via a URL on the web (see Chapter 2).

highlight the ways in which computers and networks do *not* operate in neutral, transparent ways, and instead promote certain user interactions while precluding others, particularly in commercial contexts. To sum up, the issues associated with visual presentation and access in the archive of complex born-digital cultural works, which are themselves critical towards standard interface design metaphors, have been explored much less in existing design scholarship, compared to more traditional, and largely standardized contexts, such as digitized collections of traditional artworks. Consequently, new interaction paradigms and visual metaphors need to be developed, which can prioritize user agency and informed interaction in the archive framework, over passive consumption of *transparent* content.

c) The role of user communities

The final set of problems for the ArtBase redesign discussed in this thesis concern the design methods used to ensure effective and equitable collaboration with user communities. Studies into user behavior in the context of digital archives (Johnson, 2008) have demonstrated that taking into consideration the role of user communities when deciding on backend structural approaches and developing new frontend interactions can benefit the development of interaction design frameworks.¹¹ Such studies can generally be described as user-centered design research, or what is also referred to as UX design research in commercial or design industry settings.

The field of human-computer interaction (HCI) has developed progressively more sophisticated tools and methods to study various aspects of a UX situation, including physical, sensual, cognitive, emotional, and aesthetic aspects (Forlizzi and Battarbee, 2004). The methods can be organized within different frameworks for user-centered design such as participatory, co-design or empathic design, among others (Mattelmäki et al., 2011, 2014; Bødker, 2015). These frameworks utilize more or less similar tools and methods—observation, interviews, group discussions, workshops, collaborative prototyping, etc.—towards the promise of a more equitable design process, where users become stakeholders in the product's design and development. At the same

¹¹ See multiple papers from the MuseWeb archives: Haynes and Zambonini, 2007; Fantoni et al., 2012; Tasich and Villaespesa, 2013; MacDonald, 2015; Coburn, 2016. MuseWeb (formally Museums and the Web) is the largest museum innovation and technology conference in the world (MuseWeb, 2020).

time, the methods for identifying users to co-design with, or the ethical and political implications of empathizing with someone else, without being a part of that person's social world, remain problematic and under-theorized within HCI discourse (Meill, 2015; Bennet and Rosner, 2019). New discussions in critical design scholarship attempt to move beyond typical engineering and design industry 'solutionism' in order to seek new human-centered (or even planet-centered) design approaches (and thinking) (Antonelli, 2014; Manzini, 2015; Escobar, 2018). Often such design discussions focus on case studies of archival institutions or community archives (Srinivasan, 2017), as the case for 'decolonizing' such sites from Western-colonial and capitalist ideological and ontological 'solutions' is particularly poignant. However, many of these discussions lack precise articulation of design methods that critically engage with entire communities of users during, as well as after, the process of designing and developing, so that users can be active agents throughout the lifecycle of a digital information system.

Due to the ArtBase's grassroots history, artists, curators, developers and other Rhizome community members have all previously played important roles in the archive and should continue to do so given the need for net art to be performed and experienced through user interaction. Therefore, the research methods to facilitate critical engagement with user communities during the embedded practice at Rhizome, and the strategies to better support user agency in encounters with the archival system cannot rely on ready-made solutions from the HCI field. Instead, this thesis articulates the need for new, research-driven, reflective methods to designing born-digital archives. Thus, the Model–Database–Interface (MDI) framework I developed during the redesign of the ArtBase, became both a method for the situated practice at Rhizome, and an outcome of the research process which can be applied to broader digital cultural heritage contexts.

Research methods

The design problems related to the infrastructure, interface and user communities of the ArtBase archive identified so far, concern a range of fields including art, archival science, conservation and digital cultural heritage at large, in addition to humancomputer interaction and user-centered design. This range of disciplines positions the

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PhD project firmly within the realm of "second wave" digital humanities (DH 2.0), which can be summarized not as "a unified field, but an array of convergent practices" involving "qualitative, interpretative, experiential" engagement with digital processes and materials (Presner et al., 2008, p.2; Schofield et al., 2017, p.104). To address the specific problems of this project, I undertake a reflective design practice, which blends "qualitative, interpretative, experiential" methods from the fields of HCI, design research and the digital humanities, and leads to the development of the MDI framework.

Reflective practice in the context of the ArtBase

In this PhD project, the reflective design practice unpacks the particular, problematic entanglements encountered in the ArtBase in order to iteratively refine the problem– solution space throughout several phases of fieldwork. Traditional HCI methods for user research and usability testing were still part of the practice fieldwork. However, additional activities built upon and extended the existing work of critical design researchers¹² in order to accommodate the specificity of my case study—the net art archive.

Within the field of HCI, there has been a shift of focus away from pure usability studies (i.e. studying users and user behaviors via empirical lab research and/or field ethnography) towards user experience design (UX) over the past few decades.¹³ This has led to the inclusion of the act of designing, i.e. generating *particular* design artifacts, as an integral part of user-centered design methodology (Vermeeren et al., 2016; Shneiderman et al., 2018). At the same time, emerging from the art and design field in UK academia during the early '90s (Frayling, 1993), the Research-through-Design framework (RtD)¹⁴ was developed as "a research approach that employs

¹² Important reference studies include the work of design researchers who design and develop software and interfaces for the cultural heritage and archives field specifically, notably Kräutli, 2016; Schofield et al., 2017; and Vane, 2019. However these studies predominantly work with digitized, rather than borndigital collections (see Chapter 3).

¹³ UX is concerned with how users experience a particular interface, or set of interaction design patterns, and how they make meaning out of it all (see Chapter 4).

¹⁴ Since it was first named by Frayling (1993), RtD has matured as a field of practice through the projects and research outputs of a variety of academic and research communities across Europe and the US: "the art and design community in the UK and Scandinavia, the technical universities and design academies in the Netherlands, and the human-computer interaction community in the US" (Stappers and Giaccardi, n.d.).

methods and processes from design practice as a legitimate method of inquiry" (Zimmerman et al., 2010, p.310). Since its initial articulation, RtD has been primarily adopted among researchers in the HCI, UX and interaction design fields (Stappers and Giaccardi, n.d.). Explaining the interest in applying RtD in HCI, Zimmerman et al., argue that:

[...] the HCI research community has moved beyond a focus on usability and is increasingly engaging in research on "Wicked Problems," (for example, societal problems such as sustainability) which cannot be easily reduced. RtD lends itself to addressing these problems through its holistic approach of integrating knowledge and theories from across many disciplines, and its iterative approach to reframing the problematic situation and the preferred state as the desired outcome of the research. (2010, p.310)

Rittel's (1973) concept of the "wicked problem" is often invoked in relation to RtD practice, as a way of distinguishing design inquiry from scientific inquiry. Wicked problems, by definition, cannot be addressed by scientific modes of inquiry, because solving a wicked problem is not reducible to the discovery of truthful facts. Therefore, wicked problems are amenable to RtD according to design researchers (Zimmerman et al., 2010, p.311). The design problems of this thesis could be described as "wicked problems", too, but I do not rely on this concept here, as I find it too broad to be genuinely useful; it is applicable to a virtually endless range of complex sociotechnical assemblages.¹⁵ Instead, what might be a more productive way of distinguishing between "rational" problem solving, i.e. the scientific approach to design (Newell and Simon, 1972; Dorst, 2003), and the RtD framework is what Schön calls "reflection-in-action" when articulating his influential concept of reflective

¹⁵ A more helpful term to refer to design problems is the term "underdetermined", as discussed by design scholar Dorst in his paper "The Problem of design problems" (2003). Dorst examines several ways in which design problems can be considered "underdetermined": First, connecting "needs, requirements and intentions" to specific forms or structures is not a closed, but an open path of reasoning, there could be many forms that meet "needs, requirements and intentions" in different ways or to different degrees (*ibid.*). Second, determining "needs, requirements and intentions" is not a process that can be "completed" in a meaningful sense, as co-evolution is context-specific and depends on how a situation is "seen through the eyes of the designer" (*ibid.*). Not all parts of a design problem are underdetermined. In any situation there may be objectively "unalterable" requirements, but a major part of most design problems is underdetermined and requires a reflective design approach, wherein the "interpretation of the design problem and the creation and selection of possible suitable solutions" is an iterative process throughout a situated design practice (*ibid.*).

practice.¹⁶ RtD's use of prototyping and other mixed methods to iteratively refine the problem–solution space (Gaver and Bowers, 2012; Kräutli and Boyd Davis, 2016), enacts situated "reflection-in-action" in order to address design problems which can be complex, dynamic, or otherwise difficult to define in a narrow scope. The reflective design practice in the context of the ArtBase included four phases of fieldwork, which contributed different forms of situated knowledge:

- Discovery and User Research, which gathered contextual knowledge around the subject domain, user expectations and landscape of existing interaction design patterns;
- 2. *Design Exploration,* which iteratively refined the problem–solution space of the design artifact;
- 3. *Design Specification*, which developed specific data model and interface design propositions for implementation;
- 4. *Evaluation,* which gathered feedback from research participants and stakeholders beyond the solo design-researcher's area of expertise.

The methods and outcomes of each phase contributed to the conceptual and methodological development of the MDI framework, which aims towards a preferred, not perfect, state for the ArtBase redesign—opening up opportunities for future research, rather than foreclosing them.¹⁷

The four phases of the design practice

The four phases of the ArtBase redesign were distinct but were not implemented in a linear manner. Flexibility, iterative learning and adjustment are accepted parts of the whole design process, even in traditional user-centered design workflows (Shneiderman et al., 2018). All phases and micro-phases are vehicles for the generation of procedural insights (Kräutli and Boyd Davis, 2016). Thus, knowledge

¹⁶ Reflective practice in design was developed as a counterpoint to Newell and Simon's classic theory of "Human problem-solving" (1972) which "proposed to fill the gap between natural sciences and design practice with a science of design", but according to Schön, this "science can only be applied to wellformed problems, already extracted from situations of practice" (Schön, 1983). The type of contextuallyspecific problems typically encountered by designer professionals, therefore, required an alternative paradigm.

¹⁷ The preferred state acts as "a placeholder that opens a new space for design, allowing other designers to make artifacts that then better define the relevant phenomena in the new space" (Zimmerman et al., 2010, p.311).

gathering and discovery continued throughout, while the parameters of the redesign's preferred state remained flexible.

Phase 1. Discovery and User Research

The initial phase corresponded to the "Requirements gathering" phase in typical usercentered design workflows (Shneiderman et al., 2018, p.131). I expanded on this by complicating the traditional understanding of "system requirements" and how these were gathered via user research. I used "micro-phases," an RtD approach (Kennedy-Clark, 2013), and explored how various expressions of what in-house staff and external users perceive as requirements are impacted by:

- 1. different aspects of the archive's history and organizational background;
- 2. past and present use-cases for access to the archive;
- 3. common interaction models seen in other online collections.

In the first micro-phase, I applied qualitative research methods, such as literature review and ethnographic observation, in order to study the organizational context and history of the case study institution, Rhizome, and their archive. The primary focus of this micro-phase was the backend infrastructure. The aim was to position the ArtBase not as a system that requires a brand new implementation, decontextualized from previous iterations of its software/hardware implementation, but a system that can build upon and explore its own history.

The second micro-phase focused on user communities. I conducted semi-structured experience interviews (Vermeeren et al., 2010) to gather information about past and current use-cases of the archive, and to learn more about user expectations. These aimed to go beyond pure "usability" questions about buttons and functionalities and reach some of the more nuanced questions about user perceptions of value-production in the archive.¹⁸ Throughout this process, I also questioned the contested notion of users: who they are, and how they are classified into clearly delineated categories according to their needs and goals. Alongside the interviews, I used critical frameworks from science and technology studies (STS) to describe and analyze user

¹⁸ Precedents for using user interviews to evaluate software in this critical, qualitative way include the work of design researchers Vane (2019), Kräutli (2016) and McCurdy et al. (2015), among others.

requirements within the larger context of: user-formation and co-construction with technology (Oudshoorn and Pinch, 2003); ongoing negotiations across different (user) communities of practice (Bowker and Star, 1999); and processes of collaboration that do not rely exclusively on consensus (Star, 2010).

The third micro-phase considered the question of the frontend interface with regards to complex, non-linear born-digital artifacts. I followed the standard design practice of looking at other design as points of inspiration and benchmark comparison (Gaver and Bowers, 2012, p.40). I gathered examples of related R&D and pilot projects of digital archival interfaces from cultural institutions as a representative sample of common design paradigms and interaction patterns. In a reflective report, I annotated the design examples with a provisional taxonomy of design patterns for digital media representation, adapting an "annotated portfolios" method. Design researchers Gaver and Bowers (2012) have devised the "annotated portfolios" method, as part of the RtD framework, in order to make the implicit knowledge embodied within design artifacts explicit and to contribute towards a better understanding of the design process across disciplines.¹⁹ By annotating the existing design patterns and paradigms used across other institutions in a report, the implicit design knowledge was made available for analysis and evaluation-so that patterns which were relevant to the case of the net art archive could be taken forward into the new design iterations, while patterns developed for containerized formats only (text, image, video) could highlight what was missing and where new design research was needed.

Phase 2. Design Exploration

In the second phase, which corresponds to "Preliminary design" in user-centered design workflows (Shneiderman et al., 2018, p.131), I used findings from Phase 1 and iterative prototyping to define a space of possible solutions (Gaver and Bowers, 2012, p.46). This included working with a variety of materials—low-fidelity sketches,

¹⁹ Annotations can take the shape of short sets of keywords or bullet points, or whole journal papers, but they should not simply describe the design, they should also "reach out beyond the particular" (Gaver and Bowers, 2012, p.49), as Gaver and Bowers argue: "Annotations and the designs they annotate are mutually informing. [...] Annotations can shape how artifacts are appreciated and understood, and what scientific and aesthetic value they might have, as well as suggest future research and design possibilities." (*ibid*, p.46-7)

diagrams, clickable visualizations, etc., and using mixed methods to gather feedback from users. Drawing on examples of collaborative DH projects, design researchers Kräutli and Boyd Davis have pointed out that discovering more about research questions *during* the development of a software tool, rather than *after* the implementation of the tool, is a commonly experienced phenomenon (Kräutli and Boyd Davis, 2016, p.2). Kräutli and Boyd Davis therefore argue for the importance of prototyping in generating procedural insights in the *making* stage of a design inquiry: "Prototypes help to expose and identify yet undiscovered problems. Our aim is not to work immediately towards an ideal—potentially idealized—answer but to discover the problematics." (Kräutli and Boyd Davis, 2016, p.4)

Each design iteration generating a prototype can be a considered a micro-phase during the Design Exploration Phase, which feeds into a next iteration opening up new questions and possibilities in the process (Kennedy-Clark, 2013, p.28). The micro-phases in this part of the project included obtaining user feedback via methods including semi-structured interviews, surveys, as well as workshop activities for users, inspired by Gaver, Dunne and Pacenti's (1999) "cultural probes" method.²⁰ The cultural probes I developed for the workshops in this phase were low-fidelity prototype sketches and collages of the archive's interface, co-designed with workshop participants. These co-designed visuals indicated preferences, biases and conceptual hierarchies in the participants' thinking. Most of all, these visuals became useful shared objects of discussion over which users could exchange ideas during the workshops. Workshop activities opened up questions of data modeling²¹ and database structures, rather than simply focusing on end results and frontend presentation. Iterative prototyping and workshopping with users were key to exploring which ideas and practices 'work' (or not) within specific user communities, rather than

²⁰ Probes are "collections of evocative tasks meant to elicit inspirational responses from people", the focus is less on comprehensiveness than on "fragmentary clues about their lives and thoughts" (Gaver et al., 2004, p.53). My intention in using cultural probes was to gather information about which problem spaces my designs should be exploring, not how to design for these problem spaces.

²¹ A data model here refers to the formal protocols of structuring (meta)data in a database. These vary depending on the logical structure of the database (e.g., relational, networked, etc.) and determine how data can be queried and returned via application programming interfaces (APIs) and graphical user interfaces (see also Chapters 6 and 7).

instrumentalizing an 'agile'²² methodology (or ideology) which aims at perfecting an end solution to meet user needs.

Phase 3. Design Specification

The third phase–Design Specification (corresponding loosely to the "Implementation" stage in Shneiderman et al., 2018), took into account the limitations of my research position, wherein literal implementation was outside the scope of this single project, but a tangible design artifact (or group of artifacts) could still be generated. I transformed the initial design proposals into concrete design specifications and recommendations: a data model with a pilot implementation in the backend database of the archive, as well as a functional frontend prototype, which could be evaluated with users. The data model specified the application of linked open data (LOD) standards in the ArtBase database software, and revealed the extent to which the data standards and the database structure could accommodate (or not) different views of what constitutes context around a net art work in the archive. The frontend prototypes developed proposals for making the workings of the data model and the database system more visible and open to users' inspection and feedback. Producing fully-specified design artifacts as tangible outcomes of the practice was not perceived as a solution to all aspects of the research question. Instead, these outcomes were perceived as carriers of provisional and context-specific theoretical propositions relating directly to two dimensions of the research problem: infrastructure and frontend interface.

Phase 4. Evaluation

Evaluation is a distinct phase in most design workflows (e.g., Shneiderman et al., 2018, and Vermeeren et al., 2010). Evaluation in both HCI and RtD processes is conducted within "expert groups"—users and stakeholders with detailed knowledge and/or

²² Despite its origins in early computer programming in pairs, which simply aimed to clear out errors in the code early on and in fact promoted going "slow" (Cooper, 2019), the "agile" methodology has been instrumentalized in recent years in the development of some particular California ideologies of speed and efficiency in shipping products, such as the "move fast and break things" paradigm popularized by social media moguls (Taneja, 2019) or the "doing one thing really well" slogan of the software-as-a-service paradigm in cloud computing (Gürses and van Hoboken, 2017). Neither of these paradigms can help address some of the more complex and nuanced ethical issues in software development beyond the production-consumption cycle (*ibid.*).

extensive experience around the subject matter and software tools of the project (Kennedy-Clark, 2013, p.28). The expert groups gathered in this phase included past and present ArtBase users, Rhizome stakeholders, as well as other researchers and practitioners in relevant fields such as digital preservation and archiving. The aim of the expert group evaluation is to mitigate the tensions of a single researcher taking on multiple roles at the same time (designer, developer, facilitator and evaluator). This switching across multiple roles typically allows the designer-researcher to gain an overview of the whole process, but RtD warrants the introduction of "checkpoints" throughout the process in order to include additional perspectives and reflection (*ibid.*). Bringing in the expertise of members of different social worlds during the evaluation process, aims to balance against potential criticisms such as lack of reproducibility or scalability, more common to other forms of empirical study (Reeves et al., 2005; Kennedy-Clark, 2013).²³ And so, as part of the evaluation process, I conducted further user observation and testing sessions on the design prototypes from Phase 2 and the specifications from Phase 3, in order to gather additional perspectives when reflecting on the results of the practice. However, evaluation in this project was not limited solely to consulting expert members of other social worlds, outside my own design community. Drawing on social science theories of the development of standard practices within communities and processes of community enrollment (Bowker and Star, 1999), the Evaluation Phase, alongside the Discovery Phase, aimed to blur the sharp boundary between designer and user communities. I invited expert users into the design process, to provide additional perspectives for reflection. But I also engaged with those expert communities outside the strict boundaries of an evaluation session or a formal workshop. My embedded position within Rhizome offered opportunities to do so, taking a standpoint from within the archive's expert user communities. From this position, the design artifacts became dynamic tools facilitating discussion and collaboration across different communities, as opposed to static entities produced outside those communities, in need of their evaluation and validation.

²³ Digital humanities researchers have argued that the design artifacts produced within RtD frameworks need not follow reproducibility criteria and instead should incorporate humanities-based values and methods "into the entire research process 'from design to evaluation'" (Coles, 2016, p.4, cited in Vane, 2019, p.39). This includes "using domain experts to assess the quality, originality, and persuasiveness of the arguments and other research products" and trusting their answers about their perceptions (*ibid*.).

To conclude, the data model and the interface prototypes resulting from the work in Phases 2, 3, and 4, iteratively refine the problem–solution space towards a preferred state. In addition, findings from each design phase, including the 3 micro-phases of Phase 1, were described in reflective reports as part of the PhD practice portfolio.²⁴ The reports included detailed notes on the procedures of designing and conducting various activities, e.g., user interviews, workshops, etc., and featured annotations on the design artifacts, following Gaver and Bowers' "annotated portfolios" method. The goal of collating these reports as part of the PhD practice portfolio, and making them public, was to make the implicit design knowledge embodied in artifacts—explicit, and to "produce and refine design principles that can provide guidance for similar research studies or development endeavours" (Amiel and Reeves, 2008, in: Kennedy-Clark 2013, p.29). When references to the design practice are made throughout the rest of this thesis, the following schema is used:

- See PhD portfolio, Report #1: to refer to findings from Phase 1, micro-phase 1.
- See PhD portfolio, Report #2: to refer to findings from Phase 1, micro-phase 2.
- See PhD portfolio, Report #3: to refer to findings from Phase 1, micro-phase 3.
- See PhD portfolio, Report #4: to refer to findings from Phases 2, 3 and 4.
- See PhD portfolio, Data Model: to refer to the data model specified in Phase 3.
- See PhD portfolio, Prototypes: to refer to the design prototypes specified in Phase 3.²⁵

The Model-Database-Interface (MDI) approach

The different phases of the design practice outlined so far, set out to develop a nonsuperficial understanding of organizational context and archival use, and to generate artifacts which can facilitate access to the digital archive while promoting informed interaction and collaboration across user communities. As such, the intended outcome and contribution to knowledge of the practice was not particular UX knowledge: it was

²⁴ Reflective note-keeping is a standard design inquiry method used: "to keep a record of the events and the researcher's reflections so that changes in options and ideas could be mapped across the study," and as "a mechanism for refinement, reflection and triangulation over a number of phases of research" (Kennedy-Clark, 2013, p.26).

²⁵ All reports, the data model and the prototypes are accessible from: <u>https://sites.rhizome.org/artbase-</u> <u>re-design/</u> [Accessed 23 January, 2021]

not about improving the usability of a specific design pattern, such as an archive search interface or a timeline visualization. Such knowledge is always embodied in the resulting design artifacts (Gaver, 2012, p.944). Instead, the primary contribution of the practice lies in its conceptual and methodological framing.

I developed a new and original approach to reflective design practice: the Model– Database–Interface (MDI) framework, adapting generic HCI and design inquiry methods to the context of born-digital archives, and specifically the ArtBase case study (<u>Fig. 0.1</u>):

- 'Model' stands for data model, and considers how information is structured in the archive; which ontologies and agents are involved in this process.
- 'Database' stands for the software which enables certain ways of structuring, storing and operating on the information, while precluding others.
- 'Interface' stands for the user interfaces used by administrators to access the database, as well as the interfaces used by the public to access the archive in their own browsers.

MDI posits that the redesign of the ArtBase includes multiple, overlapping areas and processes, rather than separate layers in a technological stack which can be designed in isolation; it includes actors with different agencies, not simply users who passively consume the interactions afforded by the interface, and whose behavior can be studied (sufficiently) through usability tests. The articulation of the MDI in this thesis depends upon two crucial concepts. The first is the concept of digital materiality, which is inclusive of technical infrastructure *and* organizational relations. The second is the concept of the archive as a network of relations enacted between users and infrastructure.

Digital materiality and the ArtBase redesign

The issue of digital materiality in the ArtBase archive directly influenced what outcomes were pursued throughout the different phases of the design practice described above. Following the definition developed by Dourish and Mazmanian, I consider the materiality of digital interfaces and information systems to include: "those aspects of the fabric of information systems that constrain, shape, guide, and resist patterns of engagement and use" (Dourish, 2014, p.26). As Dourish (2014) has

elaborated, such a materiality extends back towards the hardware and the engineering principles behind it, includes the software and its mathematical principles, and moves forward into business and organizational practices. Within this understanding of digital materiality, I address the redesign of the archive in terms of its software infrastructure-the choice of formal representation schemas (i.e., data models and standards), data storage applications (i.e., database software) and applications built to access and operate on the data (i.e., content management software). I also address the organizational (and user-community) practices that impact on the software and are impacted in return. I do not address questions of hardware and physical computing architecture. These are understood as part of the total archival infrastructure, and as conditions upon which the software is reliant for its performance and execution, however they remain out of scope for this thesis.²⁶ Focusing specifically on the software and organizational layers of the infrastructure, allows me to explore in detail the problems specific to the redesign of the ArtBase, i.e., problems concerning the links between the operations of the (backend) database software which structures the data in the archive, the (frontend) application software which enables user interaction, as well as ongoing processes and practices among different user communities concerning access to the archive.

The archive as a network of relations

Within this conceptualization of digital materiality, I approach the archive as a network of processes and relations enacted between users—including staff, artists, programmers, academics—and digital infrastructure. This network has concrete technical, material manifestations, in the sense of servers, network protocols,

²⁶ Hardware is of course intricately connected to the design of software. Specific software can be optimized in different ways to run most efficiently on specific hardware. For example, the first relational databases were designed to run efficiently on IBM's mainframe computers. However, with the rise of distributed and decentralized cloud computing data centers, and the popularity of containerized applications, some of the earlier restrictions of hardware are less relevant for contemporary software (Dourish, 2014). Of course, some limitations linked to geographic locations and network speeds remain, e.g., some of Rhizome's infrastructure used for preservation runs only on servers in Europe, North America or East Asia, which means access from geographic areas such as Latin America or Africa would be less optimal. The colonial biases of much of contemporary network infrastructure are not irrelevant to this thesis, however, these biases have been explored by other scholars (Starosielski, 2015; among others) and are beyond the scope of the design practice discussed in this thesis. On occasion, and if relevant to a specific software performance or execution issue, this thesis may refer to hardware specifications, but in general, the primary focus is on software and the ensuing social relations, all facilitated though widely adopted cloud computing services.

databases, interfaces, etc. But it can also be considered as a concept, not just a 'thing', in the sense of Latour's actor-network account, the latter being a descriptive tool for making sense of the former, i.e., the technical, material manifestation of a network (Latour, 2005). Using the concept of the network as a descriptive tool helps to unpack the material and abstract processes and relations enacted between different entities in the network (be it data nodes or human and non-human agents). Descriptions in the reflective reports documenting the phases of the design practice, as well as descriptions in subsequent chapters of this thesis, highlight which key processes influence the material dimensions of the MDI framework. These key processes are:

- *Classification*, which relates to the processes of selecting, organizing and categorizing archival data in logical structures. Usually, this involves curators, information architects, and software engineers. In the case of the ArtBase, however, artists and early users of the archive were active participants in processes of classification, due to the lack (then and now) of formal categorization systems for net art works (see Chapter 1).
- *Maintenance*, which relates to the processes of storing, preserving and making data accessible. Typically, this involves archivists, conservators and other digital preservation staff. However, as net art requires active user participation in order to be performed and preserved, maintenance processes in the ArtBase cannot exclude users (see Chapter 2).
- And lastly, *Use*, which relates to the varied ways different user communities access and make use (and meaning) of the archive. This is where the social worlds of users and interface designers typically intersect (see Chapters 4 and 5).

Where the MDI framework differs from other reflective design methods is in the proposition that the designer-user relationship is not concerned only with processes of 'use' or 'user access'. Drawing on the ArtBase's grassroots history and net art's processual and performative characteristics, MDI's conceptualization of infrastructure and interface design involves the active participation of user communities in all aspects of an information system's lifecycle, including processes of classification and maintenance. In addition, MDI positions the designer-researcher not as an external observer studying user behaviors and patterns of use, but as an agent enmeshed in the network, as well; enrolling into different user communities when required.

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MDI is reflective practice framework that is entirely dependent on taking up a contextspecific standpoint when addressing problems relating to the provision of access in digital information systems. The material dimensions around choice of database software, standards for data modeling and procedures surrounding access inevitably differ across different contexts and different user communities. Therefore, in this thesis, I do not articulate an easily scalable or replicable methodological framework.²⁷ However, the following chapters of this thesis analyze the key parameters: model– database–interface; classification–maintenance–use; so that relevant insights can be abstracted from the particular case of the ArtBase, and applied to other cases within the born-digital archives field, or developed further within the context of Digital Humanities research.

Thesis structure

This thesis is organized in three parts prefaced by an introduction, and followed by a conclusion. The introduction sets the stage for the research case study—Rhizome's ArtBase. It outlines the initial research problems concerning the presentation and contextualization of net art works in the archive evident at the beginning of the research process. It points to the knowledge gaps discovered in an initial literature review conducted through three primary research lenses: collection management infrastructure, interface design, and work with(in) user communities. The introduction also sets out the research methods of the study: a four-phase reflective design practice, as well as a new conceptual and methodological framing of the entanglements between data model, database and interface (the MDI framework).

The next two parts of the thesis expand on the research problems by analyzing the findings from the three micro-phases of Phase 1 of the practice (*Discovery and User*

²⁷ Anthropologist Anna Tsing (2015) has argued for the need to develop methods of 'noticing' (p.23) and 'description' (p.111), in order to study and unpack complex socio-technical assemblages. Traditional replicable and scalable research require replicating the same research questions across larger scales, but according to Tsing this limit the possibility to notice change across the assemblage elements and encounters and to adapt the research questions to new contexts (p.37-38). Without being able to ask new research questions, it is hard to imagine new ways of learning, either. Digital humanities scholars, have also argued against replicable, empirical studies when conducting humanities research through practice in favor of "subjective insights" (Vane, 2019, p.39) and "engagement over results" (Coles, 2016, p.3).

Research). The problems outlined in the Introduction required further context-specific research (i.e., taking up the embedded position within Rhizome) before they could be developed into a full brief for the design practice. Part I sets out to define a design brief for the redesign of the ArtBase infrastructure and interface, by exploring Rhizome's history and the ArtBase's context of creation and maintenance over time. Part II then focuses on problematizing further the role of user communities inside and outside the institutional context of Rhizome. This part analyzes findings from the user studies in Phase 1, and the workshops in Phase 2, to begin articulating where MDI departs from traditional methods. Lastly, Part III reflects on the outcomes of Phases 2, 3 and 4 of the design practice—i.e., the prototypes, data model and ontology specifications for the net art archive—and the implications of these outcomes for the development of the MDI framework.

Part I: Developing the design brief

In this part, Chapter 1 outlines a concise history of Rhizome's development as a grassroots born-digital organization. It reviews the internal organizational policies and decisions that guided data collection and access in the ArtBase, and the ensuing relationships between internal staff, collaborators and users of the archive. Chapter 2 discusses the emerging digital preservation program at Rhizome. It focuses on key developments in the program which address the issue of user access and have concrete implications for the redesign of the archive's infrastructure and interface. The last chapter in this part, Chapter 3, discusses specific elements from the past and present setup of the archive's interface. It elaborates on the implications for the design posed by the processes of classification, maintenance and use set in motion through Rhizome's data collection, digital preservation and user access policies. It also establishes the brief for the ArtBase (re)design, which is informed by Rhizome's post-custodial framing of their infrastructure, interface, and community development work.

Part II: Considering users

Chapter 4 problematizes the traditional understanding of the notion of 'user' and user research methods within HCI, while drawing on relevant concepts from the STS field in order to analyze *how users matter* for the MDI framework. The chapter critiques the importance typically attached to intuition and empathy within user-centered design,

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proposing an alternative framing of user agency and the designer-user relationship. Chapter 5 then articulates specific strategies developed as part of MDI which aim to blur the boundary between the social worlds of users and designers. These strategies contribute to the production of a critical standpoint in the network of relations in the archive, which aims to facilitate translation and collaboration across user communities even in the absence of consensus around which classifications and practices can be considered 'standard'.

Part III: Reflecting on outcomes

Chapter 6 discusses some of the advantages and limitations of Rhizome's choice of maintaining linked open data infrastructure, in order to set the stage for my own intervention in the network of the archive, and specifically the development of the provenance-driven data model as part of the MDI framework. Modelling data in the ArtBase, as set out in Chapter 7, considers the temporal dimensions of net art works and their records respectively, involving development, deterioration and/or various acts of preservation enacted by different agents (human and/or technical) over time. The chapter discusses how the practical implementation of the data model in Rhizome's linked data infrastructure supports post-custodial access policies: making relationships in the network of the archive more visible and open to scrutiny, analysis and intervention by user communities other than the internal team at Rhizome. The last chapter in this part, Chapter 8, discusses MDI's strategies for infrastructural inversion and cross-community collaboration embodied in the design prototypes for the new ArtBase interface. The chapter also elaborates upon areas for further study which could contribute to an ongoing development of MDI.

Finally, in the conclusion, I summarize how the application of the MDI framework has implications not only for design practice, within the fields of HCI and UX, but affects institutional practices, too, as well as the broader field of cultural archives and the digital humanities.

Part I. Organizational background: towards a new design brief for the ArtBase

In this part of the thesis, I critically analyze findings from the first micro-phase of the design fieldwork: Discovery and User Research (see Introduction). By pinpointing specific events and developments in Rhizome's history, including the set up and maintenance of the ArtBase, the analysis begins to establish threads that run through all three areas—infrastructure, interface and user communities—concerning the question of access in the digital archive. At the start of the research project, the design problems entangled across these areas remained "underdetermined" (Dorst, 2003) and there was no fixed design brief.²⁸ In this part, I show how time dedicated to in-depth design research during the first phase of a reflective design project—in other words, spending time with the problem—is an integral part of drawing up the design brief, which informs subsequent phases of the practice.²⁹ The new brief builds on the situated knowledge gathered through meeting past and present staff members of the organization, closely observing the frontend and backend of the archive (and its iterations over time), as well as studying and participating in institutional practices of maintenance and repair. This gathered knowledge allows for the design brief to open up a set of new, more specific questions for the next phase of the design fieldwork. The iterative process is reflected in the structure of this part of the thesis. A Prologue guides readers through the last iteration of the ArtBase interface which opens many questions that require peeling back layers of archival history, infrastructural policies and user interactions to answer. Chapter 1 introduces Rhizome's early programs and policies that shaped many of the archive's core offerings to the community. Next, I discuss the findings from my embedded post with Rhizome's current preservation team concerning the 'backend'. Lastly, I return to the question of the interface by

 $^{^{\}rm 28}$ See a brief discussion of underdetermined problems in the Introduction's footnote $\underline{\#15}.$

²⁹ The co-evolution of the problem-solution space is well documented in design studies, it is part of the reflective design practice paradigm (Dorst and Cross, 2001; Dorst, 2003; Gaver and Bowers, 2012; Kräutli and Boyd Davis, 2016). By mentioning the design brief here, I emphasize that this co-evolving exploration of problems and solutions needs to be formally built into the design project from the start—not only as an implicit process carried out by designers, but as an explicit approach, shared with all stakeholders institutional staff, research partners, etc. (see also Chapter 8).
focusing on the implications of net art's assembled properties and Rhizome's chosen preservation paradigms for the redesign of the archive's 'frontend'.

Prologue

At the start of this research project, the ArtBase archive had already been overhauled several times—both in terms of its backend infrastructure, and its frontend design. In 2016, the landing page of the archive was well integrated into Rhizome's main website. It offered a few curated exhibitions (not exclusively featuring works from the archive) and a single entry point into the archive via a grid of 16 small thumbnail images per page, each standing in for a single artwork in the archive (Fig. 0.2). There were 141 pages in total containing these thumbnail representations. Beneath the thumbnail image, a short caption indicated the artist's name. The title of the work was visible only on hovering over the image. A user could browse the archive page by page, or filter the artwork representations based on a simple sorting utility at the top of each page, offering sort by date, artist name or title (Fig. 0.3). In other words-there weren't many opportunities for serendipitous discoveries or drawing more sophisticated connections across groups of works other than by date or common artist. Once a user clicked on an artwork thumbnail, they accessed a landing page for the artwork record, but those pages hardly looked like a typical archive database entry (Fig. 0.4). There was a single image representing the work, a short text description of unclear provenance, and only the name of a (single) artist and a (single) date. To experience the actual born-digital works, users could click on a button, which would take the user to a new location (in a new tab)— sometimes linking to a work held in Rhizome's archival repository; sometimes linking to a location on the artists' own server; and on (frequent) occasion—rendering a 404 page, i.e., a missing link (Fig. 0.5). Even if the link was not broken, the artwork that the user would gain access to might be in a very different state compared to when the work was added to the archive. Parts of the work may be broken, missing, or dependent on browser plug-ins no longer supported by contemporary browsers. On some occasions, there might not even be a button leading to the work on the main artwork page in the ArtBase (Fig. 0.6). All of these scenarios lead to perplexing and frustrating user experiences in the archive.

With no contextualization to indicate to users how these works came to be, even the works that were well preserved by intervention of the team at Rhizome were subject to the same limited interaction patterns within the ArtBase interface design framework. This framework was not able to answer questions such as: Who was involved in the artwork production—maybe more collaborators than a single artist?; How the work evolved over time?; Did the artist(s) make intentional changes?; Did the work change because of updates in the technical protocols of the web and the browsers used to access the web?; Or did the ArtBase team change the work in order to preserve it? Rhizome's team were aware that the limitations of the latest iteration of the ArtBase interface impacted the value of the archive as a service to the community, as Rhizome's Artistic Director, Michael Connor summarized during a meeting in 2018:

It is not clear what the status of the works is—what is in the ArtBase versus what is not. It is not clear what you are looking at when you get to the artwork page. You do not know that the artwork description was authored by an artist. None of it is contextualized in a way that tells a story of what the viewer is looking at, and so unless people have done a lot of the work themselves, the archive does not offer much value. (Connor, 2018, cited in PhD Portfolio, Report #1, p.99)

Reimagining the ArtBase interface in a way that could better serve the community therefore required more than a redesign involving surface-level branding and styling. It necessitated considering how the net art archive works and for whom—in what ways could the collection management system meaningfully express the various relations between the frontend interface used by the public and the various tools and infrastructures deployed by in-house staff to store and preserve the artwork data *and* metadata. What is more, to contextualize frontend–backend relations in a non-transparent collection management system required consideration of how these relations evolved over time, and what historical developments did (or did not) lead to specific limitations of user access and interaction.

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1 Rhizome, a grassroots born-digital organization

1.1 Set up of the organization

Rhizome is a digital arts organization founded in 1996 by American artist Mark Tribe. At the time, Tribe was living in Berlin, working as a web designer within the then booming early-internet economy. He was familiar with the art and technology scene in Europe. Festivals such as Ars Electronica and the Dutch Electronic Art Festival, as well as the influential mailing list Nettime,³⁰ were formative for Tribe's own ideas about establishing a mailing list and a website where people from various backgrounds and nationalities—artists, curators, critics, academics—could connect and continue the discussions emerging at live events:

I thought of it as Artforum meets AltaVista (AltaVista was one of the first web search engines), as a kind of bottom-up alternative to the top-down hierarchies of the art world. (Tribe and Ptak, 2010)

Tribe originally conceived the list as: "broadly connected with new media art, which [Tribe] defined as art that uses emerging media technologies and is somehow engaged with their cultural significance" (*ibid*.), though Rhizome gradually became specifically associated with net art. At a time when new genres were emerging and artists were experimenting with a medium offering to potentially change the dynamics of the art world,³¹ the mailing list quickly grew in popularity and a community formed around it. To save valuable discussions from the mailing list from going into a "black hole," a term Tribe ascribes to Pit Schultz, the founder of Nettime, the core function of the Rhizome website was to serve as a frontend interface to an edited version of the email discussions—in other words, a form of archive, which became the TextBase (*ibid*.).

³⁰ Nettime is an influential discussion forum and mailing list developing a new media discourse. It was started in 1995 by media scholars Pit Schultz, Geert Lovink, among others. See: Nettime, 2020; Monoskop, 2020.

³¹ Art historian and media theorist Dieter Daniels (2009) positions art based around networks, specifically within the period 1992-97, as the last avant-garde movement of the 20th century developing its own frameworks of operation which were "independent not only of any art institution, but also existed outside of state or commercial media control" (p.28). Curator Steve Dietz also picks up on the "anti-institutional" dispositions of many artists operating via networks and relates it to the "fundamental tension between the wide-ranging and open structures of the internet and the traditional role of the museum as gatekeeper." (2005, p.88)

Rhizome³² was thus founded in 1996 as a grassroots initiative around a born-digital community forum and archive. That same year, Tribe moved back to New York to set up the more formal aspects of the new organization.³³

By 1999 the mailing list had become not only a forum to exchange ideas, but also a stage to present new works and projects, and so the ArtBase was established "to serve as a more permanent and accessible index to the broad catalog of web based work emerging from the community" (Owens and Fino-Radin, 2012).³⁴ Despite times of financial instability, the successful combination of the unfiltered mailing list and the filtered archives—TextBase and ArtBase—meant that Rhizome's popularity kept growing and by 2004, critic Josephine Bosma declared: "Rhizome is definitely the most successful art platform on the Internet ever. It gets millions of hits a month and has thousands of members" (Bosma, 2004). At the same time, the growth in size meant the niche and intimate community was being replaced by a more centralized and institutionalized operation. In the first few years after the 2000–01 market crash,³⁵ Rhizome was looking for closer integration with established art institutions—largely with the aim of stabilizing its precarious financial situation (Tribe and Ptak, 2010). In

³² The name Rhizome derives from Deleuze and Guattari's use of the term in *A Thousand Plateaus* (1987). Tribe connects the metaphorical use of rhizomes as non-hierarchical network systems in Deleuze and Guattari to some of the ideas behind Rhizome the organization, though he admits that other online communities like Nettime were more truly "rhizomatic" than Rhizome, which remains quite centralized (Tribe and Ptak, 2010).

³³ Initially, the organization was set up as a for-profit. Despite a range of successful activities during that period including various artist-led events and collaborations with New York galleries such as Postmasters and The Kitchen, Tribe also refers to the years between 1996-2000 as a time of difficult balance between trying to build a community from the ground up and, at the same time, having to manage a web business and investor interests (Tribe and Ptak, 2010). Eventually, with the loss of investment funds after the dotcom bubble crash in 2000, Rhizome went through a transition into a non-profit and, at least in some ways, a more conventional arts organization—relying on arts grants from various charitable foundations for funding its operations (Tribe and Adams, 2002).

³⁴ Tribe pointed to the lack of an art market and collecting institutions as some of the main reasons why Rhizome started the ArtBase as a permanent archive for works of net art, net.art and other works within the broader new media art category (Tribe and Ptak, 2010). There were some arts organizations and online mailing lists or artist initiatives established in the 1990s and even earlier, such as The Thing, Turbulence, ada'web and netzspannung, to name a few, which were dedicated to discussing, promoting and/or collecting net art and new media art (Jones, 2010; Blome and Wijers, 2010). However, few included longterm preservation as part of their mission statements, and fewer still have remained active as long as Rhizome and its ArtBase. The general "paucity" of institutional new media art collections identified by curators Dietz (2005) and, more recently, Rinehart and Ippolito (2014) highlights the importance of Rhizome's ongoing archival and preservation activities.

³⁵ The dot-com bubble, and subsequent crash were the result of stock market speculation with the unsustainable growth of internet companies in the mid- to late-90s. The bursting of the bubble resulted in huge losses in the stock market and the failure of numerous companies (`Dot-com bubble', 2020).

2001–02 Tribe started discussions with senior staff at the New Museum to become an organization in-residence. The museum was nearby Rhizome's offices at the time and Tribe had organized several shows in its Media Lounge already, featuring works from the ArtBase. After a period of negotiations, Rhizome took up residence on museum premises in 2003 (*ibid.*). Since then, while retaining operational independence, collaboration with the museum has intensified to include joint exhibitions,³⁶ as well as artists' events, symposia and conferences.³⁷ Rhizome's transition from a grassroots community mailing list towards an institutionally-recognized arts organization did not necessarily contradict the earlier utopian, avant-garde roots of the new media art and net art movements. In fact it mapped closely to transformations in the attitudes of new media and net artists towards the art world and inversely—the mainstream art institutions' attitude towards new media art.

The earlier, utopian perceptions of the web as an open environment where no mediation (by art museums, critics or curators) was necessary in order to reach an audience, were subsumed by the emergence of the Web 2.0³⁸ era in the early '00s when the internet was largely co-opted by corporations and existing power structures within a highly commodified and commercial space (Tribe and Ptak, 2010). In the early- to mid-'90s, net artists communicated through mailing lists and art platforms such as The Thing, Nettime and Rhizome, producing work in dialogue with each other. The arc of that movement began to dissolve anywhere between 1997 and 2001-02 according to various accounts (Daniels, 2009; Tribe and Ptak, 2010; Lialina, 2007). Throughout that period, Rhizome moved from being a small grassroots organization towards becoming part of the mainstream world of art museums and institutions. In parallel, much artistic work on the internet transitioned from consisting of a small movement with a few key figures³⁹ towards being a mode of working embraced by greater numbers of

³⁶ For example, First Look: New Art Online (2012-ongoing) is a long-standing online exhibition project curated by Rhizome and hosted by the New Museum (New Museum, 2020)

³⁷ For example, high profile annual events such as Seven on Seven running since 2010, and more recently (2016-ongoing) symposia such as Open Score and Digital Social Memory have been produced and coordinated to museum standards (Seven on Seven, 2021; New Museum, 2017).

 ³⁸ A colloquial term, popularized by Tim O'Reilly at O'Reilly Media around 2004 to denote the growing presence of user-generated content on the web, particularly in the form of blogs, starting in the early '00s. The term does not refer to any updates in the technical specification of web protocols ('Web 2.0', 2017).
 ³⁹ Curator Christiane Paul identifies a core group of European artists—"among them Russian artists Olia Lialina and Alexej Shulgin, British artist and activist Heath Bunting, Slovenian Vuk Cosic, and the Dutch team jodi.org (Joan Heemskerk and Dirk Paesmans)" (Paul, 2009, p.101).

practitioners, integrated into other genres or forms of art (performance, installations, mixed-media, etc.), and beginning to be recognized and collected by mainstream art institutions (Paul, 2009).⁴⁰

When art museums began to recognize the significance of the new media and net art movements and to collect those forms of art, all the issues surrounding the conservation and long-term preservation of such artworks came to the foreground (*ibid.*).⁴¹ And as Rhizome grew as an organization, with more staff and financial resources, gaining a more established position within the art world throughout the early '00s, Tribe and his colleagues began to recognize the need to formalize ongoing efforts within the net art community towards a dedicated preservation program (Jones et al., 2006).⁴² Rhizome's evolving position within a grassroots artist community, the art world, and the field of cultural heritage preservation, has meant that the ArtBase also evolved in terms of its vision and mission. The initial vision for the establishment of the ArtBase, was more indexical—connected to collecting and organizing current projects and activities within the community. With expansions in both size and scope of the archive, their commitment to preservation became a more conscious effort (Fino-Radin, 2011), which was reflected in both backend and frontend operations, as well as in the relations between Rhizome and the broader user community.

1.2 Vision and mission statement of the archive

In the first few years of the ArtBase, the archive database was simply another part of the Rhizome website—it was searchable by artist name or artwork title—hence functioning like an index to the mailing list community discussion (Tribe and Ptak,

⁴⁰ As Paul observes: "In the late 1990s, traditional institutions began to pay attention to Net art as part of contemporary artistic practice, and slowly incorporated it into their programming." (Paul, 2009, p.106) She includes examples such as the Walker Art Center's Gallery 9, SFMOMA's e-space, the Whitney Museum of American Art's Artport and the Guggenheim Museum. (*ibid.*)

⁴¹ In *Collecting New-media Art*, curator Steve Dietz also observes, however, that the realization of all these issues has had a backlash effect on many collecting institutions, resulting in the shrinking of collection activities and "the paucity of new-media art in museum collections" (2005, p.85). The Walker Art Center's Gallery 9 project, for instance, was closed down in 2003, despite running a successful program since 1997 (Gallery 9, 2017).

⁴² Since 2001–02 Rhizome has been a founding member of two different consortia of art museums and organizations concerned with media art preservation: the Variable Media Network (VMN) and Conceptual and Intermedia Arts Online (CIAO) (Tribe and Adams, 2002). Key members of both initiatives included the Guggenheim Museum, the Walker Art Center, the Berkeley Art Museum/Pacific Film Archive and the Franklin Furnace Archive in New York (*ibid*.).

2010). The archive operated an open submission policy where artists from the mailing list could submit their own work and some basic additional descriptive information. The document of agreement between Rhizome and the artists included the following statement: "The goals of the ArtBase are to preserve new media art for the future and to provide access to new media art in a context of relevant information and critical discourse".⁴³ Though as Lauren Cornell, then Director of Rhizome, admits in an interview with critic Caitlin Jones in 2006, the Agreement was non-binding and didn't make specific promises regarding preservation due to the limited organizational resources available to Rhizome at the time. Much of the early information gathered about artworks did not follow specific metadata standards and was not designed to accommodate any specific preservation paradigm. Financial constraints meant that the first full-time staff member whose role was primarily concerned with preservation, Ben Fino-Radin, did not join Rhizome until 2011.

Since then, digital preservation has become a central part of the organizational mission statement and has guided the development of new organizational programs and projects. In fact, the statement on the ArtBase homepage, describes the ArtBase as "founded to preserve works of net art" and positions Rhizome's digital preservation program as a direct response to the "significant crisis in digital social memory" brought on by the continuous cycles of technological obsolescence (ArtBase, 2017). And furthermore:

The works in the ArtBase, vibrant and technically diverse, provide a laboratory for the development of forward-thinking tools and strategies so that these works may be reperformed in legacy environments, giving contemporary users a sense of their initial form. (*ibid*.)

Rhizome's gradual turn towards a more institutionalized organization and the corresponding growth in scope and ambition of the preservation program impacted the vision for the ArtBase. From a platform for sharing art and ideas, a future-oriented space—aiming to showcase the latest developments in the net art community (Tribe and Ptak, 2010; Fino-Radin, 2011), the ArtBase became an increasingly retrospective environment. In this context, the preservation of obsolete software and

⁴³ For the full text of the "ArtBase Cloned Object Agreement" see PhD Portfolio, Report #1, p.12.

environments—which pose challenges to accessing older works—has become a priority, while accessioning of newer works has been temporarily paused (Connor, 2016). This shift in emphasis necessitates a reconceptualization of the context surrounding works and a redevelopment of the archival framework, which goes beyond what was originally collected as metadata in the ArtBase. By perceiving the existing state of artworks in the archive as a "laboratory", the organization has acknowledged the need to develop new digital preservation tools and approaches which can ensure continued access to historic and contemporary artworks, but it has also claimed license to draw (intentionally) subjective boundaries (Espenschied and Rechert, 2017; Connor, 2020) around what constitutes access, or a meaningful experience, of a net art work within the framework of the online archive.

1.3 Accession policies

Rhizome staff have adapted the vision and mission statement of the ArtBase over time, as well as its accession policies, in recognition of the challenges net art poses to traditional perceptions of what constitutes an archival record, how it should be preserved and later accessed. The artworks were not exclusively collected by Rhizome; in fact many existed as multiple copies across personal and institutional servers.⁴⁴

When the ArtBase was originally being set up, Mark Tribe consulted various net artists regarding the framework for the archive (Tribe and Ptak, 2010). Many net artists at the time were based in Europe and they expressed doubts about sharing their work with an American organization, which used to be for-profit (even though it was not any longer). Some of the questions Tribe received related to the server-side components of works— "What would it mean to have two copies in two places?" (*ibid*.). Other artists were ideologically opposed to the idea of preservation (*ibid*.), because early net art oftentimes intentionally opposed traditional memory institutions such as museums and archives (Daniels, 2009). The compromise solution offered by Rhizome was a

⁴⁴ The possibility for any digital media to exist as multiple copies simultaneously across variable infrastructures sets up the conditions for what media theorist Lev Manovich (2001) refers to as a fundamental characteristic of digital media—variability. The relation of variability to media art, and its collection and preservation, has been explored in depth by scholars and practitioners alike, including the establishment of the Variable Media Network (Depocas et al., 2003). Following the work of Manovich and research initiatives, such as the VMN, Rhizome chose the term 'variant' to describe the copies of artworks made available or linked in the ArtBase (Rossenova, 2017).

choice of how artists wanted their work to be archived in the ArtBase. If artists wanted to hand over digital files, these would be copied on Rhizome's servers and presented in the ArtBase under a rhizome.org sub-domain. Such works were referred to as "cloned objects" (Fino-Radin, 2011). Alternatively, if the artists did not want to supply their source files to Rhizome or there was no straightforward technical capacity to do so,⁴⁵ then they could simply provide the descriptive metadata for the work (artist, title, year, short description) and a link to the artwork's URL hosted elsewhere. These works became known as "linked objects" (*ibid*.). The existence of these two types of entities in the archive has largely resulted in the current "hybrid mode"⁴⁶ (Graham, 2014, p.48) of the archive—i.e., the archive contains some artworks which are fully accessible within the archival repository (the cloned objects), while for other artworks there is only documentation available (the records for linked objects).⁴⁷

Given that in the late '90s and early '00s the organization was still relatively young and did not have the resources to commission or purchase artworks and command full control over how artworks were added to the ArtBase, the option to add "cloned" or "linked object" was a flexible strategy. It gave more agency to the artists to decide how their artworks would be accessioned into the archive. This was in line with the emphasis on honoring artistic intent, a strategy originating in the field of art conservation and particularly popular with media art preservation practices at the time.⁴⁸ Nevertheless with time, the instability of access to the latter "linked objects"

⁴⁵ For example, in the case of a complex server-side setup, or if parts of the work were inaccessible to the artist (institutionally, technically or skills-wise), or in cases when the work was technically anchored to its location via absolute URLs being used (Espenschied, 2017).

⁴⁶ Curator and academic Beryl Graham (2014) has proposed the concept of the "hybrid mode" of collecting as a productive way of thinking through the problem of defining new media, or net art archives. She states that as "new media are both tools for collection management and media from which to make art," i.e., "the means of production is also the means of distribution and exhibition", then "in true new media fashion an archive might contain both art and its documentation" (Graham, 2014, p.48). The notion of the hybrid in relation to archives and collections, enabled through the affordances of digital media, had been raised in media studies literature even earlier. In a 1995 essay, media theorist Friedrich Kittler advocates for the creation of digital collections in museums which contain both artworks and related cultural artifacts alongside contextual documents (cited in Dietz, 2005, p.98).

⁴⁷ What constitutes artwork documentation is contentious. In her PhD Thesis, Annet Dekker (2014) outlines a comprehensive vision for various forms of documentation of net art. Within the context of the ArtBase, documentation is most often referred to as artist documentation and presented either in the form of descriptive text, or a link to external website or video documenting the artwork's concepts and/or past performances.

⁴⁸ Honoring artists' intent was advocated by the cross-institutional initiative, the Variable Media Network (Depocas et al., 2003). But the artist's or the "producer's" intent has been one of the tenets of classical

due to link rot eventually led Rhizome to the decision to stop accepting them (Fino-Radin, 2011). Additional resource- and preservation-related concerns resulted in several shifts in the accession policies, which can roughly be grouped in three phases: a) Open submission (1999–2008); b) Filtered submission (2008–2013); c) Closed / by invitation only (2013 onwards).

a) Open submission (1999-2008)

Initially, submission of artworks was open to all and any artworks were accepted into the ArtBase—either as cloned or linked objects—provided they could be categorized as "new media art", i.e., as long as they utilized "emerging media technologies" and "somehow engaged with their cultural significance" (Tribe and Ptak, 2010). Artists also had to submit an artist agreement and fill out an extensive questionnaire⁴⁹ which corresponded to metadata fields collected for each artwork record (artist name, work title, date, artist description, licensing information, technical details, etc.) (Jones et al., 2006). The questionnaire was based on concepts closely related to variable media preservation strategies developed by the Variable Media Network (VMN).⁵⁰ Nevertheless, considering the current amount of missing data in the ArtBase, the questionnaire proved too detailed for many artists to fill out completely.⁵¹ Counter to its intentions, the complexity and simultaneous openness of the questionnaire largely account for the current state of incomplete and inconsistent metadata recorded in the ArtBase backend (see Chapter 2).

b) Filtered submission (2008-2013)

As the number of artworks in the ArtBase grew during the first decade after its establishment, and access to some of the older works became increasingly at risk of obsolescent components, new strategies were necessary in order to keep the archive

conservation theory for a long time. As Muñoz-Viñas explains, original "producer's intent" was considered one of the core aspects of an object's integrity and has been advocated for by one of the key figures in the emergence of conservation as a specialist occupation in the 19th c., namely the French architect Violletle-Duc who favored producer's intent and aesthetic qualities over material or historical integrity and influenced a major part of the conservation field. (Muñoz-Viñas, 2005, p.66-67)

⁴⁹ Screenshots of the most recent version of the questionnaire (which is no longer online) are available in the PhD Portfolio, Report #1, pp.105-111.

⁵⁰ For details of these practices see *The Variable Media Approach* (Depocas et al., 2003).

⁵¹ Mark Tribe has also commented on the impact of the questionnaire: "The questionnaire was difficult and I think it was hard for artists to make the time to complete it." (Tribe and Sanchez et al., 2013)

sustainable (Fino-Radin, 2011). The ArtBase continued to use the open submission system and artists continued to fill out the artist questionnaire, but only a selection of the works submitted were accepted after vetting by the Rhizome team.⁵² Notably, linked objects stopped being accepted during this period, too.

c) Closed/by invitation only (2013-)

Increasingly the organization wanted to refocus and be able to provide more meaningful support to artists whose works were collected in the archive in terms of preservation and access, rather than simply providing a platform to upload files to.⁵³ The earlier sharing-platform model of the ArtBase was no longer able to keep up with a rapidly expanding field, in which artists working online were looking to distributed social media platforms as new possible venues for artwork-making (Connor, 2016). Since 2015 and the launch of the redesigned Rhizome website, submissions to the ArtBase have been officially closed.⁵⁴ The primary focus of the preservation team became building tools to facilitate restoring access to works from the archive which have been inoperable for a long time, as well as tools which can enable archiving of new artworks—particularly those dependent on third-party platforms.

Following the closure of the open submission form, a further policy question within Rhizome remained open throughout the scoping and planning of the redesign process, namely whether the ArtBase should become "a specialist research database put together by Rhizome, or something that has a more collaborative aspect with collaborative features" (Connor, 2018, cited in PhD Portfolio, Report #1, p.91). Various staff members worried about the implications of moving in either direction historicizing the archive *or* opening it to crowdsourcing again (*ibid*.). My embedded position at Rhizome opened a space to debate this question with staff members during

⁵² In an interview with Beryl Graham from 2014, Heather Corcoran, the Executive Director of Rhizome at the time, explains this new phase in the history of the ArtBase: "[...] we are able to judge which works are and will be significant, in terms of their contribution to the field and culture more broadly [...] So the growth of the field necessitates the filtering, but also gives us the knowledge and the insight necessary to do it." (Corcoran and Graham, 2014, p.98).

⁵³ Between 2013–15, the ArtBase data was being migrated from the old web database and into a new content management system. This transition made accessioning works via the old website submission form dysfunctional. Restoring the functionality of the submission form was a possibility, but it was no longer aligned with the newly perceived need to intensify preservation efforts (Connor, 2017).

⁵⁴ As stated on the ArtBase webpage: "[...] currently works are added to the collection by curatorial invitation and through Rhizome's commissioning and exhibition programs" (ArtBase, 2017).

general staff meetings, as well as interviews with individual staff members, conducted during the Discovery Phase of the fieldwork. These discussions didn't lead to a specific solution, but instead highlighted the need for the new archival system to be flexible enough to accommodate a move in either direction. Even if one specific approach had been chosen during the process of drafting the redesign brief, the history of the archive shows that organizational policies can change and the archival system should ideally not be tied too strictly to a single policy. Avoiding the pitfalls the archive suffered while transitioning from a crowd-sourced to a closed platform—particularly inconsistencies in data collection and data classification practices and confusion among its core users and audience⁵⁵—requires a reframing of the archival system which can accommodate change and has the flexibility to allow (a form of) openness, as well as (some level of) institutional curation and historicization. That way, the backend infrastructure and associated data model would not need to be overhauled every time a policy change requires either a more flexible approach to data collection, or alternatively a more standardized, institutionalized approach. What is more, a backend infrastructure able to capture, and credit accordingly, both data originally submitted by artists and community members, as well as data contributed by more formal institutional curation, would better reflect the archive's history. Thereby, users would be able to access data within a more nuanced context, in line with a nontransparent framing of human-computer interaction.

1.4 Access and community

The vision for the structure and operation of the archive has evolved over the years: changes in internal policies both instigate, and respond to, changes in community attitudes and developments in the wider socio-technical context of digital, networked media. Providing free and open access to a collective resource of community production remains an ongoing commitment. However, one specific episode in the history of the ArtBase played a particular role in this commitment and is useful to highlight, as it further emphasizes the importance of user communities and how the

⁵⁵ During the studies with various user communities, there was a common confusion among artists, in particular, around the status of works in the archive and how questions such as copyright got affected during the transition from an open platform to a closed/ by-invitation only program (see PhD Portfolio, Report #2).

way users engage—or want to engage—with the archive can shape its form and cultural significance.

The ArtBase was only ever completely closed for a short period (2002–2003) when a subscription revenue model restricted full archive access to members only (Jones et al., 2006). This change in the original open policy exposed the challenge of financing the infrastructure and staff resources necessary for an online archive of born-digital art, without institutional backing or corporate sponsorship. Lively discussions on the Rhizome mailing list and other online channels⁵⁶ debated the values of universal open access versus various membership subscription schemes. One group set up a spoof website⁵⁷ which mirrored the indexical information in the ArtBase, while providing free access to this index. Others, such as artist duo MTAA, wrote blogposts pointing to the fact that value in the online archive derived from the (hyperlinked) relations between parts of the archive and other nodes in the network—artists' websites, community mailing lists, blogs, art news sites, etc. (Whid, 2006). A paywall on the archive blocked all these dynamic relations and rendered the archive a static objectfocused infrastructure, which was thus not able to fulfill its cultural memory function within the online community. The backlash in the community ultimately proved the value of the original open access policy and renewed a commitment in the organization to secure alternative funding routes, while reinstating public access to the archive. If the archive of net art was to remain culturally relevant, it had to be networked and open access—just like the artworks it presented, whose meaning- and value-production resided in the networked relations and user interactions they engendered.⁵⁸ The ease with which spoof copies of the ArtBase were set up, proved that simply indexing metadata and static HTML and CSS files hosted on a server was not what made the archive a valuable community resource.

⁵⁶ See Tribe (2002) for the original message from Mark Tribe from October 2002 to the Rhizome community and ensuing discussions. See some further discussion: Nettime (2003b); Whid (2006).
⁵⁷ A spoof archive website was set up in protest to Rhizome's paywall on the ArtBase (Net.Art Connexion, 2003) [Currently only available as an archival capture in the Internet Archive]. The link to the spoof was also circulated via mailing lists and online forums (Nettime, 2003a; Net Art Review, 2004).
⁵⁸ This Line followed by the set of the set of

⁵⁸ This line of thought follows the arguments presented by Dekker (2014) in relation to net art as an assemblage of heterogeneous but networked and interlinked parts, which relate to both technical as well as socio-cultural factors. In the artwork as an assemblage "processes and emergent properties are not seen as belonging to properties of individual parts, but attain meaning through the relations" (*ibid.*, p.37).

A decade later, the renewed focus on access and openness which followed the removal of the paywall in 2003, led to the paradoxical situation which forced the archive to close its open submission process in 2013 in order to prioritize access. The artwork copies stored as static HTML and CSS files, were increasingly becoming inaccessible due to obsolete mark-up or browser plug-ins, while the 'linked' artworks and other links in the metadata index were no longer networked due to link rot. And so, following their original commitment to access, Rhizome's recent digital preservation approach has privileged providing a faithful user experience to net art works in terms of frontend interaction, over other forms of preservation which may focus on backend codebase instead. This new approach has been referred to as "reperformance-aspreservation" by Rhizome's Preservation Director, Dragan Espenschied (Espenschied and Corcoran, 2016).⁵⁹ While the archive remains temporarily closed, this approach has put an emphasis on providing access to interactive and networked artworks, so that they are readily available to different users to reperform via their own screens, rather than providing access for artists to continue depositing new works. This particular view on access policies, has specific implications for both the backend infrastructure of ArtBase, and the frontend interface. How to store and contextualize information about works' reperformance while providing multiple access points that users can interact with and interpret critically, requires further inquiry into the concepts and methods of Rhizome's preservation program, associated software tools and interaction modalities.

⁵⁹ See Chapter 2 for details on the use of the term "reperformance". More recently, the approach has been described as "screen essentialism" by Rhizome's Artistic director, Michael Connor during his talk on 'Online Curating' given as part of LIMA's Cultural Matter series on 13 May, 2020 (Connor, 2020).

2 Backend infrastructure for net art preservation

Becoming an established arts organization with large membership and institutional affiliation put Rhizome in the position to formalize their preservation program and to partner with other cultural heritage institutions, research organizations and softwaredevelopment communities.⁶⁰ The development and implementation of the current digital preservation program at Rhizome can be linked to the shift in organizational focus towards ensuring public access to functional historical artworks and developing new ways to archive and contextualize contemporary artworks, which for technical reasons could no longer be accessioned following previous submission procedures (Connor, 2016). Although the field of digital preservation is not a primary topic of this thesis, a discussion of Rhizome's digital preservation program is nonetheless necessary in order to establish the links between user access and institutional processes of maintenance and repair. Furthermore, Rhizome's tools of choice for performing these processes directly impact the design problems concerning backend infrastructure and user interface. This chapter does not narrate a complete history of preservation within Rhizome, but instead focuses on some key policy developments in the program since 2014. This most recent period informs what metadata needs to be collected, structured and presented in the archive's new data model and database, and what user interactions need to be supported by the user interface in order to grant effective access to the works. The Introduction to this thesis posited that providing meaningful access to complex, non-linear born-digital materials presents significant challenges to contemporary archival data management systems and infrastructures. Here, I discuss further the specifics of these challenges, in order to establish the design brief, which informed the design practice discussed in Parts II and III of this thesis.

2.1 Reperformance-as-preservation

In order to better facilitate access to works in the ArtBase, since 2014, Rhizome has articulated the development of new preservation strategies and tools within the

 $^{^{60}}$ See Chapter 1, footnote <u>#42</u>. See also Chapter 5.

conceptual framework of a reperformance-as-preservation paradigm (Corcoran and Espenschied, 2016). This paradigm stresses the processual properties of net art works, and has precedents in digital archival practice. ⁶¹ The word "performance" has been explicitly used in relation to the preservation of digital records as early as 2002 in a report published by the National Archives of Australia: "An Approach to the Preservation of Digital Records", which argues against the perception of digital records as objects. The report outlines a "performance model" for preservation, wherein digital records are broken down into source and process:

The source of a record is a fixed message that interacts with technology. [...] The process is the technology required to render meaning from the source. When a source is combined with a process, a performance is created and it is this performance that provides meaning to a researcher. (Heslop et al., 2002, p.8-9)

The idea that it is the enactment of performance that allows for meaning-making is important not only for Rhizome's approach to preserving and exhibiting net art, but also for the redesign of the ArtBase, as users become critical agents in this meaningmaking process, rather than passive content consumers.

Rhizome's reperformance paradigm for net art preservation focuses on what happens on a user's screen: what users see and how they can interact with the objects and environments they are presented with.⁶² It involves providing conditions for the execution of born-digital files in an environment which is the same as, or as close as possible to the environment the work was originally presented in. Reperformance refers both to the technical alignments of software and network protocols needed to execute and render the work in a browser, and the interactions users must enact to engage with and experience the work. It is a reperformance (rather than simply performance) because it typically involves several layers of abstraction between what would have been a digital file executed in an original version of a particular operating

⁶¹ Van de Vall (2013), among others, has articulated a "performance paradigm" as an emerging practice in contemporary art conservation, too, though it is beyond the scope of this chapter to explore in detail the role of performance in contemporary art conservation discourse. For a more detailed account of the useful parallels that can be drawn between music and the performing arts in relation to time-based media, see Laurenson (2006; 2014). See also Dekker (2018), for the role of documentation practices from the gaming, as well as contemporary dance and music fields in the preservation of digital artworks. ⁶² Hence, the reference to "screen essentialism" mentioned in the previous chapter, see footnote <u>#59</u>.

system, and its contemporary restaging by Rhizome, accessible online via a user's own screen space and personal computer. Within this context, the following preservation actions are key to reperformance:

- 1. restaging the operating system and browsing environment wherein the work was originally performed through emulation;
- 2. ensuring links within the artwork go to networked resources from the appropriate time period through web archiving;
- 3. and providing metadata and documentation which can describe and contextualize preservation activities to users.

Tools to facilitate these actions have been prototyped and tested with artwork reperformances featured in the Net Art Anthology exhibition (2016–2018), however they are yet to be implemented in the ArtBase infrastructure. The following subsections focus on the processes of emulation and web archiving in order to highlight how the brief for the redesign needed to allow for multiple interpretations of the artwork assemblage to be presented to users and contextualized as such.

2.1.1 Restaging environments through emulation

Rhizome have adopted the preservation strategy of emulation, and more specifically cloud-based emulation, for its capacity to scale relatively easily across multiple artwork instances and its support for greater user agency in user-artwork interactions.⁶³ However, instances of emulated artworks are yet to be incorporated in the ArtBase archive, as both the data model and interface of the archive cannot yet accommodate the metadata needed to describe such instances and the interface elements needed to embed and make the emulations accessible alongside other variants of the same work.

At its most abstract, the emulation strategy means "to emulate obsolete systems on future, unknown systems, so that a digital document's original software can be run in

⁶³ It is beyond the scope of this thesis to explore in full why Rhizome favored emulation over other preservation strategies. This strategy is not exempt from technical and conceptual challenges. Other digital preservation methodologies such as storage, migration and reinterpretation have also been explored in the context of digital art preservation (Depocas et al., 2003; Rinehart and Ippolito, 2014). More recently documentation (Dekker, 2018) and publishing (Barok et al., 2020) have been proposed as alternative strategies appropriate to tackling the challenges of net art preservation.

the future despite being obsolete" (Rothenberg, 1999). Emulation is highly scalable for works of net art which are typically executed with a browser application, but could otherwise run on a range of operating systems (Fino-Radin, 2011; Espenschied and Rechert, 2017). For example, an artwork created in 1999 can run on any operating system as long as it is reperformed within a contemporaneous browser which has the necessary plugins such as Flash or Shockwave enabled. Hence a single customized emulation setup could reperform a large number of works from that same period. Given the grassroots history of the archive and early accession policies, oftentimes data about the works in the ArtBase remained partial and incomplete. But simply knowing the date a work was created and accessioned to the ArtBase as a cloned and/or linked variant would be enough to reperform its approximate environment based on what was available on standard personal computers at the time (in terms of operating system, browser software and browser plug-ins) (Espenschied, 2019). What is more, emulation could provide access to a work's original environment directly in a user's own computer, and not only in a special recreation scenario at a physical exhibition involving original hardware.⁶⁴ Both of these principles—ease of scalability and direct user interaction—were formative in Rhizome's partnership with the University of Freiburg to develop the Emulation-as-a-Service (EaaS) project.⁶⁵ EaaS takes advantage of the development of cloud computing services to deliver preconfigured emulation environments which can be reliably deployed online and accessed via a browser. This makes online access to reperformed artworks possible, without requiring users to download and install additional software.⁶⁶

The benefits of providing users with direct access to the environment wherein net art was originally performed become particularly clear with examples which rely heavily on aesthetics derived from contemporaneous components, such as Alexei Shulgin's *Form Art* (1997) (Fig. 2.1). This work uses default browser styling elements, such as

⁶⁴ This approach is also connected to the explicit decision at Rhizome from early on not to accept or store any works in the ArtBase that relied on specific physical components, such as a particular computer shell. Thus, preservation and archiving has been intentionally limited to works that can be reperformed sufficiently in a browser (Fino-Radin, 2011; Espenschied and Corcoran, 2016).

⁶⁵ This research-based project aims to fill the gap in provision of scalable and cost-effective emulation components available to cultural heritage institutions on demand (bwFLA, 2021).

⁶⁶ This was not possible in the past, and hence emulation for a long time was not a widely-used preservation method (Rothenberg, 1999; Fino-Radin, 2011).

scrollbars, check boxes, and buttons to create formal compositions. These elements are entirely dependent on the default style settings built into the browser. Not only do these vary between different browser software applications, but the defaults change over time across different versions of the same browser applications. In 2017, Form Art was reperformed in a legacy Netscape Navigator environment (via EaaS) as part of the Net Art Anthology. Compared to the way the work appears in a modern browser when accessed through its ArtBase record, the legacy browser environment used in the exhibition provides a very different experience, where check boxes, scroll bars and buttons perform and appear as they did in 1997 (Fig. 2.1). The value in the reperformance of the work lies not only in making the work accessible in its original environment, but in making the act of comparison possible, too. Being able to show the context of the performative environment of the artwork, i.e., the browser and its associated interface and interaction patterns, as that environment changed and evolved alongside the artwork itself, offers new opportunities for interpretation and meaning-production for users of the archive. For example, being able to experience multiple variants of an artwork across different environments from different time periods communicates to the user that these works are not single static objects, but context-dependent assemblages.

The ArtBase redesign, therefore, needs to enable users to access artworks through multiple access points—including via legacy browsers running through cloud-based emulation, when appropriate. However, this raises multiple new questions, which the redesign brief needs to address, too, including: How do users navigate and interact with an artwork when faced with multiple variants of artwork presented across live and/or emulated environments? How can users be made aware that the emulated browser is a fully interactive environment? How do contemporary users understand and navigate historic environments which may use obsolete interaction patterns such as frames, pop-out windows, or even—as in the case of the Netscape Navigator browser—a button to edit the web page inside the browser? Last, but not least, how can users be made aware of the limitations of emulation? While visually similar to legacy environments, emulation has limitations resulting in variability in loading

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speeds and pixel dimensions between contemporary and legacy systems.⁶⁷ In addition, emulation cannot account for the networked characteristics of the works: it can recreate the environment of the early web, but not its content. Therefore, the archival record for an artwork needs to also make visible the boundary drawn out by the emulated reperformance around the networked characteristics of the work. It needs to indicate which links or embedded media are still accessible and whether the accessed content is rendering live or archived web resources.

2.1.2 Preserving networked characteristics through web archiving

As well as environmental restaging, the reperformance paradigm is concerned with the networked characteristics of net art, such as references to external resources or dynamic databases, hosting on third-party platforms, or distribution across more than one location or platform. Rhizome have sought to address these various forms of dependencies on networked resources through web archiving activities, more specifically though the development of the tool Webrecorder⁶⁸ (McKeehan and Kreymer, 2016; Rossenova and Kreymer, 2017). However, as with the emulated variants, artwork variants which include (or entirely consist of) web archived resources were yet to be included in the ArtBase. The model of the database did not provide a classification schema of various networked resources, which had (or had not) been archived. In addition, the interface of the archive needed to be capable of presenting and making accessible web archived variants of the artworks, which may or may not have included emulated environments, alongside the "linked objects" of the ArtBase, which remained on the live web. These new conditions for the redesign brief, required a better understanding of the interface interactions and technical processes introduced by the Webrecorder tool.

⁶⁷ Emulation is computationally intensive and when run on cloud servers, speed issues related to individual user's bandwidth and geographic location can result in severe lags when interacting with the emulated environment. Furthermore, emulation does not correct for modern pixel density—in other words, legacy browsers are rendered at their original pixel dimensions, in some cases as low as 800x600px, which is rendered very small on contemporary high-definition screens over 1920px wide (Lurk et al., 2012).
⁶⁸ Webrecorder is an open-source tool built by Ilya Kreymer in collaboration with Dragan Espenschied and maintained by a team of developers and designers at Rhizome until 2019, when the project split up. Rhizome's hosted service is now called Conifer, whereas Webrecorder has become an expanded open source project involving multiple tools (Conifer, 2020; Webrecorder, 2020).

Webrecorder is both a web app and a desktop tool, which records client-server traffic in real time as the user browses a webpage. In contrast to other common web archiving tools which rely on automated crawler technology,⁶⁹ Webrecorder prioritizes the decisions of the web archivist/curator who draws the boundary around the artwork by making explicit decisions as to which external links to follow while creating the archive (Hawes, 2018). In addition, Webrecorder is able to capture and reperform client-side interactions, like pressing play for videos, or reloading of social media feeds, which are dependent on the execution of scripts triggered only by manual user interaction (ibid.). The reperformance of works archived with Webrecorder enables users to engage in all of these interactions, just as they would when browsing the live web. Crucially, the temporal dimension of the web archive is made explicit via the timestamp of capture for each URL. This timestamp is displayed in the URL bar that forms part of the top navigation in the interface of the app when it is in reperformance mode (Fig. 2.2). A full list of captured URLs with timestamps is also available in a different part of the app's interface (Fig. 2.3). These features of the Webrecorder interface can inform how web archives are documented and made available for browsing via the ArtBase.

An artwork which was presented in the Net Art Anthology, Marisa Olson's *Marisa's American Idol Audition Training Blog* (2004-5), can illustrate the benefits of using Webrecorder for preserving and making the networked characteristics of artworks accessible to users.⁷⁰ The work documents the artists' endurance performance of training and auditioning for the popular US TV show *American Idol*. More than mere documentation, her blog explores the affordances of the, then nascent, medium of

⁶⁹ Web crawlers are software tools used for most large-scale web archiving operations. They perform automated archiving of webpages following pre-determined rules, such as following a set number of links on each page. Once a crawl script is set into motion, it cannot be manually adjusted by the archivists on a page-by-page basis; this means crawls can become unnecessarily large in some cases (following too many links), or too limited in others (following too few links). For more details on the technology, see 'Web crawler' (2017). For an overview of the current web archiving landscape, both in terms of the literature, as well as the tools and practices in use, see Ogden et al. (2017).

⁷⁰ However, there are limitations to this approach to preservation. There are 3rd-party services and data sources which cannot be entirely bound within the institutional archive (Espenschied, 2017) Examples include Google Search or Maps services, live Twitter feeds, among others. While it may be possible to "artifactualize" (Espenschied and Cerf, 2017) certain networked aspects of net art within the structure of the archive, such as the external links in the example of Marisa Olson's piece, in many instances the archival variant may represent only a single possible encounter with the work.

blogging as a participatory user environment, where the artist engaged with a large online following (Connor et al., 2019, p.222). The artwork is still accessible as a 'linked object' in the ArtBase, but contains multiple links to broken and/or no longer active pages. If users try to navigate to the artwork directly via its original link stored in the ArtBase, they will not be able to fully experience the work in its networked context and will likely miss large sections of what may once have been considered within the work's boundary. This kind of partial experience can have a negative impact on how users are able to interpret this work without extensive and didactic curatorial text (which is not offered by the ArtBase, for any works). However, the web archive variant of the work which was presented in the Net Art Anthology, linked to archived versions of those external resources instead. Where possible, the web archive used versions of the linked resources from the relevant time period.⁷¹ Rhizome utilized Webrecorder to create this variant of the work in WARC format.⁷² Of course, the artwork never existed in this self-contained form. The external links ingested as part of the WARC file were not single pages, but rather they existed within a networked context of their own. It was curatorial choice that guided where the boundary around the archive was drawn, and where the archivist/curator stopped following external references. Furthermore, the archive represents a single snapshot in time. It is possible to argue that the web archive variant prepared by the preservation team at Rhizome is a form of documentation of a past performance, rather than reperformance per se. But this documentation, contained within a subjective boundary around the artwork assemblage, can still play an important role in contextualizing user experience in the archive, precisely because the WARC file and the reperformance software hold the traces of the archivist's decisions.

To conclude, web archive variants of net art works address the temporal, networked and performative characteristics of the works in two important ways which need to be

⁷¹ These were sourced from other public web archives, such as the Internet Archive, among others. (Espenschied and Moulds, 2019, p.439)

⁷² A web archive here refers to a variant of an artwork in WARC format, rather than simply as a set of files submitted by the artists and stored on Rhizome's server. WARC is a standard file format for web archives, which the Library of Congress defines as: "a method for combining multiple digital resources into an aggregate archival file together with related information. The WARC format is a revision of the Internet Archive's ARC file format that has traditionally been used to store 'web crawls' as sequences of content blocks harvested from the World Wide Web." The WARC file also contains metadata related to the harvesting (WARC, 2017).

reflected in the ArtBase redesign: 1) By drawing up explicit temporal and locationbased boundaries around web resources and services needed for reperformance, web archive variants highlight to users accessing and navigating them the ways in which complex born-digital artifacts, are not like other object records in traditional archival and collections; and 2) Human and non-human agents such as users, archivists, and technical dependencies have as much agency in the ongoing development of the work, its preservation, reperformance and interpretation, as the artists. In this respect, the reperformance-as-preservation paradigm, and particularly its web archiving strategy, depart from other art conservation approaches which privilege artistic intent (Depocas et al., 2003), and/or assume maintenance and repair procedures must remain invisible to the audience (Muñoz-Viñas, 2005). Instead, maintenance and repair processes, and the associated agents, can be made more visible in the ArtBase archive, highlighting decisions around boundaries which may be driven by subjective curatorial choice, or particular technical limitations. This requires further research into the metadata models and ontologies used to describe artwork variants and associated preservation activities in the archive.

2.2 Metadata in the ArtBase

Throughout the two-decade history of the ArtBase, Rhizome staff members remained aware of the importance of metadata, or data about the artwork records in the archive, to contextualize the works, and to make the database easier to search and navigate. Various metadata-related infrastructural problems were iteratively worked on, including:

- What storage model should be used for the data? (Rinehart, 2002; Tribe and Ptak, 2010)
- What protocols should be followed for its semantic and syntactical structure in order to ensure data is searchable and interoperable? (Fino-Radin, 2011; McKeehan, 2016)
- What constitutes sufficient technical metadata that can support Rhizome's digital preservation program and efforts to provide access to functional artwork reperformances? (McKeehan, 2016; Espenschied and Rechert, 2017)

In the Discovery Phase of the fieldwork, I examined different solutions to these questions from different periods of the ArtBase history (see PhD Portfolio, Report #1), and I added one more question to the redesign brief:

• What metadata is needed to accommodate different variant presentations (emulation, web archives, etc) and how should it be presented on a frontend interface for users to gain contextual understanding of the processes and agents involved in the preservation and reperformance of these variants?

The study of processes, agents and the relations between them, and how the latter can be represented as metadata via a user interface, became an important part of my design practice methodology, which led to the articulation of the MDI framework. Different data collection policies and data management strategies applied to the archive throughout its history have all played a part in the formation of the archive as a network, both in the technical and conceptual sense of the word.⁷³ In the ArtBase and its embodiment as a technical communications network, artwork assemblages are nodes, and the metadata that connects the nodes must follow specific protocols of communication.⁷⁴ These protocols are important, because "in order to initiate communication, the two nodes must speak the same language [...] Shared protocols are what defines the landscape of the network—who is connected to whom." (Galloway, 2004, p.12). The logical model (e.g., relational, hierarchical) that determines how metadata is structured is a protocol, so is the ontology (or classification vocabulary),⁷⁵ in other words "any networked relation will have multiple, nested protocols" (ibid., p.10). While the technical protocols may be "nested" and therefore hierarchical by default, the processes that determine how certain nodes relate to others and how these relationships may change over time under the influence of various agents (themselves nodes in the network) are anything but strictly hierarchical. To make sense of all these protocols and their forms of interrelatedness

⁷³ For an overview of database management systems and metadata policies in the ArtBase see PhD Portfolio, Report #1, p.21-31.

⁷⁴ The materiality of the technical network here draws on Latour's distinction between the technical and conceptual networks (Latour, 2005), but also on Castells reading of the importance of the technical infrastructure for the effective operation of any communication network (Castells, 2009). Lastly the use of the term protocol here follows Galloway's conceptualization of protocols as the essential "principle of organization native to computers in distributed networks" (Galloway, 2004, p.3).

⁷⁵ An ontology in information science is the formal naming and definition of categories, properties and relations between concepts and data entities (`Ontology', 2020).

in terms of the design of the archive's interface and infrastructure, I frame the relations within the archive's network as processual operations of: 1) classification, 2) maintenance, and 3) use. As elaborated in the Introduction, classification relates to designing and developing data model structures and ontologies, maintenance relates to preserving and making archival records accessible, whereas use relates to accessing and making use of the records. Next, I will discuss how the entanglements between these processes and the archival infrastructure helped me to the articulate new questions for the redesign brief, and develop the processual dimensions of the MDI framework.

2.2.1 Classification, maintenance and use in the ArtBase backend infrastructure

The initial data structure of the ArtBase followed a "basic web model" (Fino-Radin, 2011). It began as a MySQL database structured around a custom taxonomy, devised by Rhizome staff members (Espenschied, 2017).⁷⁶ The early model of the ArtBase followed common web conventions of the time rather than any particular archival or information science model (Tribe and Ptak, 2010). In addition, the open submission policy and artist questionnaire (see Chapter 1) meant that many of the key terms used to describe and classify artworks were contributed directly by Rhizome's user community. In an interview from 2013 (Tribe and Sanchez et al., 2013), Tribe pointed to the lack of suitable protocols or vocabularies among standard schemas at the time such as Dublin Core,⁷⁷ which could account for the needs of describing net art, including the ability to specify more than one 'author' or 'artist' for the work, or the possibility to assign different roles for different active participants in the artwork's creation (or maintenance) (*ibid.*). Since then, newer standards and ontologies for classification in digital archives and software preservation have been developed.⁷⁸ However, there are gaps between the needs of the ArtBase and the digital preservation

⁷⁶ MySQL is a commonly used open source relational database management system. It is based on the relational model of knowledge organization which structures data according to entities and their attributed values ('MySQL', 2017).

⁷⁷ A small set of vocabulary terms which can be used to describe physical resources, such as books and CDs, as well as digital resources (images, videos, web pages, etc.). This schema is also an ISO standard (Dublin Core, 2017).

⁷⁸ Relevant examples include PREMIS, a digital preservation metadata standard, and CIDOC-CRM, a standard model and ontology for structuring cultural heritage data, among others. See Chapters 6 and 7 for a discussion of possibilities and limitations of these standards.

paradigm at Rhizome on one hand, and the ways in which traditional collection managements systems model and classify data on the other. There have been efforts in the past to migrate the ArtBase database from its initial unstructured format to a more formal archival system following internally-recognized standards (Fino-Radin, 2011). However, the efforts to map data and to link the system that stores metadata (the digital catalogue) to the locations where artwork data is stored (the digital repository) reveal the limits of these systems and standards which remain tied to analogue collection principles and where digital representations are limited to images or videos (see PhD Portfolio, Report #1, pp.21–27). Through inability to support the complex and interrelated knowledge production that happens in contemporary cultural heritage institutions in general (not only born-digital archives), classic collection management systems, effectively force a separation between classification processes and maintenance processes (Haidvogl and White, 2020). But the ArtBase requires a different approach, which recognizes the entanglements between classification and maintenance.

The hybrid mode of the archive—the presence of "cloned works" and "linked objects", complete artworks alongside various forms of documentation—complicates standard collection classifications by opening the question: How can the logical model of the archival database software express the artwork record not in terms of parts-and-whole relationships, but as an assemblage encompassing multiple variants, all of which are also artworks in themselves.⁷⁹ What is more, the development of the reperformance-as-preservation paradigm creates the need to link artwork records not only to a server location where a complete copy of the work is stored, but to various environments— launching different processes in the user's browser (e.g., an emulated variant embedded in an iframe, or a web-archive reperformed in Webrecorder), which need more clarification (and classification) than simply a button that states "View artwork". The list of diverse techniques and additional customizations applied by Rhizome in the production of the Net Art Anthology exhibition (Espenschied and Moulds, 2019, pp.433–444), indicate further that a fixed vocabulary of standardized procedures and a

⁷⁹ This problem is not unique to net art but it has not been resolved when it comes to archiving and cataloging performance and installation art, time-based media, and other cultural forms involving iterative processes (Engel and Wharton, 2017; Wildenhaus, 2019).

limited set of relations between the 'catalog' infrastructure for metadata storage, the 'digital repository' storing artwork copies and archives, and the reperformance environments, is not sufficient in the case of the ArtBase. Crucially for the redesign of the ArtBase, the question can be also be reframed around decision-making: how can decisions around reperformance environments and web archive boundaries be surfaced within the interface of the archival framework so that users can understand the context around the reperformance and act accordingly? Maintenance work carried out by preservation team involves subjective decision-making, but it is also a collaborative endeavor with the broader artistic and user communities around the archive, because works rely on resources originally provided and often continuously maintained by the artists (even if these resources are then represented within an emulated environment) and cannot be reperformed without the participation of users. At the same time, without preservation actions such as emulation or web archiving, user access in many cases would not be possible. Hence, use, or informed user access and interaction, and maintenance are also intricately entangled processes.

An ArtBase infrastructure wherein the different roles played by Rhizome staff, grassroots artistic community, as well as archive users, in processes of classification, maintenance and use, can all be made visible, is a key expression of the MDI framework which recognizes the entanglements between processual and material manifestations of the archive and aims to support user agency throughout. This can be achieved by maintaining an expanded and more flexible metadata ontology; by representing different artwork variants and their documentation as distinct but connected nodes in the archive's network; and by using data protocols which allow for non-hierarchical and non-predetermined relations to be drawn across various archive nodes. But these requirements cannot be met by the technical infrastructure of a traditional collection management database.

2.2.2 Linked open data infrastructure

To address some of the challenges of classification and metadata modeling in the ArtBase, in 2015 the digital preservation team decided to move away from standard collection management software systems, which tend to act as siloed catalogues describing an external repository (Espenschied, 2017). The idea was, instead, to

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explore the newly released Wikibase,⁸⁰ a free and open-source software for creating, managing and sharing linked open data (LOD). By then there was already a growing popularity of linked data being utilized for cultural heritage preservation, but open platforms to easily experiment with and test the capabilities of LOD to connect cultural resources were lacking (Fauconnier et al., 2018).⁸¹ Although a new and notyet-widely-adopted platform at the time, Wikibase was considered better-suited to the diverse needs of the ArtBase because it provided more flexibility with regards to heterogeneous types of data and data relations. The logical model of the LOD protocol is a network, and not a hierarchical tree as in many other standard classification systems (Dourish, 2014), which makes it more apt for the development of a growing ontology around artworks, which can change and evolve into new variants, around ongoing preservation activities, and various forms of additional documentation of the works-texts, screenshots, web-archives and more. The flatness of the LOD software environment blurs the sharp edges between the artwork, its multiple variants and their documentation, which is well suited to the hybrid mode of the ArtBase. But it also opens new design problems for the development of interface and interaction design prototypes which can clearly communicate the shape of the network (its nodes and relations) to users who may be more familiar with the hierarchical protocols of standard archives and collection databases.

The redesign brief for the archive interface therefore needed to outline the requirements for new patterns of interaction via a frontend interface to a non-hierarchical, LOD backend infrastructure. These requirements also needed to account for the plurality of access policies and preservation tools developed and maintained by Rhizome. The impact of individual policies and tool platforms needed to be analyzed against the backdrop of existing interface instantiations at Rhizome, as well as common interface conventions in other archival systems (see PhD Portfolio, Report #3). Supporting access and user agency in the context of an unfamiliar environment

⁸⁰ Accessible at: <u>http://wikiba.se/</u> [Accessed 3 September, 2017]

⁸¹ The concept of using linked data in the field of cultural heritage has been growing in popularity through various international consortia and initiatives. Among them the LODLAM or linked open data in Libraries, Archives, and Museums community has been particularly active since its first international summit in 2011. Voss (2012) traces the development of the community and the benefits of using linked data for GLAMs (see also Chapter 6).

(such as the LOD database) needed to a strike a balance between two extremes. On one hand, the total transparency of conventional collection interfaces, which are familiar and easy-to-use, but which also obscure all backend operations and thus fail to meet the needs of Rhizome's preservation paradigm. And on the other hand, a lack of transparency in the frontend metaphors and interaction patterns that would effectively render the database too cumbersome for external users to access and engage with, let alone participate in classification and maintenance processes.

3 Interface design for the net art archive

This chapter discusses specific elements from the past and present setup of the archive's interface in order to further unpack the design questions posed by the discussion of processes of classification, maintenance and use in the previous chapter. The history of previous user interface designs of the ArtBase plays an important role in the development of the archive as a network of data, software and various human and non-human agents and processes. However, it is not necessary to reproduce this history in full to talk about the development of the new design brief around this network.⁸² Studying the links between interface design decisions and previous data model and database implementations throughout the Discovery Phase of the fieldwork proved that trying to separate problems of interface and interaction design from the underlying data infrastructure is not a productive approach. Hence, the goals of the redesign brief, as well as the articulation of the material dimensions of the MDI framework throughout the iterative process of refining it, were a response to the necessity of considering all three aspects of the ArtBase archive—model, database, interface—in parallel. The most recent implementation of a linked open data database software in the ArtBase backend called for new visualization metaphors and user interaction patterns which could better represent the flexibility and relational capacity of LOD. In contrast, the metaphors and patterns typically used in digital archive or collection interfaces lacked the means to account for flexible contextual relations, and tended to assume a neutral, 'view-from-nowhere' perspective (see PhD Portfolio, Report #3). Such metaphors had been used in previous instantiations of the ArtBase interface but could not facilitate nuanced, contextual and non-transparent interactions with net art archival records (see the prologue to Chapter 1). In addition to the problems of frontend interactions in the ArtBase, this chapter also looks to related issues of sustainability of both frontend and backend design decisions in the context of grassroots efforts to preserving born-digital culture. This sets up the discussion of the role of user communities and the findings from the user research

⁸² See PhD Portfolio, Report #1, pp.31-37, for a more complete historical overview, and consult Fig. 3.1.

carried out during the Discovery and Exploration Phases of the fieldwork which follow in the next part of the thesis.

3.1 Non-transparent interfaces

The early interface design iterations of the ArtBase reflected contemporaneous conventions and due to the slow speeds and predominantly text-heavy characteristics of the early web, the interface consisted of primarily text-oriented lists which were navigated via vertical scroll and pagination (Fig. 3.2, 3.3). Around 2010–11, well into the "Web 2.0" era in the history of the internet, Rhizome introduced a more visuallyled interface for the ArtBase with image-based grids (Fig. 3.4). The archive could be sorted by a number of structured categories, as well as user-generated unstructured tags. At various points, the archive interface offered additional ways of highlighting specific works, such as a featured section, a visual timeline, as well as member- or staff-curated exhibitions (Fig. 3.5). However, all of these strategies were merely following what was being done in other 'virtual exhibition' environments (see PhD Portfolio, Report #3). The image grids and the labels on the home page, or the thumbnail representation alongside text and basic bibliographic data on the artwork pages, were common patterns used in most museum websites presenting digitized surrogates of their physical collections. What is more, these patterns were based on the metaphors of the gallery (or salon) wall and the catalogue raisonné page. This presented two problems for the ArtBase. First, these interaction patterns and metaphors were better suited to digitized physical artifacts than to the needs of multivariant, processual born-digital works. And second, this standard framing of online collection interfaces follows the assumption that interfaces should be transparent and neutral 'windows' delivering unmediated content to users (Bolter and Gromala, 2003). The latter is a key point of critique in many net art works, which highlight how interfaces, network protocols and software are anything but neutral (*ibid.*, Fuller, 2008; Andersen and Pold, 2011).

Many of the artworks in the ArtBase intentionally challenge the conventions of interface design, making use of easily identifiable metaphors and interaction patterns and requiring users to 'think' about the formal and abstract characteristics of

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interfaces and networks, instead of absent-mindedly scrolling along.⁸³ Formalist works, such as *Form Art*⁸⁴ (1997) by artist Alexei Shulgin or *untitled[scrollbars]*⁸⁵ (2000) by Jan Robert Leegte draw the attention of the user to the material conditions of the interface by featuring playful visual compositions built entirely of basic interface components, such as check boxes, radio buttons, and scroll bars (<u>Fig. 2.1, 3.6</u>). By the late '90s, such features may have become metaphorically 'transparent' to users, whereas two decades later elements such as scroll bars have become literally invisible in many contemporary browsers and operating systems.

Within the field of HCI, transparency has traditionally been framed as a necessary condition of a good interface—an indication that the interface delivers content to its users without interference, or judgement (Norman, 1990). Transparency means the interface, associated software and hardware infrastructure, and all decisions framing that infrastructure should remain invisible, so that the user of the interface can focus only on the task at hand: typing a document, watching a video, etc. The premise is that this interface and infrastructure are purely 'technical' constructs: value-free and neutral; and therefore, not worthy of being visible. Of course, this perceived neutrality is an illusion, which has been eloquently unpacked by many critical media studies scholars (e.g., Manovich, 2001; Andersen and Pold, 2011; Emerson, 2014; among others). Transparency has its place in interface design—some level of abstraction is useful, as users do not always need to be aware of every single operation a computer executes in order to serve a particular GUI. In *Reading/ Writing Interfaces*, Lori Emerson (2014) traces the history of the transparent interface paradigm in early computing, and connects it to the development of the user-friendly interface ideology. Transparency in this context is the opposite of rendering opaque systems and networks visible. The more 'transparent' an interface appears to its users, the more opaque the underlying infrastructure is rendered (Bolter and Gromala, 2003, p.55). The user-friendly paradigm in design which favors ease-of-use manifested in limited interaction

⁸³ The notion of users thinking about the interface here is a response to one of the most formative UX design reference books, titled *Don't make me think* by Steve Krug (2000), which argues for the need to create intuitive experiences (see also Chapter 4).

 ⁸⁴ Form Art is accessible at: <u>https://anthology.rhizome.org/form-art</u> [Accessed 26 November, 2019]
 ⁸⁵ untitled[scrollbars] is accessible at: <u>https://artbase.rhizome.org/wiki/Item:Q2508</u> [Accessed 26 November, 2019]

pathways and opaque infrastructures at the cost of user agency is problematized further in Chapter 4, in relation to the user communities working with digital archives. This chapter proposes that the transparent paradigm is ill suited to the design of the ArtBase interface, because it wrongly presumes users to be passive content consumers rather than active agents in a network. Based on the history of the ArtBase narrated so far, and the development of the preservation program at Rhizome, users in the ArtBase may be creators who contribute to the creation, classification or maintenance works, or they may be active participants in the reperformance of works. Hence, a nontransparent alternative is needed for the redesign of the ArtBase.

Digital Humanities scholar Johanna Drucker (2013) has argued that interactions between users and interfaces are interpretative events within a paradigm she defines as "performative materiality". Instead of the static consumption of pre-defined messages, Drucker draws on media archaeology (Kirschenbaum, 2008; Parikka, 2011) and textual analysis (among other disciplines), to argue for the interplay between the material qualities of digital interfaces and the interpretative act of user interaction, which like reading a text is not a one-way process of receiving information, but rather a dynamic process of meaning-making and value-production (2013, par.15). The concept of performative materiality is relevant in the context of Rhizome's reperformance-as-preservation paradigm, which involves users as active agents in the reperformance process. A view of digital materiality as performative is also relevant the development of the MDI framework, as it adopts a holistic view of the processual and material entanglements in digital archives and the role of user communities therein. Drucker further argues for the need for new, humanities-driven practices in interface design which depart from classic HCI methods and allow for "content modeling, intellectual argument, rhetorical engagement":

In place of transparency and clarity, [such practices] would foreground ambiguity and uncertainty, unresolvable multiplicities in place of singularities and certainties. (*ibid.*, para 34)

The material and temporal context of artwork assemblages in the ArtBase is variable, not singular, and may often involve uncertainties and ambiguities (Dekker, 2018; see also the introduction to Part II), so a framing of the ArtBase redesign practice that may

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facilitate the type of critical engagement advocated by Drucker is more apt than the pursuit of an instrumental 'user-friendliness' or transparency.

Other design practitioners and DH researchers have also challenged epistemological norms around neutrality and transparency in HCI displays and proposed practical design strategies for working with large, heterogeneous datasets, particularly where data may be missing, incomplete, or ambiguous.⁸⁶ However, most of these projects work with cultural data of digitized, rather than born-digital objects. What is more, strict institutional protocols usually prevent research design projects from deeper engagement with infrastructure—projects tend to remain 'client-side', for example by utilizing JavaScript libraries to analyze and visualize data directly in users' browsers in a variety of interesting ways. Rarely (if ever) are 'backend' database software and data models discussed.⁸⁷ In this respect, the ArtBase case study presented in this thesis, and the MDI framework developed alongside it, take advantage of a unique opportunity for an HCI project to have the freedom and capacity to intervene on an infrastructural level that extends back to the database software and the model of the data structure, as well as forward to the user-facing interface, and even the broader online platform of the institution.

What is more, because the ArtBase is not just a digital archive, but an archive of complex, born-digital artworks, its new interface design can also draw inspiration from interface strategies proposed by net art works and the ways in which they make

⁸⁶ Relevant examples, include: the work of Mitchell Whitelaw and his conceptualization of the generous interfaces metaphor (Whitelaw, 2015; Schofield et al., 2017); the work of Micah Walter and Seb Chan on the Cooper Hewitt online collections (Chan, 2012; Walter, 2013; Brenner, 2015); the PhD research work of DH researchers Florian Kräutli (Kräutli, 2016) and Olivia Vane at the Royal College of Art, London (Vane, 2019); and the embedded research of designer Philo van Kemenade at the Dutch Institute for Sound and Vision (Open Images Browser, 2020). Some of these were explored as part of the landscape review design micro-phase of this project (see PhD Portfolio, Report #3).

⁸⁷ Whitelaw has already commented on the "tight coupling of collection data and dynamic representation" which is part of the data visualization process and challenges traditional binaries between frontend versus backend, and associated roles and capacities: "Traditional collection interfaces reflect a clear delineation of 'back end' (collection management and metadata) and 'front end' (web design) as distinct functions and roles. Generous interfaces require a combination of approaches and skills spanning visualization, information design, data analysis, manipulation and processing." (2015, p.45). Even within that extension of designers' skills and capacities the focus is on the client-side of visualizing data that the designer is able to understand and manipulate, rather than on having the capacity to intervene in the underlying data ontologies and organizing standards.

different aspects of communication networks more visible. Whether it is the formalist approaches to interface components of early works by Shulgin and Leegte (Fig. 2.1, 3.6), or the critical approaches to network protocols and database visualizations of works presented in the Net Art Anthology such as *The Web Stalker, Image Atlas, Starrynight,* among others (Fig. 3.7);⁸⁸ the ArtBase redesign, too, can pursue a similar line of critique of interface transparency, which aims to separate what is visible on the surface from processes that run in the background. Therefore, the prototypes developed as part of the design practice and discussed further in Chapter 8, reflect on critical areas of intersection between 'backend' and 'frontend', by working towards:

- presenting the new database model and ontology in a visually explorable way, which helps to make classification processes more visible;
- presenting temporal and performative context around net art works, which helps to make maintenance and preservation processes more visible;
- and lastly, presenting the data interconnections enabled by the new LOD structure, which opens new possibilities for user interactions in the archive.

As well as prototyping specific visual design strategies, the non-transparent, reflective MDI framework has also been developed through the exploration of and advocacy for specific policy approaches at Rhizome with regards to their broader infrastructural work, discussed in the following two sections of this chapter (see also PhD Portfolio, Report #1, pp.89–105).

3.2 Plural interfaces

Developing the MDI framework, throughout the situated practice with Rhizome while studying their programs and policies, led to the articulation of the interface dimension of the framework as concerning not just a single uniform user interface, but rather a

⁸⁸ *The Web Stalker* (1997) is a work by collective I/O/D. The aim of this new piece of software was to: "look behind the assembling of smooth surfaces and into the plumbing ... to create a way of interfacing with the web that foregrounded some of the qualities of the network", as Matthew Fuller, one of the artists, writes (Fuller, 2017). It is accessible here: <u>https://anthology.rhizome.org/the-web-staker</u>. *Image Atlas* (2012) was created by activist Aaron Swartz and artist Taryn Simon. It shows how image search engine results vary widely across different countries, highlighting how underlying data is both culturally embedded and politically contested. It is accessible at: <u>https://anthology.rhizome.org/image-atlas</u>. *Starrynight* (1998) is an artistic interpretation of and a functional interface to Rhizome's early mailing list discussions, developed by Alex Galloway, Mark Tribe and Martin Wattenberg. It is accessible here: <u>https://anthology.rhizome.org/starrynight</u>. [All links accessed 20 January, 2021]

plurality of interfaces. Facilitating connections to records and artwork variants across multiple access points, supported by Rhizome's new digital preservation tools, requires the development and adoption of appropriate data policies within the organization, alongside visual strategies for navigating new user interaction environments such as emulated browsers and web archives, among others. While it is possible to speak of an archival infrastructure tightly coupled with an archival interface in general, a more precise expression of the networked relations in the ArtBase would in fact observe multiple infrastructures and multiple interfaces. As Espenschied (2017) has noted:

The ArtBase cannot be a single platform that embodies all the preservation techniques that Rhizome uses, but it can use the linked data database to connect across distinct technical approaches and preservation tools. (cited in PhD Portfolio, Report #1, p.96)

Rhizome's growing assemblage of infrastructures and interfaces, which I examined during the Discovery Phase and later referenced throughout the Design Exploration and Specification Phases of the fieldwork, included:

- Rhizome's main website⁸⁹
- Rhizome's archive of exhibitions⁹⁰
- The Webrecorder tools⁹¹
- The EaaS tools⁹²
- The Wikibase software suite⁹³

⁸⁹ This includes: a content management system with its own administrative interface; a frontend user interface at <u>rhizome.org</u>; and the contents of the old archive of mailing list messages transferred under <u>https://rhizome.org/community/</u>. This infrastructure and interface assemblage played a bigger role in previous instantiations of the ArtBase when the database storing website data was still not separated from the archive's artwork data, and the interfaces across website and archive were more uniform. [Accessed 26 July 2020]

⁹⁰ This is split across: pages hosted on Rhizome's current website (<u>https://rhizome.org/art/</u>); pages hosted on the New Museum's website (<u>https://www.newmuseum.org/exhibitions/online</u>); pages hosted under the dedicated Net Art Anthology sub-domain and server space (<u>https://anthology.rhizome.org/</u>); and lastly older exhibition pages hosted under a separate institutional archive sub-domain and server space at <u>http://archive.rhizome.org/</u>. [Accessed 26 July 2020]

⁹¹ This includes: the cloud hosted version (<u>https://conifer.rhizome.org/</u>), the desktop application (<u>https://github.com/webrecorder/webrecorder-desktop</u>), and the dedicated custom instance used by Rhizome to stage net art reperformances for the ArtBase and the Net Art Anthology (<u>https://webenact.rhizome.org/</u>). [Accessed 26 July 2020]

 ⁹² This includes the specific instances when it was used to stage emulated artworks in the Net Art Anthology, e.g., here: <u>https://anthology.rhizome.org/the-web-stalker</u>. [Accessed 26 July, 2020]
 ⁹³ This includes: its multi-database instantiation (a relational database to manage the Wikimedia software and a graph database to handle the RDF data and the SPARQL queries); a default administration interface
Next, I will discuss different points of intersection between these platforms on an infrastructural, interface, as well as policy level, which set out new considerations for the redesign brief. Coherence and continuity in terms of data interoperability across platforms, user community involvement and long-term sustainability could not be achieved through branding or visual style means only. Instead, the redesign needed to explore further the potential of the LOD database to facilitate connections across Rhizome's platforms through its data model and interface, but also through recommending certain organizational policies over others, as part of the reflective, non-transparent MDI framework.

3.2.1 Archive for the institutional program

As the ArtBase data has been decoupled from the main Rhizome website, the degree to which the institution decides to integrate the new ArtBase interface into its main platform can be flexible and respond to future changes in the branding and information architecture of rhizome.org. The prototypes for the new archival interface throughout this project were purposefully created without any specific branding style. Such styles can easily be added later on, and changed over time to match current branding guidelines at the organization. The overreliance on visual coherence in the past belied a lack of deeper interconnections between the archive of artworks, exhibitions and text messages or articles across the Rhizome platform. Instead, the new linked data approach offers interconnectivity without dependence on structural or visual unity. Separate infrastructures, databases and even visual styles (if the organization chooses so) can still facilitate interconnectivity between the program of Rhizome's main communication platform and their archive. Even so, the use of the Wikibase database capacity within Rhizome does not need to be limited only to data relating to the artworks formally part of the ArtBase legacy. In discussions with staff throughout the redesign process, they expressed an interest in Wikibase becoming a resource that is more reflective of both curatorial and preservation pursuits at the organization (see PhD Portfolio, Report #1, p.102). Given the widely distributed

for data entry and preview (<u>https://artbase.rhizome.org/wiki/Main_Page</u>), as well as separate default user interface to write and execute SPARQL queries (<u>https://query.artbase.rhizome.org/</u>). [Accessed 26 July, 2020]

infrastructure of the exhibiting and commissioning programs at Rhizome, the Wikibase database should link out to exhibition URLs whenever these relate to the exhibition history of a particular ArtBase artwork. But the database should act as a defacto institutional archive, too, and store metadata regarding particular events and exhibitions, even if they remain hosted on distributed infrastructure. Such data would help with both internal care-taking and institutional-memory-preservation processes at Rhizome, as well as expand and enrich the context around artworks in the archive.⁹⁴

3.2.2 Reperformance interfaces

Considering how the archive could further reflect the preservation pursuits at Rhizome opens up new design problems for the redesign brief in terms of facilitating connections between the interfaces of tools that enable artwork reperformance, following Rhizome's reperformance-as-preservation paradigm (see Chapter 2), and the archival records in Wikibase. While the Wikibase database would hold all the metadata for artwork reperformances and could present that to users via its visual interface, the actual execution of emulated variants or web archive variants would happen within the infrastructure of separate tools such as EaaS and Webrecorder. The redesign brief therefore included the need to prototype at least partial integration of ArtBase data into the reperformance environments, and in turn integrate access points to these environments in the interface of the ArtBase. Such integration would ensure user experience continuity around the classification ontology and maintenance procedures linked to the temporal and performative context of net art works, e.g., displaying details such as the original URL of the artwork, when it was archived, and by whom, what preservation actions were taken, if any, what particular dependencies inform the current presentation on view, etc. Chapters 7 and 8 reflect on the development of data model proposals and visual prototypes which establish connections between the

⁹⁴ The prototypes described in Chapter 8 and in Report #4 from the PhD Portfolio feature some visualizations of the possible connections between individual artworks and exhibitions or blog entries on rhizome.org. If these exhibitions and texts are considered as nodes in the database and include more data than just a title and a date, further connections (and historical narratives) could be drawn and visualized across agents, institutions and artworks in the database. Nodes for these database items could include long-form text, too, just as artwork record pages currently do, which could preserve additional institutional memory not readily reduceable to data.

reperformance environments which utilize EaaS and Webrecorder infrastructure and the reperformance-related metadata which are stored in Wikibase.⁹⁵

3.2.3 The many (inter)faces of Wikibase

The sustainability of maintaining 'plural' interfaces needs to also be addressed in terms of the preservation program at Rhizome and the processes of classification, maintenance and use that guide much of the development of the ArtBase. The Wikibase database already has a default interface that allows data upload and management to anyone with a login (which could be a community broader than just in-house staff at Rhizome), as well as data access and discovery to anyone not logged in. This default 'backend' interface could be visually customized (within limits), but the database could also be used as a source for programmatically-accessible data, which could then be served via a completely separate, custom 'frontend' interface. These multiple options raised questions related to interface design from the start of the project: Should all users (including staff) simply use the Wikibase default interface as a way into the archive, with some light styling of fonts, logos and page templates?; Or should there be a separate, custom-branded portal, which is designed specifically for external users, whereas staff access the default Wikibase interface and use it to perform administrative tasks (cataloging, auditing, etc.)?; Given how often the frontend interface of the archive has changed over its 20-year history (more often than the backend management systems, see PhD Portfolio, Report #1, pp.50–51), how could future frontend interface instantiations be more sustainable, in terms of maintenance requirements and risk of obsolete dependencies?

Discussions with staff and external users (see PhD Portfolio, Reports #1 and #2), highlighted some distinct benefits and drawbacks to both approaches. On one hand, the Wiki interface is recognizable to many users already, particularly its collaborative editing features and version control. On the other hand, some users pointed out that Wikibase is heavily data-driven, and lacks visuals. Narrative texts, not just machinereadable data, and visual imagery are important elements in telling a compelling story, as evidenced by the majority of popular interaction patterns utilized in online

⁹⁵ See also PhD Portfolio, Report #4, pp.83-87

collection interfaces (see PhD Portfolio, Report #3). In addition, the possibility for the database to serve plural interfaces, rather than just a singular view, could better serve the variety of use-case scenarios possible within the ArtBase:

Possibly the ideal situation would be to have multiple interfaces: one designed to be similar to other museum archive interfaces, with images and thumbnails and more narrative information. But the Wiki interface can also be there, providing query access for more advanced users. (Moulds, 2018, cited in PhD Portfolio, Report #1, p.95)

However, opting for a custom, branded interface should be balanced against the burden of maintaining additional layers of bespoke software dependencies over the database software, which carry the risk of obsolescence. The interface prototypes discussed further in Chapter 8 took an approach which is not prescriptive in terms of visual style (see also PhD Portfolio, Report #4). Some of the proposed features such as the timeline visualizations and the multi-variant access points within the artwork record page would stretch what is possible to implement purely via template updates within the framework of the default Wikibase interface. However, the latter is preferable to a completely separate and bespoke interface, even if that interface could implement the prototype designs more faithfully.

The brief for the redesign of the frontend interface favored long-term sustainability over advanced features and sleek visuals in order to better support the role of the ArtBase as a community resource. Within MDI's conceptualization of such a resource, different users would be able to work with the ArtBase in different ways, even if it could not meet all user needs at the same time (see also Chapter 4). Even so, prototypes of more speculative features remained useful tools for community engagement and discussion, as outlined in Chapter 5. As the linked data database provides both an API⁹⁶ and additional ways to selectively download sets of machine-readable data, there could be other ways for users to participate and collaborate within the network of agencies entangled in the ArtBase, than just interacting with a single sophisticated interface, dependent on maintenance by Rhizome. The history of the ArtBase could be used to provide some guidance and inspiration here. *Alt.interface*

⁹⁶ API stands for application programming interface. It is a software facility that allows one application to programmatically communicate with another (`API', 2021).

(~2000)⁹⁷ was a commissioning program inviting artists to design and develop alternative interfaces to Rhizome's text and artwork archives. Similar programs could be reactivated with artists or researchers being invited to develop alternative frontend interfaces, all the while taking advantage of a structured, richly-contextualized, and sustainably-maintained backend infrastructure.

3.3 A post-custodial approach to the archive's interface, infrastructure and community development

The recommendation to involve the user community once again in developing plural interfaces to Rhizome's archive was influenced not only by the technical affordances of the linked data database, but also by ongoing discussions with staff concerning the evolving position of Rhizome as an institution versus Rhizome as a community. Since articulating the reperformance-as-preservation paradigm (see Chapter 2), the organization has also expressed a desire to move in the direction of a post-custodial archival paradigm.⁹⁸ This paradigm was developed alongside the rise of electronic record-keeping and the "rediscovery" of the significance of provenance in archival science theory and practice—i.e. considering "records in context", rather than just describing their content, as core to value- and meaning-production in digital environments (Cook, 2007, p.401-3, 406-7, 414-15).⁹⁹ It adds emphasis on the importance of "the context, purpose, intent, interrelationships, functionality, and accountability of the record and especially its creator and its creation processes" (ibid., p.418). In other words, a shift in focus from "static cataloguing to mapping dynamic relationships" (*ibid.*, p.416), and in the case of the ArtBase a shift towards the notion of the network, consisting of nodes connected through specific protocols.

⁹⁷ See Archive.Rhizome.Org (2020). *Starrynight* (1999) referenced earlier in this chapter was one of these commissioned interfaces (see footnote <u>#88</u>).

⁹⁸ Aiming for comprehensiveness in an ever-expanding field has been identified as unsustainable, and staff members have suggested that: "the next phase should be that the ArtBase as a comprehensive archive of the field is over and we should have more micro archives—working in tandem and supporting other organizations" (Connor, 2018, cited in PhD Portfolio, Report #1, p.102).

⁹⁹ For a detailed account of the origin of the concept in contemporary archival science, see: Cook, 2007, pp.415-16. It is also worthwhile noting that Cook identifies Australian archival thinking in the 60s and particularly the work of Peter Scott and colleagues as predecessors to the post-custodial approach. Scott developed the concept of the series system approach versus singular records (or record groups) and shifted focus away from "things in archives" to the "idea of archives", and the interrelationships across multiple "series" of records and multiple creators, which Cook argues set the stage for the "post-custodial revolution" in archival thinking (pp.416-17).

Preservation tools, such as Webrecorder, already take an explicitly post-custodial stance in facilitating the creation of user archives, which can either be hosted on Rhizome's infrastructure, or remain on the infrastructure of its users whether that's private computers or other institutions' servers (Connor, 2019, p.6). Even the early provision for the submission of "linked objects" in the ArtBase was a form of post-custodial archival practice. However, a post-custodial approach does not have to simply mean that someone outside the archive institution is literally taking custody of the archival files. The position adopted throughout the design practice and development of the MDI framework is that others, besides institutional staff, are active agents in the processes of classification, maintenance and use in the archive, too. Thereby, they all play a role in the post-custodial account of the "the context, purpose, intent, interrelationships, functionality, and accountability of the record" (Cook, 2007, p.416). But what are the implications of Cook's proposal to focus on context and "mapping dynamic relationships" in terms of the Wikibase interface and its approach to cataloging data?

In light of evolving institutional conversations within Rhizome, the brief for the ArtBase redesign also considered the following question: Should the archive not only be accessible, but also editable by all; should users also have access to the administrative area of Wikibase? During the course of studies with users, those who were more familiar with the archive's history, questioned whether the archive should go back to its earlier open submission policies or adopt a new, authoritative position of historicizing (see Fig. 5.4; PhD Portfolio, Report #2). Discussions with Rhizome staff also raised the question of who should be deciding who gets to add/ edit/ remove data from the archive (see PhD Portfolio, Report #1, pp.103–105)?¹⁰⁰ Could a post-custodial

¹⁰⁰ A paper from the 2019 Museums and the Web conference argued that while the rest of the web has become increasingly participatory, most digital collections remain "online card catalogs" (Stimler and Rawlinson, 2019). The paper further proposed that platforms such as Wikipedia and Wikidata push user expectations to include "the ability to create, edit, and publish knowledge in real time", and hence "wikification" of online museum collections would "enhance the user experience as well as the cultural and intellectual vitality of cultural heritage" (p.2). The paper actually cites the ArtBase as playing a "unique role in the history of collections online", due to its early open read/write access (p.6). It is relevant to think how the early pioneering role of the ArtBase and this recent push for "wikification" or "participation" could inform a renewed policy for the ArtBase interface, without nostalgia for the past, nor complacency with current trends.

interpretation of collection management systems move beyond the dichotomy of all logged-in users having access to everything versus no one having access other than institutional staff?

When the database was officially closed for new contributions in 2015, staff members recalled that one of their concerns was that there simply was not enough diversity of voices in the archive, and instead it was dominated by a relatively small group of predominantly Western male technologists (see PhD Portfolio, Report #1, pp.17, 101– 105). Their impression at the time was that the only way to allow marginalized voices into the archive was to enforce stricter curation and to acquire works in the archive only by commission (*ibid*.). As Rhizome's curators, Aria Dean and Michael Connor, have noted in conversation—contemporary net art practices are different from practices in the past, and the artistic communities are also different (*ibid*.). The notion of a unified community building up a common discourse around a mailing list, such as Rhizome's early platform which later turned into the ArtBase, does not need to be replicated in the new system redesign. Further, that notion is also problematic, considering the concerns raised above about the homogeneity of artists and lack of diversity and representation of marginal voices in that community. So instead of reifying old tropes around community building, such as discussion forums and features for logged-in users only, the design of the new archival interface should look to alternative strategies.¹⁰¹

The redesign of the archive should accommodate a space where neither the authoritative voice of formal administrators, nor the interest in collaboration and cooperation among some of its users are precluded or inhibited. The authority of specific statements should continue to leave space for individual interpretation—through appropriate source accreditation and transparency around data classification and collection policies; whereas openness should not mean full public access to edits and changes, but instead strategic partnerships with commissioned artists or

¹⁰¹ Some staff members have expressed concern that an open ArtBase could lead to a situation where the majority of submissions come from men, and further: "Even if Rhizome are constantly staging edit-a-thons, those could never quite keep pace with societal bias which an open database could easily amplify—especially in this age, where any open platform is understood as a resource to be gamed, and those best at gaming it are often pursuing unsavory political projects." (Connor, 2019)

researchers whose work can help enrich the archive. Rhizome should take advantage of the native, built-in features of the Wiki software as a collaborative working environment, and follow models already established in other memory institutions, e.g., the way the Smithsonian have invited researchers to come in and enrich specific collections with data (Kapsalis, 2019), or the program at the Library of Congress to invite artists in residence into their archives (Library of Congress Labs, 2020). Similarly, Rhizome should invite trusted community members to edit and enrich the data based on their own research or oral history knowledge.¹⁰² Additionally, making available the download of data in a structured, machine-readable format offers opportunities for researchers to expand the work of the archive in other DH projects or for other archives to connect to resources available in the ArtBase by reconciling and ingesting the data.¹⁰³ These are just a few of the possible practices and policies the new archival system should consider adopting and implementing, in order to facilitate working relations among multiple communities of practice, rather than attempting to be a shared space which promotes the creation of one unified community of ArtBase users. The more the archive infrastructure and interface act as a hub-linking out and connecting with other archives,¹⁰⁴ building upon practices established among multiple communities¹⁰⁵ and using interface design strategies to facilitate collaboration across different communities,¹⁰⁶ the more likely it is to retain long-term sustainability.

¹⁰² This would be particularly productive for early-career researchers who might have gathered relevant data and are looking for ways to disseminate their research, but lack adequate DH infrastructure to do so. For example, the collaboration with Dr Karin de Wild, briefly discussed in Chapter 7, emerged from related conversations, and de Wild's interest in structuring the data gathered throughout her own PhD research into the history of net art as a networked online resource.

¹⁰³ There is an increasing interest in the GLAM community, particularly among those who are able to export and import data from and into their collections databases, and who maintain their own APIs, for 'metadata round-tripping'. This is a term used in Wikimedia communities to describe: "synchronization between the institution's collection database and the data about their collections that lives on Wikimedia sites" (Fauconnier, 2019). However, with the new strategies proposed with regards to the expansion of the Wikidata and Wikibase ecosystem to include multiple individual instances of the software maintained by small or large institutions, the potential for round-tripping is not limited to an exchange between a GLAM and Wikimedia, but could extend across any GLAMs running a Wikibase instance (or another LOD infrastructure with an open API).

¹⁰⁴ For example, the Wikidata platform, other authority control repositories, such as Virtual International Authority File (VIAF) or the Getty Art and Architecture Thesaurus, or other archives structured in linked data repositories (see Chapter 6).

¹⁰⁵ For example, software preservation, web archiving, linked open data, etc. (see Chapter 2).

¹⁰⁶ For example, timeline visualizations providing expanded context around artworks, self-descriptive ontologies, visualizations of pre-configured data queries, etc. (see Chapter 8).

Working through some of these policy-related questions while defining the redesign brief did not immediately lead to fixed design solutions. However, it was productive in opening up discussions and conversations during research sessions with staff and various user communities throughout the first phase of the fieldwork. These discussions informed the development of new methods for user research and engagement, for organizing workshops and utilizing prototypes, and subsequently devising the design specifications, all part of the MDI framework. Considering the role of users in participating (or not) in classification and maintenance activities either through direct intervention in the software infrastructure (e.g., through open submission forms or editing access in Wikibase), or indirectly via workshops and community consultation sessions, helped to articulate a critical standpoint for the MDI framework within the archive's network of relations (see Chapters 4 and 5). And further, Rhizome's reperformance-as-preservation paradigm and post-custodial policies informed the need to develop the provenance-driven data model (see Chapters 6 and 7), which would replace "static cataloging" with a process for "mapping dynamic relations" (Cook, 2007) enacted through various preservation-related, custodial activities involving staff, but also artists, collaborators and the broader user community of the ArtBase.

Part II. User communities: classification, maintenance and use

A complete description of all possible relations in the archive's network is beyond the scope of this thesis. However, the collaborative context of the case study—being able to switch between a position from within the institution (designer at Rhizome) and outside it (researcher at the university)—offered the opportunity to carry out user studies involving a range of user and stakeholder communities. In this part of the thesis, I discuss findings from the Discovery and Exploration Phases of the design fieldwork, in order to address two key questions for the MDI framing of the ArtBase redesign: first, how users matter in the ArtBase?; and second, how can standard user-centered HCI methods become more attuned to complex, dynamic networks of relations, rather than individual user experiences?

In Chapter 4, I start by problematizing the designer-user relationship, as conceived by standard HCI practice. In such a relationship, the designer is the translator, moving between the worlds of business and consumers, synthesizing user problems into accessible products by applying universal design principles (or metaphors).¹⁰⁷ Arguably, to be successful, this narrative is dependent upon operating within standardized scenarios, such as online retail experiences (Lohse and Spiller, 1999). Rhizome's online archive, on the other hand, presents a highly unconventional context. The ArtBase itself eschews easy classification, while its objects, net art works,

¹⁰⁷ The notion of universal design principles is often used colloquially in design teaching and literature to denote a general idea of "best practice". The concept actually derives from an influential 20th century design movement, which set out principles that purportedly make any design space (most often the built environment, but also digital and textual spaces) accessible to everybody (Habet, 2019). Only recently, critical design scholars, have traced the history and politics of this movement asking: "who counts for everybody" and whose marginalized, embodied experiences are designers choosing to account for or not? (see Hamraie, 2017). In the context of computers and user interfaces, universality typically relates to specific "metaphors", as computers are well-known "metaphor machines". The "user-friendliness" of an interface, and by implication its "accessibility", is predicated on how familiar the metaphors it uses are: from desktops and windows, to trash bins and floppy disks. An uncritical view towards metaphors continues to be a tenet in HCI textbooks even today (Chun, 2011, p.55). On the flipside, computers, and interfaces, also operate as metaphors "for the mind, for culture, for society... affecting the ways in which we experience and conceive of 'real' space" (*ibid*.). This proposition is explored in critical STS and software studies (see Chun, 2011; among others), but much less so in HCI and UX practice to the detriment of the critical development of these fields.

remain largely not canonized by museum and curatorial practice (Paul, 2009; Fino-Radin, 2011; Dekker, 2018;).¹⁰⁸ The agents involved in the maintenance and reperformance of the works, also, pose challenges to unambiguous classification from early grassroot artist collectives to in-house staff and contract collaborators, to researchers, academics, and other users. Therefore, not all matters concerning artworks, agents, and processes of classification, maintenance and use in the archive can be easily translated via a binary designer-user relationship.

To account for these more complex relational dynamics, I introduce concepts from the social sciences and science and technology studies (STS) such as communities of practice, boundary objects and infrastructural inversion, into the analysis of how user-centered HCI methods were applied, and modified, in this case study.¹⁰⁹ In Chapter 5, I propose that collaboration in the net art archive is possible without reliance on standardized HCI metaphors or design by consensus, but requires a new standpoint for the reflective practice. The standpoint of the MDI framework intersects the social worlds of different communities entangled in the archive's network of relations. From this standpoint, the boundaries around designers', users' and institutional stakeholders' communities are fluid and porous, enabling the translation and migration of metaphors and practices not-yet-standardized across different communities.

¹⁰⁸ Net art works continue to occupy a marginal category across various forms of classification, such as museum registrar systems, collection management metadata schemas, the art market. The specific issues that arise from this marginal status for information systems at large collecting institutions, e.g., SFMoMA, the Guggenheim and the Stedelijk Museum, have been studied and documented by researchers Karin de Wild (2019) and Dušan Barok (et al., 2019b), as part of their PhD research at the University of Dundee and University of Amsterdam, respectively. My conceptualization of marginal categories is based on Bowker and Star's theory of classification (1999).

¹⁰⁹ Some strands of user-centered design already experiment with a "hybridization" across the fields of HCI, social science and anthropology in order to study users and contexts of use in more holistic ways (Forlizzi and Battarbee, 2004, p.261). Bødker (2015, p.27) points to studies mixing concepts such as infrastructure and infrastructuring (Star and Ruhleder, 1996) with participatory design methods as a way of thinking about "networks of technological infrastructures and use situations", rather than individual user personas or user journeys. Even earlier, Nardi and O'Day (1999) introduced the concept of "information ecology", as a way to articulate the interconnected designer-user-product relations within HCI: "an interrelated system of people, practices, values and technologies within a particular local environment" (Forlizzi and Battarbee, 2004, p.266). However, much of this hybrid-method research is still applied to the design of "products and services that fit (intuitively) into people's lives" (Bell, 2001, cited in Forlizzi and Battarbee, 2004, p.266). In Chapter 4, I elaborate on why the concept of "intuitive" design ignores, or at best undermines, the agency of users and is not pursued by this research.

4 How users matter

In this chapter, I discuss various interpretations of the notion of a user and the designer-user relationship in the context of HCI, while drawing on relevant concepts from the STS field, in order to analyze the question of "how users matter" in the ArtBase (Oudshoorn and Pinch, 2003, p.3). The discussion does not only aim to highlight or critique the power relations and agencies involved in the practices of conducting user studies. It also aims to examine how applying user study methods and utilizing user data can inform design practice in ways that are not totalizing and instrumental but instead reflective of the complex entanglements of user communities and the archive infrastructure. Asking "who is the user?" is not a trivial question (*ibid.*). In fact, designers conducting user studies are engaged in processes of "classification" and "sorting", as defined by STS scholars Bowker and Star (1999), even before they begin their studies. Bowker and Star (1999, p.293-4) use the concept of communities of practice¹¹⁰ to unpack the wide-ranging implications of processes of classification to the development of information technologies specifically, and social order in general, wherein some categories (of objects and actions) come to be considered as natural or standard. The implications of classifications apply equally to communities of users developing particular patterns of interaction with software products, as well as to professional communities of designers "sorting" users into categories and over time developing standard classifications of who the users of a specific product/service are, and what forms of use of the product/service are considered acceptable. The problem with any form of classification, of course, is that standards oftentimes miss or obscure residual or marginal categories, categories that may not fit neatly or fall into a predictable pattern (*ibid.*, p.300-301).

¹¹⁰ Bowker and Star define a community of practice as: "a set of relations among people doing things together", which cuts across formal organizations, institutions and social movements (1999, p.294). They use Lave and Wenger (1991) and Becker (1986) as references to this understanding of the concept and use it synonymously with Strauss's concept of social worlds. This thesis also does not draw a significant distinction between the two concepts.

This is not to say that because the process of conducting user studies is flawed, it is therefore useless. Standardized methods are key to making any form of intersectional work, involving actors and objects from multiple social worlds, possible (Star and Griesemer, 1989, p.392). In the case of the ArtBase, the work of redesigning the archive interface intersects the worlds of interface design, software development, expertise in the domains of art and exhibition making, as well as art conservation, funding, public engagement, etc. The ArtBase is not unique in this case, all HCI projects, and particularly those concerning public knowledge resources or cultural heritage span a similar variety of social worlds. Standard methods for conducting user studies facilitate communication exchange across these worlds. The use of methods such as user interviews, online surveys, static and dynamic prototypes, A/B testing and more, in this research project, have enabled productive debate between myself in the role of the researcher-designer, Rhizome's in-house staff and the broader community of ArtBase users. However, paying attention to the conditions under which certain methods and tools in HCI-such as user personas,¹¹¹ user journeys,¹¹² user-friendly design, intuitive interface metaphors, etc.—are standardized, while others are marginalized, can provide for a more reflective reading of the data gathered via user studies and lead to more transformative applications of standard HCI methods. Such transformative applications address the question of how users matter, not only in the context of defining specific design requirements, but also in the context of the MDI framework wherein users matter as active agents throughout processes such as classification, maintenance and use in the archive.

4.1 What's in a name—users, personas, people

A brief look at the development of the HCI field and the emergence of distinct "waves" over the past several decades points to an arc of changing attitudes towards the notion of the user (Bødker, 2015). The first wave was heavily influenced by cognitive science and focused on studying "human factors", perceiving the user as a subject to be

¹¹¹ Personas are one of the most frequently used tools in HCI and UX (user experience) research, they aim to be "reliable and realistic representations of key audience segments" (Usability.gov, 2019a). They typically include information, such as: "fictional name", "job title", "demographics", "physical, social, and technological environment" (*ibid*.).

¹¹² A user journey is a series of steps which a user might take in order to interact with a design product. They aim to capture a user's goals, motivations, pain points and desired outcomes. They usually tie back to personas (Mears, 2013).

studied through "rigid guidelines, formal methods, and systematic testing" (ibid., p.24). The second wave is characterized as a move "from human factors to human actors" and focused on studying the collaborative practices of users within their work environment (Bannon, 1986). New "proactive" methods were added to the designer's toolbox-"participatory design workshops, prototyping, and contextual inquiries" (Bødker, 2015, p.24). Lastly, third wave HCI began around the time when computers spread "from the workplace to our homes and everyday lives and culture" (*ibid*.). This new wave focused on individual "experience and meaning-making" (*ibid.*). Throughout these 'waves', the term 'user' remained useful-either in the form of a test subject, a co-worker, or an owner of a home PC—'user' signified a relationship between a human and a computer interface. By the late '90s–early '00s, however, third wave HCI paved the way for UX or UXD (user experience design), a field of design research with roots in industry rather than academia.¹¹³ With UX, the focus of design research was shifting towards "the interactions between *people* and products" [emphasis added], even though 'user' was still part of the name of the field (Forlizzi and Battarbee, 2004, p.261). This shift is significant, because it indicates that UX is not, or at least not only, concerned with the working relationships between humans and computer interfaces, but rather more so with people, products and the marketplace.

The most universal tool in every UX designer's toolkit is the 'persona': a tool which classifies users, or rather 'key segments' of the target population into reified categories (for example, 35-year-old, US-citizen, female, artist, NYC-based, etc.).¹¹⁴ However, by segmenting users into distinct categories, this tool is prone to miss opportunities to acknowledge the multiplicity of users and use situations based on the fact that users can be members of multiple communities of practice.¹¹⁵ The findings

¹¹³ Don Norman is often credited as the first HCI expert to coin the term in 1993 when he became head of Apple's research group: "I invented the term because I thought human interface and usability were too narrow. I wanted to cover all aspects of the person's experience with the system including industrial design, graphics, the interface, the physical interaction and the manual." (Don Norman in conversation with Peter Merholz, December 13, 2007, cited in Lialina, 2016, p.139)

¹¹⁴ Practitioners have already raised concerns that personas are tools more suited to marketing than design, see for example Boag (2018).

¹¹⁵ Design researchers who specialize in this area of HCI methodology have pointed out that the success of the persona method depends on a range of criteria concerning the quality and thoroughness of the research and the depth of knowledge of how to use the method appropriately (Nielsen, 2013; Browne, 2011). But if the criteria for success is proper research, the measurement of success is market-oriented. In her contribution to *The Encyclopaedia of Human-Computer Interaction Design*, Lene Nielsen (2013)

from the ArtBase user studies suggest that archive users tend to be members of different communities of practice (artists, researchers, technologists) simultaneously, and so cannot meaningfully be reduced to 'personas' (see Chapter 6). What is more, the implication of 'personas' is that they represent people, not users. The focus is on their position in the world (vis-à-vis marketplace), not on their relationship with computer interfaces. A 'persona' conforms to certain demographic classifications, has personal interests and hobbies, presumably independent from the interfaces they encounter in daily life. But the encounters between users and the varied interfaces of net art artworks, which change and evolve over time, are not a trivial matter. These interfaces can be challenging, and users may require the cultural and technical understanding of specific social worlds, at a specific historical time, in order to make sense of the encounters. Thinking of users as 'personas' or 'people' fails to capture the interdependency, as well as indeterminacy, within such encounters between the social worlds of users and the networked infrastructure and plural interfaces of the ArtBase.¹¹⁶

The semantic shift from 'user(s)' to 'persona(s)', and people, is not insignificant, nor does it necessarily stem from one specific ideology. Critical designers and theoreticians wary of the reductive and narrow etymology of the term 'user' have argued for the use of 'people' over 'users' and 'citizens' over 'consumers' (Manovich, 2011; Dunne and Raby, 2009). The language of 'people' and 'citizens' become connected by these critical accounts to notions of care, and critical engagement with the world, whereas 'users' and 'consumers' are criticized for working within capitalist

quotes a Forrester study, which claims that "a redesign with personas can provide a return of investment on up to four times" (Drego and Dorsey, 2010).

¹¹⁶ It is worth noting that experts on the methodology (Nielsen, 2013) distinguish between multiple methods of developing and applying the 'persona' tool, so there is not only one uniform approach. Some methods can be more critically-oriented than others, but the argument here rests on the use of the tool in industry, not academia. The routine instrumentalization of personas in industry is exemplified in a recent statement from the design team at Spotify (an online streaming music service with over 200 million users globally), which elaborated on their use of personas for capturing "the needs, goals, habits, and attitudes of existing and potential users" in order to define the "problem space" (de Souza et al., 2019). The article gained immediate traction among the design community online (e.g., on Twitter). But behind the slick interface, and the colorful persona illustrations, the design team's article blatantly ignores the mounting criticism towards their service from academics and music journalists, not only in the way it mistreats artists, or reinforces gender bias, but also in the way it structures, and in essence creates, new paradigms of user behaviors towards listening to music, instead of meeting user needs (Batey, 2019; Pelly, 2019; Dryhurst, 2019).

narratives of production and market shares. For related reasons, anthropologists working within technology communities have also called for abandoning the impersonal and imperfect term 'user', in favor of a more socially-conscious 'people' (Roberts, 2017). At the same time, it has been widely reported how large platform providers in Silicon Valley have deliberately shifted their language from 'users' to 'people' in an effort to counteract accusations of the harmful effects of their technologies on users and communities (Meyer, 2014). When 'people' use Facebook, for instance, the social world of people is implied to be fundamentally separate from Facebook. Within such a narrative, Facebook is conveniently just a (neutral) tool people use to 'connect',¹¹⁷ while people are not impacted (or harmed) by this tool in any profound way. Critical of these implications, some researchers in the field of media and interface design studies have been less enthusiastic of replacing 'users' with 'people'. Notably, net artist and academic Olia Lialina locates the usefulness of the term 'user' in early computing history and instead of seeking to dismiss it as an embarrassing moment from an irrelevant and outdated 'man-machine' discourse, she argues passionately for its reinstitution (Lialina, 2012; 2016). She warns against the implicit agendas of terms like 'people' and 'technology', which at best fail to highlight the co-constructed nature of users and computers, and at worst actively seek to hide and obscure regimes of operation wherein the technology-providers have all the agency and users have none (ibid.). Lialina further links the use of the term 'people' over 'users' as an extension of the paradigm of 'transparency' pursued in HCI and UX design, wherein *people* are supposed to experience content intuitively, but not actually interact with it in a critical manner (see also Chapter 3).

This thesis adopts the terms user, and more specifically (user) communities of practice, instead of people. The latter actively obscures the co-dependency and co-construction of users and interfaces (Oudshoorn and Pinch, 2003). By itself 'user' also carries the implication of use without agency via its vernacular links to abuse or

¹¹⁷ Facebook's original motto "Making the world more open and connected" later changed to "Give people the power to build community and bring the world closer together" in 2017, which was justified from the CEO with the statement: "We have a responsibility to do more, not just to connect the world but to bring the world closer together" (Constine, 2017). This statement, however, did not openly admit the non-neutrality of the software infrastructure or the co-construction of its users, which were still referred to as "people", or "the world" in general.

addiction. But if users are perceived as various community groups sharing particular practices, their agency (or lack thereof) can be scoped in more granular, nuanced ways. The plurality of user agencies become apparent particularly through Bowker and Star's (1999) articulation of community membership and processes of classification,¹¹⁸ and further through the concepts of enrollment (into communities of practice) versus translation (between communities) (Star, 2007). Enrollment and translation are not totalizing processes, embracing one norm or standard at the expense of all others. Rather, they are "complexly woven and indeterminate" encounters, involving "multiple memberships, partial commitments, and meetings across concerns" towards the establishment of working conditions wherein collaboration and heterogeneity, in the sense of simultaneous co-existence of multiple standards, is possible (*ibid.*, p.100). This conceptualization of the working relations within and across communities of users is applicable to the case of the ArtBase archive, since a multiple-membership condition (Star, 2007, p.102), applies to everyone in the network of (human) agents surrounding the ArtBase archive, too. At the moment of action, whether carried out by designers, institutional staff members and other close collaborators, or users, agents in the network "draw together repertoires mixed from different worlds" and create "metaphors-bridges between those different worlds" (*ibid.*, p.102).

In the late '90s, the ArtBase administrators and primary users were all artists who were part of the emerging net art movement at the time. So, their repertoire of shared practices and standardized categories around online archive access and use would have been closely aligned.¹¹⁹ In less than a decade, these social worlds multiplied. New

¹¹⁸ According to Bowker and Star (1999), on an individual level, membership in a community can be described as: "the experience of encountering objects and increasingly being in a naturalized relationship with them"; on a collective level, "membership can be described as the process of managing the tension between naturalized categories on one hand and the degree of openness to immigration on the other" (p.295). Distinguishing between members and non-members of a community, therefore is closely tied to the question of classification, and how one may become naturalized to a particular classification system, in order to enroll into community membership.

¹¹⁹ The term repertoire is used in this thesis in a general sense, to denote the collection of practices and metaphors shared by a community of practice (Star, 2007, p.102). When used to refer to Rhizome's community, it is also used within a narrower, more specific understanding. Rhizome's team use 'repertoire' to refer to their own methods, tools, and exhibition case studies (e.g., Net Art Anthology) developed around the reperformance-as-preservation paradigm. Drawing on metaphors from the performing arts and traditional practices such as storytelling, Rhizome consider reperformance of a repertoire to be a way of recuperating and rehearsing "old knowledge about [net art] works and the network culture from which they emerged" (Connor, 2019, p.7)

administrators had become deeply embedded within institutionalized structures (the New Museum), there were new financial and marketing pressures on the organization, as well as new users including art students and academics, who were beginning to study the history of this new art form (Jones et al., 2006; Owens and Fino-Radin, 2012), which was not-so-new anymore.¹²⁰ More recently, with the expansion of the preservation program at Rhizome into software development (see Chapter 2), members of various technical communities around web archiving practices or software emulation, also, entered the mix of social worlds with a stake in the working conditions of the ArtBase's infrastructure and interface.¹²¹ Members of all these various communities contributing to the maintenance and/or reperformance of artworks can decode or restructure the metaphors utilized in the presentation of web archives, emulated artworks or archival metadata in the ArtBase into related, or altogether different metaphors based on their own repertoire of social memberships. Crucially, as findings from the user studies demonstrate, members of these communities do not rely solely on Rhizome to provide them with an intuitive experience (see PhD Portfolio, Report #2, and Chapter 5). Acknowledging that users can also develop metaphors that bring social worlds together provides opportunities to reframe HCI practice beyond a didactic exercise of studying users (or their personas) towards an instrumental development of intuitive interaction metaphors. Within the MDI framework, HCI methods are adapted towards dynamic co-creation, so that metaphors created or translated by various user communities also become part of the interface design process.

¹²⁰ Some key historicizing texts had already been published in the early 2000s, e.g., Paul, 2003; Greene, 2003; Stallabrass, 2003;

¹²¹ As an extension of the practice of this PhD, I led and participated in user study sessions with an adjacent web archiving research project utilizing Rhizome's tools at the V&A Museum, London, in 2017-2018. The studies focused on the collection of digital posters online, but despite different institutional contexts and subject domains, translation across communities was possible and productive (see Hawes, 2018; 2019). For example, the notion of the curator's involvement in the creation of a web archive as a subjective and performative act which defines an object boundary around the archive was developed during this project and later influenced decisions around the language used in Webrecorder's interface. There is ongoing work at Rhizome to build new tool extensions to support the work of curators specifically based on findings from that project, as well (Espenschied et al., 2020).

4.2 Questions of intuition, empathy and translation entangled in the designer-user relationship

The notion of the *intuitive* product, which is user-friendly and transparent to use (Doorley et al., 2018; Manser, 2016), is tightly coupled with the rhetorical and methodological shift towards designing for 'people', not users, and creating 'persona' classifications, and is worth unpacking further. The 'intuitive' and 'user-friendly' UX design paradigm depends on the notion of design empathy.¹²² The *empathetic* designer adopts user-centered design methods to better understand and empathize with the problems of users explicitly outside the (often privileged) social world of the designer. Proponents of design empathy argue that because UX designers have "detailed knowledge of users" (Forlizzi and Battarbee, 2004, p.266), gained through user observation, interviews and surveys, they can act as representatives of users at the business and strategy level (Bennet and Rosner, 2019). Despite more nuanced readings and development of the concept of 'empathic design' among academic HCI communities (Mattelmäki et al., 2014), the designer-as-representative paradigm, particularly as it is expressed in industry,¹²³ perpetuates power imbalance¹²⁴ and compounds agency in the design and product development teams and away from users. The designer-as-representative paradigm, the empathetic designer, as well as the designer using 'personas' to synthesize user goals and needs into intuitive interfaces, are all variations on an attempt at one-way translation. That is, translation of categories and (inter)actions that align with specific organizational views or policies for, or on behalf of users. This view leaves little room for nuance or complexity around the multiple-membership condition of ArtBase user communities and the possibility for users to draw on their own mixed repertoires of metaphors and practices in order to engage with the archive's infrastructure and interface.

¹²² The concept was first introduced in an influential Harvard Business Review paper by Leonard and Rayport (1997).

¹²³ For example, see Aronowitz (2018), or popular design-thinking toolkits such as IDEO's "Field Guide to Human-Centered Design" (IDEO.org, 2015) and the "Design Thinking Bootleg" (Doorley et al., 2018) from Stanford's d.school.

¹²⁴ Bennet and Rosner's (2019) critical design research focuses on user studies among people with disabilities and presents an incisive critique of the promise of empathy. The authors highlight how often empathy in design is valorized as an essential ingredient of "good design", yet is operationalized without "recognizing the range of emotional, political and historical relationships of which empathy is a part" (*ibid.*, p.2). Their study draws on feminist and post-colonial theories to argue for the need to shift understandings of empathy in design away from trying to 'put oneself in the other's shoes' towards a position that "foregrounds shared experience and historicity" (*ibid.*).

Translation across different perspectives

The tools of translation have been standardized within HCI and UX practice, but these tools fail to account for the existence of non-standard practices and categorizations. Standard user-centered design methods include running user studies and usability tests with interfaces which utilize specific interface and interaction metaphors: windows and desktops, menus and search bars. Much of this standardization work is needed for the work of information system development to happen at all (Star and Griesemer, 1989, p.392). But the ends to which these tools are deployed also matter. Too often the end goal is a system which standardizes a supposedly intuitive, 'natural' behavior (Scherffig, 2018, p.69), centered around naturalized categories, at the expense of other marginal or residual behaviors or categories. For example, a traditional museum's online collection interface typically relies on metaphors from the social world of physical institutions, such as the metaphor of web pages as (virtual) galleries and thumbnail grids as salon walls, where static image files are put on view for the contemplation of visitors (not users) (Fig. 4.1). The issue with such metaphors is that while they are naturalized to the extent that most users can easily work with them intuitively, they also fail to account for the presentation of other, residual categories of artworks, which may not be so easily-represented by linear media such as image or video alone.¹²⁵ Furthermore, relying on common patterns of navigation such as searching by keyword, or browsing by fixed category filters may be intuitive, but it precludes alternative ways of navigating complex data online. Therefore, the metaphors used in most online collection interfaces (and the underlying content management systems) facilitate a user-friendly, but linear and static experience (see PhD Portfolio, Report #3), which excludes non-standardized categories or practices in the encounters between users and interface. These metaphors do not meet the needs of the ArtBase, with its diverse user base and heterogeneous mix of not-yetstandardized artwork categories or variable reperformance interactions. In this case, being empathetic with diverse user communities or designing for intuitive behavior

¹²⁵ As one user observed during a user study, none of the recent ArtBase interfaces which utilized similar metaphors and categories to more traditional digital collection websites did justice to the original intentions of the archive: "What is the added value of the metadata offered by Rhizome? I like that they provide a sort of cache for the artworks and that a copy is kept in the ArtBase. What puzzles me is that the whole set of criteria seems very much coming from an art historical method. Isn't net art begging for something radically different? I was a fan of the experiments of Martin Wattenberg." (see PhD Portfolio, Report #2, p.68).

cannot resolve the metaphorical mismatches arising in an archive spanning multiple social worlds *and* temporally-sensitive standards.¹²⁶ What is needed instead are strategies that can facilitate enrollment and collaboration across user communities. Therefore, MDI frames the designer not as a central figure mediating and facilitating translation, but as a node within a network of cross-community communication and collaboration exchanges.

What is more, consensus is not necessarily a prerequisite for collaboration within such a network. The design paradigm premised on intuitive interaction relies on consensus among its users in order to produce operational systems. However, as Star has demonstrated in her research on working relations among different communities of practice, this is not a universal rule (2010, p.604). Nor does it need to be, if the design of the system is conceived as a space for collaborative learning and imagining, rather than a fixed artifact which "fits intuitively into users' lives" (Bell, 2001, cited in Forlizzi and Battarbee, 2004, p.266).¹²⁷ In a study of the relations among scientists, expert museum staff and non-expert volunteers in the context of a zoological museum, Star and Griesemer have conceptualized the possibility of cooperation across "social worlds which share the same space but different perspectives" by means of "nway translation" or in other words, translation across different perspectives (1989, p.412). In the context of the ArtBase, n-way translation is a useful concept to think with beyond the centralized one-way translation model of deducing user needs via user studies and translating them into interface metaphors, which then become epistemic norms. Designing with the explicit goal of facilitating translation across different perspectives allows for marginal categories and practices to co-exist with standardized ones.¹²⁸ This is significant within the grassroots archival system, built by

¹²⁶ These standards may relate to a number of entities in the assemblage which are sensitive to changes over time. Examples include standards for programming languages (e.g., updates across multiple versions of HTML resulting in deprecated parts of the language) or network protocols (e.g., the recent switch for browsers to serve and request data via HTTPS rather than HTTP); among others.

¹²⁷ HCI researcher Marc Steen (2013) has defined co-design as a process of "joint inquiry and imagination" drawing heavily on 20th-century American philosopher John Dewey's philosophical pragmatism. While Steen clearly articulates the many benefits of a collaborative process, he does not address the logistics or practicalities of what such a process entails, in order to be successful in achieving Dewey's concept for "positive change".

¹²⁸ From here onwards, when the term "translation" is used in this thesis it is meant to indicate n-way translation in the sense proposed by Star and Griesemer (1989). Of course, the different perspectives across which this translation happens are not infinite. There are still boundaries around the network of the

different generations of artists, as well as in-house staff members, wherein different standardized and non-standardized categories concerning art, software, networks, interface critique and more, are drawn together.

Analyzing how and why notions of intuition, empathy, and translation—as commonly understood in UX and HCI practices—are problematic for the ArtBase case study leads into the discussion of what alternative conceptualizations and methods might look like. Conventional categories are inevitably utilized differently across different communities and different institutions, and in the case of net art this process is complicated further by the lack of canonization of concepts, terminology and presentation paradigms. This does not mean that the design of the ArtBase should try to fit data into ill-suited categories in order to provide a user-friendly experience. Instead, the design of the archive could work to better inform users about the ways a particular institution, or community, has chosen to conceptualize certain categorizations, and *why*—aiming to render the internal workflows, processes and decisions which tend to remain invisible and inscrutable, more visible. In other words, this is pursuing the opposite of the transparent paradigm in UX design. In order to facilitate migration of concepts and enrollment across the different communities entangled in the network of the archive, and thus open up possibilities for translation across perspectives, I needed to develop several new fieldwork strategies as part of the MDI framework. These included coordinating user studies with the aim of enrollment in, rather than just observation of, some of the communities interacting with and contributing to the ArtBase archive, and using prototypes as starting points for crosscommunity discussions and collaboration.

archive, however fuzzy. The communities outlined in the user studies analyzed in Chapter 5 is where MDI proposes cross-perspective translation to be a meaningful method towards enhancing user agency in the archive.

5 User research in the context of the MDI framework

Due to the lack of any recorded user research data regarding the ArtBase prior to this project's launch,¹²⁹ my initial user study sessions aimed to gather broad contextual information and answer questions, such as: 'Who are the current ArtBase users?'; ¹³⁰ 'How are they using online archives in general and the ArtBase specifically?'; 'What roles are online digital archives expected to fulfil and why?' (see PhD Portfolio, Report #2). I focused on using open ended questionnaires and semi-structured interviews, and facilitating informal discussions, rather than empirical lab testing sessions. My aim was to explore problems associated with an archival interface which relies on few established interface metaphors, rather than test the usability of a specific design solution.¹³¹ In addition, my decision to open the Discovery Phase of the fieldwork with such broad questions was based on a hypothesis that the user base of the ArtBase is more diverse than it may seem at first glance; that it is no longer a homogeneous artist-led community. This hypothesis included the notion that a user-friendly approach pursuing universal metaphors would not be well-suited to diverse communities, because a metaphor or interaction that is 'friendly' to some users may seem at best unfamiliar, and at worst uncritical or unsatisfactory to others. The findings from the studies confirmed that indeed users are diverse and come from

¹²⁹ Apart from anecdotal summaries in some internal reports and blog posts (Smith, 2008; Fino-Radin, 2011; McKeehan, 2016b), there has been no systematic research of users of the ArtBase conducted by Rhizome to date.

¹³⁰ The discussion in this chapter is mindful of the limitations of the gathered data and the fact that it does not and cannot represent all communities. Multiple marginal voices are bound to remain out of the reach of this study. Working with an awareness of the limitations of the study, I benefitted from the relative lowcost and flexibility for conducting qualitative studies with small groups because multiple sessions could be conducted over a relatively short period of time, while engagement methods and questionnaires could be honed and iteratively refined after each session.

¹³¹ Even though large-scale quantitative studies were not deemed appropriate to my research question, the pragmatic approach I adopted towards the number of users to contact and how to communicate with them bears several limitations worth noting. Firstly, the small sample size of the groups may rule out the broader validity of the results, particularly as the diversity of the participants was limited to people within the network of the researcher and/or Rhizome's community reach, as well as people who have the time and availability to dedicate to participation without being compensated for that time. There was an effort for a balanced gender representation among research participants. However, the equal representation of people of color and people from nationalities other than the US or Western Europe was harder to achieve, in part due to the systemic lack of diversity in the cultural sector, and in part due to the lack of wider recruitment resources.

different communities of practice, but more significantly, results indicated that users also share multiple community memberships to different communities at the same time. These findings offered opportunities to think about user agency beyond the user-friendly, transparent paradigm commonly deployed in UX and HCI contexts, and its linear understanding of the process of translation within the designer-user relationship.

In the Design Exploration Phase of the fieldwork, I developed prototypes which did not aim to be intuitive, but could serve as a starting point for discussion among users. During the Design Specification and Evaluation Phases, prototypes and discussions became tools for enrollment: enrolling various users from different user groups into the multi-membership social world of the archive. Lastly, workshops and other user sessions, community meetings and summits, helped my own enrollment into other communities intersecting across the network of the ArtBase. Developing the MDI framework throughout these phases and activities, I refined my original hypothesis about ArtBase users into a new proposition: the multi-membership condition was, in fact, key to facilitating greater user agency in the archive and the translation of categories and metaphors across communities.

5.1 User studies of standardized vs non-standardized community practices and categorizations

5.1.1 Multivocal communities

The following analysis of research data foregrounds the multiplicity and multivocality of user communities in the ArtBase that became evident even in a small number of studies with a total of just under 80 participants, and pays attention to the residual categories and marginal practices that exist outside established conventions.

A preliminary set of user research sessions were conducted in the summer/autumn of 2017. These drew on contacts from within Rhizome's network and my research group at LSBU. The intention was to recruit a mix of artists, academics and curators in order to evaluate the two most recent iterations of the ArtBase interface. The sessions were conducted partly in person, partly remotely, and involved completing a set of tasks

within the ArtBase interface followed by a structured interview.¹³² In the end, the seven participants who took part in the sessions were exclusively academics and researchers. The study yielded data, which was valuable in confirming assumptions about problems with the usability of the archive interface, but due to the highly scripted nature of the sessions, there were few genuinely surprising or unexpected contributions from the participants. Learning more about who the users of the ArtBase are and how they use online archives, with a view beyond simply fixing a few existing usability issues within the ArtBase interface, required a different approach. In the Spring of 2018, I posted an online user survey on the ArtBase website and promoted it throughout Rhizome's media channels (Rossenova, 2018a). The survey asked only a small number questions and gathered quantitative and qualitative information about which communities of practice users affiliate with, and what their reasons for visiting the ArtBase were. The survey received over 50 responses. A sample selection of respondents representing different user communities, based on the results of the survey, were contacted and invited to participate in a follow-up study involving a longer semi-structured interview which was conducted remotely.¹³³ The interview questionnaire aimed to gather responses about users' online habits more generally, rather than focusing solely on the ArtBase. Participants were asked questions about their experiences of other online archives, including but not exclusively focusing on born-digital art. They were also prompted to discuss ideas around institutional policies in online archives, building context around archival objects, and asked further questions which probed into patterns of navigation and use of metadata that may or may not be standardized within certain communities of users.

Following an initial data analysis of these studies, no clean-cut personas or patterns of use emerge. The data from the multiple-choice online survey posted on the ArtBase website suggested that roughly 50% of current visitors to the ArtBase identify as artists; but these users also identify with multiple other categories, such as technologist, student, researcher or academic, etc. (see PhD Portfolio, Report #2, p.12) Other respondents who did not select the artist category, also tended to select more

¹³² See PhD Portfolio, Report#2, pp.20-21; 63-84.

¹³³ Nine out of 12 invited participants took part in this study (see PhD Portfolio, Report#2, pp.16-19).

than one option under the "field of work" question.¹³⁴ Similarly, the responses to "reasons for visiting the ArtBase" often included more than one option, spanning from research on internet art, browsing for inspiration, to conducting research on digital preservation. These preliminary results indicated that ArtBase users often affiliate with multiple community memberships and may have more than one goal when visiting the archive. Participants who accepted my offer to take part in the follow-up study also identified as belonging to several communities, with more than half (five out of nine) combining an art practice with an educational or institutional research position (see PhD Portfolio, Report #2, p.16).

In addition to these studies, 30 artists (and some artist collectives) were also invited to participate in more in-depth, semi-structured interview sessions.¹³⁵ The purpose of these additional sessions was to gather data not only about use-cases for artists visiting the archive, but also to consult artists about how they might want their work to be presented in the archive. Only six participants took part in the sessions in the end, and some of these did not complete the whole study, but a shortened version (see PhD Portfolio, Report #2, p.25;87–88). It is possible to speculate that practicing artists do not have the time to participate in an hour-long study session. On the other hand, because the archive has not been open to submission of new work, many of the artists who are otherwise active in the Rhizome community (by being profiled in articles or commissioned for exhibitions) might simply have less interest in a largely historic archive. If the ArtBase is to reengage the community of practice of contemporary studio artists, Rhizome would need to reconsider how the archive can be better integrated into their cultural program as a whole, and how it can be reactivated as a communal space. This would require further research into systems of classification and patterns of engagement with digital archives that are standardized versus those that are not among artist communities, which could not be achieved in the limited

¹³⁴ Of 54 respondents in total, only 15 selected a single category to describe their field of work, and only one of them chose the "artist" category (see PhD Portfolio, Report #2, p.12).

¹³⁵ The selection aimed to be as diverse as possible, while remaining within the approximate boundary of Rhizome's artistic community, and included a mix of established and emerging artists. But they were all artists with active studio practices, as opposed to the students or academics which were surveyed in the previously discussed studies. The selection included both artists who had been involved with the archive from its inception, as well as artists who may not have artworks in the archive, but had previously been profiled on the Rhizome blog and/or had been commissioned for special events or exhibitions organized by Rhizome.

study sessions conducted as part of this project's fieldwork. However, the notion that the archive must address the needs of any one narrowly-defined community is still tied to HCI paradigms that pursue intuitive interactions and user-friendly metaphors. With the MDI framework for the redesign of the ArtBase, I propose an alternative view, one wherein all users who interact with the archive share multiple-community memberships by default. In this view, findings from the user studies can lead to propositions for further design exploration, even if a single user community is less well represented in the results.

5.1.2 Institutional contextualization towards bridging community and generational divides

In the reflective report documenting the user studies, findings are interpreted in the form of 'user stories' (see PhD Portfolio, Report #2). Given the plurality of community memberships that the initial studies pointed to, solution-oriented tools for analyzing and making sense of the data, such as user journeys or scenarios were considered less suitable, as these tend to rely on the categorization of users into specific personas.¹³⁶ User stories, on the other hand, typically record a single objective a user might have and one or two reasons behind it, without focusing too much on details of the user's persona or how their objective will be achieved (Government Digital Service, 2016). They are a useful device in highlighting aspects within the design of the interface that need addressing, without prescribing how to do the design—user stories rarely describe situations that move users from interaction A to interaction B.¹³⁷ Studying these stories highlighted ongoing discussions within heterogeneous communities of

¹³⁶ Scenarios describe the stories and context behind why a specific user or user group needs to use the interface, what their goals are and (sometimes) define the possibilities of how the user(s) can achieve these goals (Usability.gov, 2019b).

¹³⁷ The stories included in the report were developed based on direct quotes from users given in surveys and interviews, but rewritten in the standard format of a story card: "*As a...* [who is the user?], *I need/ want/ expect to...* [what does the user want to do?], *so that...* [why does the user want to do this?] (*ibid.*) (see Fig. 5.1). It can be argued that the story card format for research data analysis is also an attempt on the part of the designer to sort users into groups such as 'researchers' or 'artists'. However, users were not profiled into a limited set of predicted behaviors based on their community affiliation. As a textual and graphic device, user stories do not seek to subsume individual opinions into a seamless user journey. They recognize that user objectives may change over time from one type of activity (learning about net art) to another (researching preservation standards), due to changes in the community memberships or experience level of the users.

practice, which in turn became helpful points of departure for the themes to be explored in more depth in later sessions involving design prototypes.

User stories and the community affiliations of the majority users who participated in the surveys and interviews of the fieldwork suggested that as a historical artifact, the recent closed instantiation of the ArtBase held more value to researchers, students and archivists than to Rhizome's grassroots community (Fig. 5.2). Increasingly, users who may have only known about the archive for a few years were using it as a resource to access artworks which can no longer be found anywhere else (see PhD Portfolio, Report #2, p.29). If Rhizome accept that their most active users are members of multiple communities of practice including education and cultural heritage, as well as studio art, then the archive needs to engage in a discourse around data historicization, contextualization and preservation largely absent from all previous instantiations of the ArtBase interface (see PhD Portfolio, Report #1, pp.31–37). The perspectives expressed in story cards, such as the examples in Fig. 5.2, indicate the need for Rhizome to take a stronger institutional stance on the role of the archive in relation to the rest of their programming and infrastructural platforms. This relates to how the ArtBase is integrated (or not) within the main rhizome.org web space, but also in terms of how the archive can be historicized through narrative texts, mission statements, as well as data provenance. While the institutional focus has shifted to preservation over the past few years, the information on official institutional channels has remained ambiguous with regards to the role of the ArtBase in relation to this shift (see PhD Portfolio, Report #1, p.101).

The interest in institutional positions, origin and provenance of the data in the archive that is expressed in user story cards can be attributed to a user base affiliated with communities of practice engaged in critical discourses in contemporary scholarship focused on archives, institutional operations, and the politics of databases (Fig. 5.2, 5.3). However, there is no evidence that the current ArtBase user base is more interested in postmodern critical and archival theory than previous user communities. Discussions with users during the study sessions following the open online survey, suggest that many current users are less naturalized to the original archival vision. Seven out of nine participants in that study had only been using the archive for the

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past 2–3 years and were unaware of its grassroots history and earlier mission statements (see PhD Portfolio, Report #2, p.47). Several participants posed questions about logins and data access, and the apparent lack of social features (*ibid.*, p.51). Such questions speak to a user base unaware of the vibrant community that not only shared and discussed artworks via Rhizome's mailing list, but also submitted all the data currently populating the archive (see Chapter 1).

Findings from the user studies suggest that users in the ArtBase belong to multiple heterogeneous communities, whose practices and conventions evolve depending on shifts in contemporary discourse, as well as the make-up of the socio-technical structure of the archive (for example, moving from an open grassroots community to a historical resource). The needs and interests of the artistic community may not always be contrary to the needs of the scholarly community, and vice versa (Fig. 5.2, 5.4). At the same time, the way that an artist, a researcher or a student conceptualize access and interaction in the net art archive may be very different based on experiences within their communities, even if those communities overlapped to some degree at various times. In this context, an approach that privileges user agency over user-friendliness would need to be more explicit about the act of choosing certain categories or metaphors over others. It would also encourage active participation in the translation and migration of categories across communities.

As a key strategy of the MDI framework, engagement with heterogeneous, multivocal communities—on the part of the designer, as well as the institution—involves not only responding to requests for specific features or metadata categories, but also communicating relevant aspects of the history of the archive, so that current communities of users can better understand the concerns and practices of past users. Being aware of what forms of interaction and archival use may or may not be standardized within certain communities, also involves studying existing archival and collection interfaces on the web, in order to better understand the influences on current users' expectations of archival interactions (see PhD Portfolio, Report #3). An analysis of user stories of multiple-memberships, alongside an analysis of common digital archive interface metaphors and patterns of interaction, informed the design the new ArtBase prototypes, which aim to subvert the user-friendly paradigm, without

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being user-unfriendly either (Drucker, 2013, para 34). During the Design Exploration Phase of the fieldwork, I did not refer to popular interface patterns as benchmarks for user-friendliness. Instead, I used familiar metaphors as bridges for translation and migration of categories that may not be standardized across all communities (yet). For example, Rhizome's reperformance paradigms including web archives and emulated environments were not yet standard practices across all user communities (PhD Portfolio, Report#2, p.56–57). Buttons with color-coded icons, timelines, information boxes and tool-tip pop-ups designed into low-fidelity wireframes (<u>Fig. 5.5</u>) and later clickable prototypes (<u>Fig. 5.6</u>; See also PhD Portfolio, Prototypes), are all standard graphic devices which were used to engage users in discussions and processes of translation during the workshops and evaluation sessions following the initial user studies.

5.2 Reflective design prototypes as boundary objects

5.2.1 Prototypes

Following the initial data analysis and the assembly of user stories, several prototypes, as well as visualizations of the ArtBase data model, were developed and tested iteratively with users in two in-person workshops and several remote evaluation sessions (see PhD Portfolio, Report #4). Prototypes are well established HCI and UX design tools deployed not only to test the feasibility of design concepts, but also to facilitate communication between designers and users. Oftentimes prototypes are framed as tools for collaboration and translation between stakeholders and production teams, or between end-users and stakeholders (Mason, 2015, p.395, 396, 406). The commonplace narrative, linking smooth collaboration, translation and flexibility to prototypes is dependent on consensus—by communicating ideas via a prototype, designers, stakeholders and users should be able to reach a consensus.¹³⁸ In contrast, within the MDI framework and the heterogeneous context of the ArtBase redesign, I conceptualize prototypes as *boundary objects*, facilitating translation across multiple perspectives and communities of practice. Introduced as a concept by Star and Griesemer in 1989, boundary objects are flexible and ill-structured—objects "at once material and processual" (Star, 2010, p.604), which users of different communities can

¹³⁸ Design researcher Marco Mason uses the term "best compromise" to describe a prototype that "satisfies all the stakeholders involved" (2015, p.394).

interpret and use without consensus.¹³⁹ Using prototypes as boundary objects was a key strategy of the MDI framework for opening up discussions around what access to an artwork, or an artwork variant, means; how different types of variants are classified; and what can be considered provenance, or other forms of contextual information, around the works. In addition, as well as testing complete prototype designs, the workshops included co-design sessions during which participants were invited to prototype and discuss their own variations on the archival interface.¹⁴⁰ Seeing specific classifications or visual metaphors committed to paper mockups or low-fidelity digital artifacts encouraged participants (and designer) to debate where these converged or departed from their own communities' standards and norms, and whether that was an obstacle or not to understanding, translation and possible adoption of new norms. Consensus, or total agreement, was not necessary for participants to be able to make sense of and critique the design prototypes or the usergenerated mockups. Through these workshops and subsequent remote evaluation sessions, users from different communities of practice shared their practices with me, in my role as designer-researcher, but also among each other. Thus, the prototypes not only communicated ideas in one-directional exchanges between designer-user or designer-institution, but also facilitated the exchange of ideas as part of a collaborative learning process across user communities and institutional stakeholders.¹⁴¹ In the context of the ArtBase redesign, discussions around what types

¹³⁹ Following Star and Griesemer's definition of boundary objects, they are crucial tools for effective collaboration to occur within the multiple-membership community context of the ArtBase: "They have different meanings in different social worlds but their structure is common enough to more than one world to make them recognizable, a means of translation. The creation and management of boundary objects is a key process in developing and maintaining coherence across intersecting social worlds." (1989, p.393) ¹⁴⁰ The co-design sessions used the cultural probes method outlined in the Introduction (Gaver et al., 2004, p.53). See also PhD Portfolio, Report #4, pp.34-40,46-50.

¹⁴¹ The concept of boundary objects is already used in information science research and literature, but its use tends to focus on its "explanatory potential" (Huvila et al., 2016). As a recent literature review of the use of the term in the field establishes (*ibid.*, p.21): "Thinking about the concept can make us more sensitive to how individuals, communities, and things interact on the levels of artifacts, practices, and their epistemic premises, and how these interactions have implications for their respective positions in mutual context." In their recommendations for further research, the authors of the review suggest that thinking with this concept can be developed even further, particularly when combined with "bridging and spanning of boundaries" across other disciplines (*ibid.*, p.22). In my case study, I conceptualize prototypes as boundary objects, not only to explain, but to actively support the bridging and spanning of boundaries different user communities. In this sense my use of the term "boundary objects" and the method of prototyping aims to have "world-making effects" (Puig de la Bellacasa, 2011, p.99). See also Section 5.3.2 in this chapter.

of data and metadata are collected in the ArtBase, how these are stored and then presented via the user interface, were key to this collaborative learning process.

5.2.2 The category of provenance

Conversations with users both within and outside Rhizome revealed a "fascinating ontology" of ongoing negotiations about what Bowker and Star generally refer to as "the minutiae of classifying and standardizing" (1999, p.44). The question of what constitutes the artwork's provenance is a particularly relevant example of the tensions that arise between standardized and non-standardized categories across various community standards of categorization, and how these impact the design of the archival interface and infrastructure. As the ArtBase is a "hybrid" archive whose objects both consist of and are described by data (see Chapter 1; Graham, 2014), the question of the provenance and history of that data is deeply entangled with broader questions of concern to the MDI framework. Namely, how is data classified, maintained and used by various agents in the network of the ArtBase over time? As discussed in Chapter 2, these agents are both human (Rhizome staff, collaborators, artists, users) and machinic (classification standards, metadata ontologies, database infrastructure, network protocols, among others).

The question of what constitutes a net art work's provenance, and whether the term provenance was used appropriately within the interface of the prototypes shared during workshop activities, proved divisive, particularly among users coming from a museum studies or art historical perspective compared to those with an archival training (see PhD Portfolio, Report #4, p.52–3). Within a traditional art historical context, provenance is associated with a history of ownership and custody of a piece of art (Rossenova et al., 2019); it serves as a means of "validating" an artwork's authenticity and its market value, as one user observed during a workshop (see PhD Portfolio, Report #4, p.52). However, what does that mean when the work is an assemblage of socio-technical components and processes? Is it still possible to refer to provenance of net art in the narrow sense of ownership and collection? For example, the Guggenheim Museum has collected the work *Brandon* by artist Shu Lea Cheang, and so the provenance of that work can be traced to the museum. But a more detailed and nuanced research of the history of this work would reveal a much more complex

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story, one wherein different elements of the work's assemblage have entangled and ambiguous histories of production, maintenance and long-term care (or lack thereof) (Dekker and de Wild, 2019). Should all that information not be recorded as part of the provenance of the work in an archival record too? Does it make sense to call this type of information provenance at all, or would a different term be better suited in the context of the ArtBase?

The prototypes developed for user testing and co-design workshop sessions aimed to provoke discussion around these questions rather than provide finished solutions. Different versions of the prototypes were iteratively developed following feedback during these sessions. Users acknowledged that the implicit values embedded in a more traditional understanding of provenance may no longer be applicable to the context of a performative, networked artwork, because these values are predicated on an understanding of the artwork as a fixed object. Although not everyone considered it necessary to expand their understanding of provenance outside the standard categorization accepted in their fields or their home institutions,¹⁴² users with affiliation to archival communities were more open to non-standard uses of the term in the design prototypes.¹⁴³ In the field of archival science, the less clearly defined boundaries of objecthood around series of archival documents, particularly when these began to be produced in digital formats, resulted in a reevaluation of the context around records and the role of archivists (Cook, 2001; Hedstrom, 2002; Millar, 2010; Yeo, 2013; among others). Actions performed by archivists began to be regarded as subjective and part of a framework of invisible relations, which should in fact be made visible to archive users within an expanded understanding of provenance (Cook, 2001, p.21). The prototypes presented as boundary objects during workshop sessions followed a conceptual approach to provenance close to these discourse developments

¹⁴² One user noted: "I am still not quite sure if the expanded use of provenance works for me and is clear for different user groups. Within a museum, art history and art market context provenance is strongly associated with ownership history. Why not call it preservation narrative?" (see PhD Portfolio, Report #4, p.53).

¹⁴³ One of the users who subscribed to an expanded provenance conceptualization, noted the similarity between their mock-up developed as part of the group co-design exercise and the design prototype presented during the testing sessions: "we envisaged the structure for provenance data as similar to that used in the prototype, where a sequence of actions, associated with a series of individuals and anchored to particular moments in the timeline were readable as a plotted history of the object's active and archival lifespan" (see PhD Portfolio, Report #4, p.53).

in archival science theory (see Chapter 7). I propose that this approach is relevant in the case of the ArtBase, because the needs of a net art collection are conceptually and materially closer to the needs of archival institutions wherein born-digital materials are increasingly collected and cared for, than to the needs of museums wherein the bulk of their collections remain physical objects. What is more, even if it is more closely aligned to one community of practice (archivists) than another (art historians or museum professionals), the conceptualization of provenance proposed in the prototypes does not need to be universally accepted or deemed useful by all users in order for collaboration, or translation to occur.

Using prototypes and hand-made mockups during co-design sessions as points of departure for negotiations around the concept of provenance, as well as other contentious categories, highlighted how mismatches across community standards went beyond mere linguistics and arguments on wording. User engagements with the prototypes and amongst each other pointed to the great variety of ways, sometimes unconscious, by which users come to naturalize some categories over others, particularly when users belong to more than one professional community of practice and have different levels of experience with various knowledge systems.¹⁴⁴ It is unrealistic to expect full consensus on all categories across multi-membership communities, but mismatches in category conceptualizations do not necessarily prevent collaboration or communication across communities. Following the workshop and evaluation sessions, explicit references to the term 'provenance' were removed from the interface prototypes. However, all the data related to an expanded understanding of provenance including various acts of preservation or intervention in the history of the work which was output via the interface was modelled on a data provenance standard, called PROV (see Chapter 8). This standard included an ontology and a model of relating metadata within the database which users could trace, explore and query within the framework of the linked open data infrastructure underlying the new prototype. Thus, users wishing to engage with and explore the archive in moredepth, could expand their community memberships by gaining familiarity with new

¹⁴⁴ The conscious and unconscious processes of negotiation and classification within communities have been well documented by detailed ethnographic studies such as Star's (2007) study of the operationalization of "sameness" at fast-food franchises like McDonalds, and Bowker and Star's (1999) study of classification in healthcare information systems.

metaphors and categorizations, or patterns of interaction (including online provenance and linked data ontologies, among others), without renouncing their own memberships to other communities, such as art history, museology or archival science to name a few. Within the MDI framework use, user engagement and user collaboration as processes operate on an infrastructural level, not just the surface of the visual graphical display. Therefore, the interface prototypes in their role as boundary objects are only one element of a more complex network of relations that involves data modeling and database infrastructure.

5.2.3 Boundary infrastructures

In Sorting Things Out, Bowker and Star extend the concept of boundary objects to entire infrastructures—"boundary infrastructures" are sets of "working arrangements" that deal with "regimes of boundary objects", but are more structured and "do the work that is required to keep things moving along" (Bowker and Star, 1999, p.313). These infrastructures are "not perfect constructions", but they are preferable to "the chimera of a totally unified and universally applicable information system" or "the chimera of a distributed, boundary-object driven information system, fully respectful of the needs of the variety of communities it serves" (1999, p. 313). If individual prototypes and data visualizations are perceived as boundary objects, then the redesigned ArtBase as a whole can be conceptualized as boundary infrastructure. As part of the development of the MDI framework, the redesign of the ArtBase's data model, database infrastructure and frontend interface did not seek universal terminology and visual metaphors which were equally accessible to all users. Instead, clearly signposted explanations of the data classifications, maintenance processes and access policies in place in the archive, and the choices behind them, would continue to support translation across communities, even after the prototypes were developed into a functional, and relatively stable, archive interface. The prototypes, interviews, workshops and evaluation sessions which comprise the fieldwork with users do not represent a great departure from standard HCI methods. However, analyzing the findings with the aim of facilitating translation within the conceptual framework of a boundary infrastructure, rather than aiming for a final solution based on consensus, or a best compromise, was a departure from established design practice.

5.3 Enrollment across community boundaries

If community enrollment begins with the naturalization of specific categories and practices common to a specific social world (Bowker and Star, 1999, p.295), then activating prototypes to act as boundary objects during workshops and evaluation sessions aimed to facilitate users' enrollment across different communities. But the fieldwork also facilitated my own enrollment into the social worlds of users and institutional stakeholders. This enrollment was necessary in order for me to be able to iteratively refine the data model and the interface of the ArtBase while reflecting on which processes and categories associated with classification, maintenance and use in the archive are naturalized across relevant communities and why. For example, particular user interface metaphors were naturalized in some communities largely because they draw on users' knowledge and frequent use of other art archives of digitized objects, although not born-digital art. Therefore, instead of adopting the same metaphors, the redesign of the archive could explore alternatives that were better suited to the ArtBase context, yet remained within reach for translation. In addition, the collaborative partnership with Rhizome involved enrollment into their particular view on preservation tools and associated infrastructure, which influenced decisions related to the data model and interface that directly impacted users.

5.3.1 Rhizome's repertoire of standardized practices and community enrollment

The embedded research at Rhizome and close collaboration with their preservation team was a key strategy for recontextualizing the relationship between designer and institutional stakeholders. Instead of performing the more traditional relationship of service provider and client, there was a mutual interest on the part of the designer and institution to draw a joint community membership around the ArtBase archive. Rhizome's preservation program of activities aimed also to enroll archive users, institutional and individual collaborators into loosely structured, but interconnected communities of practice around the Webrecorder project, Emulation-as-a-Service, and the Wikibase linked data repository: all sharing the common goal of preserving digital cultural heritage. Between 2017–2018, Rhizome organized several international events bringing together practitioners, researchers, and members of various communities of practice, including open source software development, (web)
archiving, data science, art and art history, law and ethics, among others, to discuss critical questions around the need and context of developing web archiving tools, or using linked data platforms.¹⁴⁵ In addition, the preservation team was engaged in conducting various collaborations with research and/or art institutions.¹⁴⁶ These efforts were directly connected to Rhizome's pursuit of the reperformance-as-preservation paradigm, and the move towards a post-custodial approach in their programming and archiving work (see Chapter 3):

[...] Rhizome's larger efforts to put preservation tools in the hands of other users and institutions [make] the archiving of net art and network culture a truly distributed project. (Connor, 2019, p. 6)

Because of these institutional policy developments, much of my own research within the organization involved meetings and workshops with the preservation team, as well as the broader digital preservation communities Rhizome were engaging with.¹⁴⁷ These communities have an established discourse of metaphors and standards around the areas of preservation pursued at Rhizome such as data management, software emulation and web archiving, which I became familiar with through community involvement. But Rhizome's team were also developing their own practices and standard procedures, attuned to the particular context of the net art archive and the properties specific to born-digital artworks.

Rhizome's digital preservation program was focused on establishing a repertoire of standardized methods that would serve the daily needs of Net Art Anthology project and address access provision issues in the ArtBase in the long-term (Espenschied and

¹⁴⁵ These events include: the symposium *Digital Social Memory: Ethics, Privacy, and Representation in Digital Preservation*, 4 February 2017 (New Museum, 2017); the conference *National Forum on Ethics and Archiving the Web*, 22-24 Mar 2018 (EAW.Rhizome.Org, 2018); and the Wikibase Summit, 19–21 Sept 2018 ('WikiProject Wikidata for research', 2018).

¹⁴⁶ These include collaborations with the researchers at the University of Freiburg for the development of the Emulation-as-a-Service (EaaS) project (see Chapter 2). Other collaborations include The New York Art Resources Consortium (NYARC), who have been using Rhizome's web archiving tools since an early pilot study in 2015 (Kempe, 2016). In addition, LIMA, a Dutch media art organization, is working with Rhizome to launch their own containerized browsers presentation platform (presented at Lives of Net Art, Tate workshops 4-5 April, 2019). Other large institutions, such as The British Library, V&A and Tate Modern have also conducted pilot projects using Webrecorder workflows established by Rhizome. Representatives from these institutions have participated in the user studies I organized in 2018 and have shared perspectives on adopting these workflows and practices.

¹⁴⁷ A list of relevant events and participation documentation is provided on the PhD Portfolio site (ArtBase Redesign Documentation, 2021).

Moulds, 2019, p.433). These methods drew on developments in professional and hacker¹⁴⁸ communities specializing in software preservation, born-digital and web archives, as well as digital curation and fine art conservation, but did not rely on any one theory or ideology, nor was such theoretical alignment necessary for the productive collaboration between Rhizome staff and members of different communities. Rhizome's team attained a range of allies and resources from different social worlds by rallying around a "weakly-structured" and "weakly-constrained" common goal (Star and Griesemer, 1989, p.409), namely preserving digital cultural heritage.¹⁴⁹ The interaction practices and interface metaphors Rhizome developed within the context of that goal: web archiving with Webrecorder, emulation via EaaS, as well as the presentation of these practices in action with concrete examples from the Net Art Anthology exhibition; helped facilitate (at least partial) enrollment across communities. Users who became familiar with these practices and metaphors through Rhizome's artistic program could gain a level of understanding of the reperformanceas-preservation paradigm, even if they did not necessarily subscribe to that paradigm or use Rhizome's tools in their daily practices.¹⁵⁰ At the same time, various cultural and research institutions have adopted Rhizome's web archiving tools and methods.¹⁵¹ Not all institutions use these tools or follow Rhizome's proposed practices in the same way, or for the same reasons. For example, institutions such as The British Library and The National Archives still rely on automated web archiving methods, and may only repurpose parts of Webrecorder's open source codebase for access and presentation purposes (Webber, 2018; Storrar et al., 2018). Alternatively, they might use Webrecorder as a way of supplementing their efforts in web archiving with other tools, producing multiple documentation outputs around interactive works which can be hard-to-capture and preserve with any single solution (Salomón, 2018; Clark, 2019).

¹⁴⁸ The contribution of hacker culture, or power user fandom, to fields such as video game preservation has been widely recognized as influential to the broader digital preservation discourse and practice (De Vos, 2018; Heiss et al., 2018; among others).

¹⁴⁹ Star and Griesemer (1989, p.409) developed the notion of a weakly-structured and weakly-constrained base as a requirement for the formation of alliances across disciplinary or community practices, which could collaborate successfully despite individual differences, or even in the absence of consensus.

¹⁵⁰ User stories from my initial user studies in 2017-2018 point to how users from different social worlds perceived the representations in the NAA largely positively even without great familiarity with Rhizome's preservation program (see PhD Portfolio, Report #2, p.55)

¹⁵¹ See footnote <u>#146</u>.

Despite differences in the application, Rhizome's tools and workflows have been naturalized to some extent across all these other communities.

Rhizome were keenly aware that operating in silos was not going to help meet the demands of preserving distributed, networked resources, and that instead open sharing of practices, methods and tools and active collaboration across communities was a more sustainable approach to the preservation program (Connor, 2019, p.6; Espenschied, 2019).¹⁵² My own participation and enrollment with Rhizome's internal community, and the adjacent digital preservation and archiving communities, allowed me to better understand the metaphors and practices adopted differently across these communities, and how despite these differences, collaboration was still possible and in fact necessary. This understanding informed the evolving problem-solution space of the ArtBase redesign and the MDI framework. I was able to reframe the original question, *how to support user agency in the archive?*, towards a more specific articulation, namely: how to make the linked open data environment a possible site for translation across perspectives and cross-community enrollment? This new articulation of the research question led to the need to formalize enrollment as a key MDI strategy, and to conceptualize how my own position as designer-researcher within the MDI framework aims to blur the established boundaries between designer, user, and institutional-stakeholder communities.

5.3.2 Establishing a critical standpoint within the network of relations

Enrollment in Rhizome's own internal community, as well as having the chance to actively participate in a range of other adjacent communities, provided the opportunity for this project's conceptual and methodological framework to produce a new critical standpoint within the network of relations entangled in the ArtBase and

¹⁵² The importance of the active involvement of users and other non-institutionally-affiliated stakeholders in the long-term care for works of net art, has also been addressed in Dekker's conceptualization of the "network of care" (2018). To illustrate this concept, Dekker (*ibid.*) has used the example of Martine Neddam's artwork *Mouchette*, where the constitutive role of a user community in the making of the work over the years, implicates this community as crucial stakeholders in any future restoration and preservation efforts. In another research case study, Dekker and de Wild (2019) discuss Shu Lea Cheang's *Brandon* as a further example where a range of institutional stakeholders (from different institutions) and various collaborators of the artist have been a part of an informal network crucial to the long-term preservation of the work over many years and layers of updates and iterations.

extending outward to all the related, adjacent networks of relations between preservation tools and communities. This standpoint did not aim to propose a new "normative" vision and erase community differences (Puig de la Bellacasa, 2017, p.59). On, the contrary, it aimed to gather what might be missing from the normative vision within any one community (Caswell, 2019). I use the term standpoint, following its articulation within feminist standpoint theories (Harding, 2004), for two reasons. First, beyond simply describing situated, epistemic knowledge more accurately, i.e., from multiple perspectives, the production of a standpoint is a "methodological path" (Harding, 2004) towards the transformation of "habits of perception, thinking and doing" (Puig de la Bellacasa, 2017, p.59). Second, by gathering marginal, or not-yetstandardized perspectives and classifications alongside normative ones, a standpoint involves detecting "what is there", "what is not", and "what could be" (ibid.). In alignment with the reflective practice paradigm, which is iterative, a standpoint "depend[s] on material configurations" but also involves active participation in "(re)making them" (ibid.). In short, a standpoint is not a fixed epistemic position, but a method and a process which aims for material and conceptual transformation. As a strategy of the MDI framework, establishing a standpoint involved gathering different community perspectives and mapping networks of relation through user research and active community participation, in order to propose tools for translation that make collaboration across different perspectives possible.

Activating MDI's standpoint in my role as designer-researcher at various events involving communities gathering around Rhizome's preservation program provided unprecedented opportunity to use standard design methods towards non-standard ends. For example, attending the IIPC Web Archiving conference in 2017, and concurrent Archives Unleashed hackathon, facilitated working closely with key scholars and practitioners from the international web archiving community, all gathered for a week in London.¹⁵³ Furthermore, the Wikibase Summit organized by Rhizome in 2018 and the WikidataCon conference in 2019 made possible encounters with the developers and researchers from the communities around the Wikibase and

¹⁵³ For event information see: IIPC, 2021; Archives Unleashed, 2021. See also: Rossenova, 2017; Rossenova and Kreymer, 2017.

Wikidata projects.¹⁵⁴ While these projects are open and anyone can apply to contribute, such events are generally accessible by invitation only. What became increasingly clear at these various conferences and events was the distinct lack of other designers. Typical participants were scholars and programmers, belonging to distinct social worlds while sharing membership in a community around web archiving or linked data databases. Instead of attempting to present finished design artifacts as solutions to specific problems encountered at these events, I used wireframes, workflow diagrams or prototypes during workshop sessions as tools for intervention into the networks of relations of these communities.¹⁵⁵ These interventions were intended to operate as boundary objects: connecting rather than dividing communities and providing a platform for discussion across social worlds (including the one of the designer). The aim was not to erase tensions across community boundaries, or to impose a one-way translation determined by the social world of the designer and a design-oriented epistemology. On the contrary, prototypes and other design tools aimed to make different epistemologies more visible across all communities.

Though discrete, these acts of intervening within a specific area of a network adjacent to, but also extending beyond the ArtBase, were also formative to analyzing how the relations that assembled artifacts, agents and processes in the ArtBase, also extended outward and were influenced by other discourses (e.g., web archiving), systems of classification (e.g., linked open data) and infrastructural requirements (e.g., graph databases). These needed to be made more visible, as part of the ArtBase redesign, so

¹⁵⁴ For event information see: 'WikiProject Wikidata for research', 2018, and WikidataCon, 2019. See also: Stinson et al., 2018.

¹⁵⁵ During the Wikibase Summit in 2018, I led a day of UX research sessions involving the mapping out of user needs and workflows and the collaborative sketching of data models and prototypes. The sketches were turned into interactive wireframes and presented to all attendees the next day (Rossenova, 2018b). Discussions and conversations continued even after the event, with participants using the links to the documentation materials to present ideas to their own communities and local Wikimedia chapters. Even though none of the prototypes are yet in production, discussions around one of the proposals, which facilitates data exchange between two different Wikibase instances, continued at WikidataCon the following year. At that conference, I participated in outlining an alternative workflow proposal using the open source tool OpenRefine. As a result, I also joined the Steering Committee of OpenRefine. At a Wikibase Community meeting in October 2020, I presented the data exchange workflow facilitated by OpenRefine ('Wikibase Community User Group', 2020). This anecdote is just one example of the possibilities of using design methods within communities, particularly open source software communities, which normally exclude design (Borchardt, 2011). Rather than focusing only on fixed solutions, leaving the problem-solution space open and using design tools as boundary objects can be productive in facilitating discussions and collaborations which lead to new development opportunities.

that the archive infrastructure could also operate as a boundary infrastructure, wherein different communities can do the work of translation and collaborate even in the absence of total consensus regarding classifications.

A framework for infrastructural inversion

If, as critical STS scholars argue, "ways of studying and representing [...] sociotechnical assemblages have world-making effects" (Puig de la Bellacasa, 2011, p.99; see also Law and Urry, 2004), then the methods of this research (including the use of prototypes as boundary objects and the production of a standpoint) and the conceptualizations of its objects of study (the archive as network of relations, users as members of multiple communities of practice) have world-making effects, too. These involve blurring the boundaries between designer, user, and institutional communities, and creating possibilities for the exchange or migration of metaphors and processes across these communities. Making the designer-user community divide more ambiguous and less clean-cut by embracing entanglement rather than siloing of roles, tasks, and knowledge-production, was an intentional way of challenging established notions of how users matter in HCI and UX design. Studying, enrolling in and working with user communities and the relations that develop and extend community networks, distinguish the MDI framework from other user research methodologies which observe user personas and behaviors from an aspiring-toempathy, but decidedly external position.

Paying attention to how systems of classification develop, overlap or diverge across different community memberships and networks; taking up a critical standpoint; and making interventions in the networks of community relations, align the methods of the MDI framework closely with what Bowker and Star have dubbed "infrastructural inversion" (1999, p.34). Infrastructural inversion is the act of making visible the underlying data structures and processes of structuring which keep boundary infrastructures "moving along" (*ibid.*, p.313), but normally remain transparent, or invisible to users. Applying this concept to the field of design practice proposes that taking a non-transparent, reflective approach towards the design of the data model, database and interface of the ArtBase means enacting infrastructural inversion. This aims to subvert traditional divisions between designers, users and institutional

stakeholders and to create possibilities for greater user agency and collaboration across the network of relations in the archive. At the same time, infrastructural inversion opens up multiple questions for the ArtBase redesign and the next phases in the fieldwork: What kind of data model and database architecture could accommodate and describe the multiple possible community discourses, systems of classification, and infrastructural requirements entangled around net art works? And furthermore, what kind of interface metaphors and interaction design patterns were needed to make Rhizome's repertoire of tools and practices for preserving net art more visible? These questions informed the next steps in the Design Exploration and Specification Phases of the fieldwork.

PART III. Infrastructural entanglements: modeldatabase-interface

As briefly discussed in Chapters 3 and 4, ubiquitous metaphors of virtual galleries, category filter menus and keyword search boxes utilized in HCI and UX practice for online collection interfaces are used as tools of translation between designers, stakeholders and user communities. These metaphors are widely naturalized across online user communities and therefore serve as base elements for many interfaces considered to be user-friendly or intuitive. Even so, these metaphors privilege a particular view of user interactions within online collection interfaces, and a particular view of the artifacts within these collections. The metaphors operate on the premise that single, clearly-bounded objects can be aggregated in homogenous lists (or virtual galleries) and then de-aggregated via single pages or records per object (see PhD Portfolio, Report #3, sections 2–3). This limited understanding of digital artifacts and the interfaces that are designed and developed to present them does not meet the needs of the net art archive, where objects are manifested as multiple variants with fuzzy temporal and material boundaries.

One of most recognizable artworks in the ArtBase is a diagram by the artist collective MTAA, illustrating the core component of all net art—the network, as well as the complex entanglements between temporalities, agents and material manifestations which exist there (Fig. 0.7). In *Simple Net Art Diagram* (also referred to as *SNAD*), the line between the creation date of the source file and the date accepted as part of the art history canon is blurry, presumably intentionally so. What is more, the image of *SNAD*, released under a CC license by the artists, has been reproduced countless times across the web and in print (MTAA, 2015); most recently inspiring the title of the physical exhibition extension of Rhizome's Net Art Anthology at the New Museum, "The Art Happens Here" (Fig. 0.8). In a blog post from 2015 detailing the history of the work (MTAA, 2015), the artists list a number of other artworks, some created by other artists, too, which are variations based on their "canonical" diagram.

After an initial release as part of another artwork in 1998, *TIME*![®], the standalone GIF image was released in 2000. But the 'canonical version' has a date included on the image: "ca.1997".¹⁵⁶ According to the artists they found a source file on their machines with creation date 1997, within its metadata. So, they decided to revise the creation date of the work, as well. Though, as they themselves warn in a post on Rhizome's mailing list in 1999, confusion and multiple "truths" should be part of net artists' official strategy:

[...] the future net art historians may begin to become discouraged by all the conflicting data, so you need to sow the "truth" through the data stream in a way that will be challenging to the historian, but not impossible for her to create a final story. to insure a place in the net art pantheon, sow 2-4 different "truths" through your data stream, this will promote healthy, attention getting debate amongst the future most ambitious net art historians. (MTAA, 1999)

The specific context surrounding the creation of this work and its subsequent circulation and proliferation across various communities (and generations) of net art practitioners illustrates the need for an archival infrastructure which can account for such plural contexts both in its metadata framework and its frontend interface accessed by users. Being able to connect all variants of the work and their associated timelines in the ArtBase database through a flexible metadata framework and a nontransparent user interface reveals more than an interesting historical narrative. It can also help represent at least some of the processual, performative and networked characteristics that make the artwork a net art piece, rather than simply an object whose material characteristics can be fully captured within a few descriptive metadata fields. Such a framework would be helpful to the "future net art historians" envisioned by MTAA for tracing the historical development of the work and establishing an understanding of the work's provenance which goes beyond the history of ownership and the notion of authenticity typically associated with physical objects.

¹⁵⁶ The ArtBase has records for several MTAA artworks, *SNAD* and *TIME*!® among them. The *SNAD*'s creation date is given as 1997, while *TIME*!® is dated as 2002. *TIME*!® is added to the archive as a cloned work, submitted in 2002, which may account for the difference between this date and that given on the artists' own website.

However, typically online collection interfaces privilege a transparent, user-friendly paradigm in interface design, one where the interface purports be a neutral vessel delivering 'content' to users, without distraction or imposition of a particular point of view. Such an approach has a limited scope to provide context beyond standardized metadata categories and virtually no provision for data provenance accountability, that is, a way to acknowledge the non-neutral and situated ways in which all data is produced and visualized (D'Ignazio and Klein, 2020). This part of the thesis asks: what should the visual and structural paradigm(s) for an interface be, if it is to work as a boundary infrastructure for different user communities, without aiming to be userfriendly at the cost of obscuring the non-neutrality of data (including data collection processes and structures of classification) and design metaphors (which visualize data)? Each chapter in this part proposes specific strategies which contribute to the conceptual and methodological development of the MDI framework for infrastructural inversion in the ArtBase. These concern all three of the material dimensions of MDI:

- the database software: Rhizome's deployment of Wikibase, a linked open data environment (Chapter 6);
- the data model: a provenance-driven model and an adaptation of the PROV standard (Chapter 7);
- the frontend interface: the patterns of interaction which support user agency (Chapter 8).

6 Linked open data and collaborative open source software

The databases and applications traditionally utilized in the cultural heritage sector do not meet the needs of the net art archive, and—as some more recent scholarship in archival and museum studies argues—they do not meet the needs of most forms of digital cultural heritage in general.¹⁵⁷ Knowledge representation via linked open data (LOD) is a popular concept which could address some of the criticisms levied against traditional collection management systems, but is yet to be fully embraced by the cultural heritage sector. To understand the specific possibilities and limitations afforded by a linked-data-driven infrastructure requires a conceptual understanding of the *semantic web* and *linked open data*. Defining these concepts in detail is, however, beyond the scope of this thesis. In broad terms, the semantic web is the proposition to move away from a web of static HTML documents towards a web of data, which is machine-readable, so that computers can handle web data in more useful ways than was previously possible through the capabilities of HTML documents alone.¹⁵⁸ The related concept of *linked open data* proposes that data should not only be structured in a machine-readable format and published on the web but it should also be published openly—without copyright restrictions, and it should be *linked*—following specific standards and relying on the technical infrastructure of a graph database,¹⁵⁹ in order for various connections (in terms of querying and representation) to be drawn across heterogeneous databases (Hyvönen, 2012).

In this chapter, I discuss some of the advantages and limitations of Rhizome's choice of maintaining a linked open data infrastructure, in order to set the stage for my own intervention via reflective practice—the development of the provenance-driven data model, discussed in Chapter 7. To begin with, I examine what lessons can be drawn

¹⁵⁷ See Chapter 2, and also Barok et al., 2019; Wildenhaus, 2019; Engel and Wharton, 2017; Jones, 2018; ¹⁵⁸ The concept of the 'semantic web' was first introduced by Sir Tim Berners-Lee, widely known as the inventor of the world wide web, around the beginning of the '00s (T. Berners-Lee et al., 2001). ¹⁵⁹ A graph database stores data as nodes and edges (as opposed to tables, the staple of relational databases), which enables semantic queries. A key concept of the system is the graph (or edge relationship), which directly relates every data element (or node) to its adjacent element (node) (Cobb, 2015, p.155).

from the extent to which linked open data strategies have, or *have not*, been developed in the cultural heritage field to date.

6.1 Linked open data for digital cultural heritage

Achieving LOD has been an ongoing goal for many institutions in the GLAM community (Mayer, 2015), and its perceived benefits for cultural heritage institutions have been widely discussed in the professional and academic literature (Voss, 2012; Hyvönen, 2012). Participating in the semantic web, rather than just being on the web, means cultural heritage institutions publishing their knowledge in a networked environment, rather than siloed webpages (Delmas-Glass and Sanderson, 2020). Such a networked environment will theoretically enable the linking of knowledge about the same or related historical artifacts or persons across institutions. Thus, institutions will be able to "[share] cataloguing, reuse and leverage the knowledge developed by peer institutions" (*ibid.*, p.21). From a scholarly perspective, this facilitates data reuse, rather than redundancy, enables new research questions to be asked, and fosters the development of new research methods (*ibid.*, Oldman et al., 2015). For small organizations with highly specialized collections, which do not easily fit established standards for data exchange, such as Rhizome's ArtBase, LOD offers the opportunity to connect its heterogeneous data to bigger knowledge repositories, such as name authorities, containing bibliographic information not available within the niche archive.160

6.1.1 The problem of infrastructure

Despite growing recognition of the benefits of linked data, the majority of institutional efforts with LOD in recent years remain experiments, rather than established practice, and primarily deal with records of homogeneous digitized collections, such as Europeana or the British Museum collection of digitized artifacts (LODLAM Summit, 2017).¹⁶¹ LOD requires the same continuous institutional commitment as any other

¹⁶⁰ Examples include: the Union List of Artists' Names (ULAN), an authority control resource maintained by the Getty Institute (ULAN, 2020); The Virtual International Authority File (VIAF), an international authority file and a joint project of several national libraries, operated by the Online Computer Library Center (OCLC) (VIAF, 2021); or PRONOM, an online registry of technical information on file formats, maintained by the National Archives UK (PRONOM, 2021).

¹⁶¹ Projects such as the *Research Space* platform jointly developed by the British Museum and the Mellon Foundation, and its practical implementation in the *Sphaera* project from Max Planck Institute for the

essential database and cannot be approached as a side project executed in isolation. However, well-documented, easy-to-implement LOD database software that can be deployed in cultural organizations as an end-to-end solution to collection management issues is yet to be developed and made widely available. Instead, ad-hoc, project-driven approaches to LOD in cultural contexts, has led to justified critique of the instrumentalization of the concept as a hyped-up solution to digital workflow problems in museums (Oates and Whitelaw, 2018; Jones, 2018). Without a broader institution-wide infrastructural framing, opening APIs¹⁶² to collection data stores or releasing data dumps on GitHub,¹⁶³ can hardly provide all the answers to the nuanced needs of documenting and preserving context, collaboration and agency (Oates and Whitelaw, 2018; Fitzpatrick, 2017).

An alternative approach, one focused less on platforms and infrastructure, but rather on modelling principles and on building a critical mass of collaborating institutions is exemplified by the Linked Art initiative, led by the Getty Research Institute (Delmas-Glass and Sanderson 2020, p.21).¹⁶⁴ Linked Art focuses on collaboration and educational activities across a number of international institutional partners in order to "lower the barrier of participation in LOD initiatives for museums" (Delmas-Glass and Sanderson, 2020, p.21). The emphasis of this initiative is on the importance of having a model that is easy to reproduce and implement, in order to exchange data across institutions at a deeper level (beyond simply mapping consistent ULANs or URIs for artist names and painting titles).¹⁶⁵ Linked Art's proposal to achieve that is via a standard API, which the consortium initiative would specify. The API would interface

History of Science in Berlin (Kräutli and Valleriani, 2018) highlight the potential of LOD to represent complex networked relationships within a cultural heritage context. At the same time, these projects were developed within the context of digital humanities research, rather than day-to-day collections care, and involved a high degree of specialist expertise for the deployment and maintenance of the infrastructure *(ibid.)*.

¹⁶² API stands for Application Programming Interface (see footnote <u>#96</u>).

¹⁶³ GitHub is a platform for developers, usually used to develop openly, releasing source code of projects and applications under an open license (GitHub, 2021).

¹⁶⁴ A presentation at the V&A Museum in London on 1 October, 2019, outlined the initiative as a continuation of the American Art Collaborative, a smaller scale project that ran 2015–2017 focused on developing linked open data for art museums in the US. Linked Art has a bigger, institutional scope—over 20 institutions have joined so far from both the US and Europe, and there is a marked focus on long-term sustainability through community collaboration (Linked Art, 2020).

¹⁶⁵ URI stands for Uniform Resource Identifier—a string of characters used to unambiguously identify a concept or resource on the web (`Uniform Resource Identifier', 2020).

with the existing infrastructure an institution has in place and other third-party applications for purposes of interoperability, though the work of customization to enable such connections would not be trivial.¹⁶⁶ Furthermore, Linked Art recipes—for now at least—only address the needs of "most traditional scenarios that cataloguers encounter" (Delmas-Glass and Sanderson, 2020, p.21) and, given the make-up of most institutional collections, these include cataloguing paintings, sculptures, photographs, etc. But the entire ArtBase archive falls outside this narrow scope of what is considered an art object. And so too, do many other performative, time-based-media works.¹⁶⁷

For a small cultural heritage organization with limited resources, the majority of commercial systems that offer linked open data infrastructure and support are not a viable option. Research-led cultural heritage initiatives, too, only offer partial support and require in-house resources to build up the infrastructure (as illustrated by Linked Art and Research Space). Looking to open source software to fill the gaps of research-led and academic initiatives is a possible alternative route, which Rhizome, among other institutions, have turned to (Godby et al., 2019; Pintscher et al., 2019a). Currently, there are few actively maintained open source software solutions providing the infrastructure necessary to support the implementation and large-scale use of LOD. ¹⁶⁸ The largest and most well-known one is Wikidata—a knowledge base of public domain structured data maintained by Wikimedia Germany, a chapter of the Wikimedia Foundation (WMF) (Piscopo, 2019). Wikidata allows for the storage,

¹⁶⁶ The Linked Art symposium held in London in 2019 provided case study examples from two pilot implementations—one from the National Gallery in Washington, DC, where existing infrastructure was retrofitted, and another from the Georgia O'Keefe Museum in Santa Fe, NM, which involved the development of bespoke infrastructure (Linked Art, 2020). The examples involved internal technology team capacity in the first case, and generous grant funding to hire external experts in the second case. Such resources are rarely available to many smaller institutions or independently-run archives, exhibition spaces or community organizations.

¹⁶⁷ Currently the Linked Art specification stipulates that extensions can be developed for such cases, but the implication is that such extensions cannot be developed by individual institutions and must be officially sanctioned by the Linked Art community (Linked Art, 2020). This level of bureaucratic organization is understandable considering the history of metadata standards development (and the role of the Getty Institute in development of thesauri, authority records, etc.), but as Section 6.1.3 in this chapter will discuss, the structure of linked data is fundamentally different than previous forms of knowledge organization, and does not technically require consensus.

¹⁶⁸ It is worth noting that open source software can only be a sustainable option if it is maintained by an active and extensive network of contributors (Eghbal, 2018).

management and querying of LOD by following the standard RDF,¹⁶⁹ besides including other common characteristics of wikis, such as collaborative and version control features.¹⁷⁰ Crucially, Wikidata does not only provide a model or an API, but a complete infrastructure: graph database software; an underlying interoperable data model architecture; and graphical user interface to operate on the data.

For Rhizome, the structured data affordances of Wikidata provide opportunities to support the complex preservation and archival needs of digital art in general, and net art in particular. Following the commitment to open knowledge of the WMF, however, Wikidata requires all contributors to submit data only under CC0 license, essentially copyright-free data.¹⁷¹ This can be problematic for cultural heritage organizations on several levels and therefore an option to deploy software which offers an interface to a graph database without the mandatory CC0 license would be much more valuable to cultural heritage.

6.1.2 The problem of openness

Art museums have for a very long time been challenged by the articulation of copyrights and intellectual property around the objects in their collection, as well as the accompanying metadata and text or visual-based documentation. This could be attributed either to the copyright laws applicable to the works of living artists, or to concerns over retaining authority over data produced by museum staff (Bray, 2009). Unresolved questions about the status of the content produced by museums on the representation, study and maintenance of objects in their collections pose just as many challenges to wide-spread open data sharing, as do technical or financial resource limitations. The proponents of linked open data have typically denounced such concerns as old-fashioned and out of touch with the realities of 21st century digital culture. They have advocated for opening knowledge—in the form of digitized museum objects and metadata—to everyone online, as the only democratic and

¹⁶⁹ Resource Description Framework (RDF) is a general method for modeling LOD, using several syntax notations and data formats (Schreiber and Raimond, 2014).

 ¹⁷⁰ The collaborative features mean that logged in users can get a range of access options to edit or contribute data, while version control means that a change log is kept and any edits carried out by a particular contributor can be tracked and reversed if needed (Allison-Cassin and Scott, 2018).
¹⁷¹ In addition, images in Wikidata can only be connected via Wikimedia Commons and must have CC-BY 2.0, CC-BY-SA 2.0 or CC0 licenses. See also: Wikidata Licensing, 2019; Commons Licensing, 2021.

progressive stance (Maher and Tallon, 2018; Martinez and Terras, 2019). The Linked Art initiative, too, sees knowledge-sharing as the core mission of all cultural institutions:

The mission of cultural heritage institutions is to share knowledge effectively to further scholarship and it is important that they participate in the development of the framework that disseminates their knowledge in the Semantic Web. (Delmas-Glass and Sanderson, 2020, p.21)

At the same time, even among those who are proponents of broadening the use of LOD in cultural heritage, the open-editing environment of Wikidata is not seen as a trustworthy repository for institutional knowledge (Zeinstra, 2019a,b). Aside from the more obvious danger of malicious intent to delete or falsify data, the idea of openness as embodied by the open source or free software movement itself oftentimes carries its own cultural mythologies that extend beyond issues of copyright and licensing. Ideologies of meritocracy, flat hierarchies, or universal access within that idea of openness tend to follow old patterns of colonial, race or gender bias (Keyes, 2019).

However, growing international concerns around the need to preserve indigenous cultures and non-Western knowledge systems have introduced more nuanced arguments into the debates surrounding what and who should be determining whether data remains structured and machine-readable or not, open or private, visible or invisible and to whom (Christen, 2012; Srinivasan, 2017).¹⁷² These conversations have been increasingly making an impact within the Wikimedia movement, as well as at developer-oriented events such as WikidataCon (Allison-Cassin, 2019). Amid such concerns, WMF and the team behind Wikidata have acknowledged the limits of centralization. There is simply too much data for one organization to manage and also

¹⁷² Indigenous knowledge systems pose a counterpoint to a Western, colonial discourse which equates openness with democracy. In her article "Does Information Really Want to be Free? Indigenous Knowledge Systems and the Question of Openness" (2012), digital humanities and indigenous cultural heritage scholar Kim Christen unpacks what she refers to as the "information wants to be free meme" as a Western construct, which weaves "a narrative of information freedom as a bedrock of national freedom". She discusses legal scholars and internet freedom advocates who routinely quote "[Thomas] Jefferson or [U.S. Supreme Court Justice Louis] Brandeis, along with a handful of other early American thinkers ... in support of a "balanced" intellectual property regime that takes as its main focus the maintenance of a public domain where ideas move freely, creating an information commons." (*ibid.*, p.2876)

to facilitate trustworthy and fair treatment to culturally-sensitive data (Pintscher et al., 2019b). In 2014, the Wikidata team took the first step towards decentralization by releasing Wikibase, the software infrastructure used to run the public platform. Crucially, Wikibase can be deployed as a stand-alone instance, independent from Wikidata and when being hosted independently, it does not hold the same licensing restrictions. What is more, individual users and institutions deploying their own instances of Wikibase can create data models and determine levels of openness that suit their cultural outlook better than the public environment of Wikidata (Fauconnier et al., 2018). In Wikidata's open environment even non-logged in users can edit data and take decisions about how data models are made in presumably democratic, but more-often-than-not, culturally-biased ways, too. The opacity of administrative procedures and the technical know-how needed to contribute to structural decisions in the platform tends to lead to the creation of homogenous and semi-closed, rather than truly open communities (Keyes, 2019).

For arts and culture organizations like Rhizome, which oftentimes hold bespoke agreements with the copyright holders to their collection and archival holdings, Wikibase provides more flexibility as to what information (and media) is made public or kept private (Fauconnier et al., 2018). For example, Rhizome's Wikibase facilitates listing the specific license type agreed with each artist for each artwork held in the archive and enables assigning appropriate licenses to media files (images provided by the artist) or even text descriptions linked to each artwork record. What is more, within Wikibase, Rhizome can determine a new data model that suits the needs of the ArtBase. The process of developing the data model, as conceptualized within the MDI framework, offers opportunities to involve other agents from the network of the archive in productive discussions, that do not resort to the type of administrative (or administered) openness pursued in some open source projects, nor aim to enforce a consensus across all user communities.

6.1.3 Decentralized and federated open source infrastructure

Many of the existing LOD initiatives in cultural heritage operate on the basis that consensus across all of its participating communities is necessary, and focus on adherence to a particular platform or model (e.g., Linked Art initiative). But such a

centralized approach is technically unnecessary for LOD to work on the web, and may also be inappropriate to certain use-cases or scenarios. As well as providing LOD infrastructure, Wikibase allows organizations using it to take advantage of two further aspects of the vision of the *semantic web*: decentralization and federation. In a decentralized¹⁷³ and federated¹⁷⁴ semantic web, multiple, heterogeneous databases, hosted by different organizations or individuals, can connect and exchange data via *SPARQL endpoints*.¹⁷⁵

Decentralization and federation of LOD via open source infrastructure can help resolve some of the main challenges of the net art archive, such as the difficulty of conforming net art archival data to fixed standards. In the case of an LOD environment, conforming to a pre-determined metadata standard is not a pre-requisite for interoperability with other data sets. Federated linked data enables users to interact with a single user interface in order to access and query data from multiple databases, even if the constituent databases are heterogeneous (Ladwig and Tran, 2010). For example, the ArtBase may not need to store detailed information about a software dependency for an artwork, if that information is available elsewhere as structured data and can be queried through a SPARQL endpoint. This level of distributed responsibility would essentially facilitate a post-custodial approach (see Chapter 3) to maintaining domain-specific metadata across institutions and could significantly ease

¹⁷³ Decentralization is a subset of distributed networking. There is a subtle but important difference between decentralized and distributed networks. Typically, distributed networking distributes process across multiple computing resources for greater efficiency, but may still rely on centralized control for task coordination. Decentralized networking allows individual nodes in the network to make independent decisions while still participating in some shared processes ('Distributed networking', 2020). ¹⁷⁴ Federation is also a subset of distributed networking and is used differently across different open source projects and communities. In recent years federation, or the "Fediverse", has come to be associated with self-hosted instances of software that seek to replace corporate social media. Instead of operating on centralized, corporate platforms, the Fediverse consists of distributed, but interconnected open source alternatives, which provide users with more agency over their data and interactions (Mansoux and Roscam Abbing, 2020). In the context of LOD, however, federation tends to be used in a different sense. Because LOD is based on the principle that all data on the web described with an LOD model is already interoperable by default, federation efforts focus on the development of interfaces (both programmatic and graphical) which would enables users to access and query data from multiple databases—even if they use heterogeneous software applications (Ladwig and Tran, 2010). ¹⁷⁵ SPARQL is an acronym for SPARQL Protocol and RDF Query Language. It is an RDF query language, i.e., a semantic query language for databases, and is able to retrieve and manipulate data modelled in RDF (`SPARQL', 2017).

the workload on individuals and smaller, or under-resourced institutions leading to widespread benefits for the cultural heritage community (Thornton et al., 2017).

While in principle, federation is a possible and desired outcome of the semantic web, it is by no means trivial, both technically and culturally. Before and after the release of their strategy documents with regards to the development of a decentralized ecosystem, WMF ran consultation sessions with users and institutions. The published findings revealed a whole range of possible interpretations when it comes to the way different communities envision federation and its manifestation.¹⁷⁶ As well as discussions around technical protocols and modelling conventions to facilitate exchange over SPARQL, interpretations also diverged on the question of openness and its cultural value. While many open source projects, including Wikidata, accept openness as a universal virtue, this liberal, Western view is increasingly being challenged by new communities entering the federated ecosystem of open source applications (Mansoux and Roscam Abbing, 2020). Organizations dealing with nonstandard cultural heritage, like Rhizome; scholars and activists working with indigenous knowledge systems (Allison-Cassin, 2019); as well as representatives of communities which have been traditionally marginalized or under-represented in open source projects, including women, people of color, or queer-identifying people (Mansoux and Roscam Abbing, 2020; Keyes, 2019), have all contributed to the expansion of the debate around openness, and the need to allow for federation, as well as defederation, where appropriate. Defederation implies the ability to select which database instances to federate within a distributed ecosystem, rather than defaulting to all of them, or a select centralized one (such as Wikidata). In the context of Wikibase, this means enabling users of individual instances to select which data to make open via its SPARQL endpoint, and open to whom.

¹⁷⁶ The findings were available on talk pages and on project pages within the Wikidata platform ('Wikidata Strategy', 2019; 'Federation input', 2019). Talk pages (also known as discussion pages) are administration pages where editors can discuss improvements to articles or pages on various Wikimedia platforms— Wikipedia, Wikidata, etc. Talk pages can be associated with specific pages in Wikipedia, Wikidata, etc., with specific Users, or with specific Project pages. Project pages are special pages in the Wikidata platform only, where ontologies are discussed amongst various communities.

For now, talk pages and user forums where possible interpretations and implementations of federation, with regards to the minutiae of namespaces, properties and cross-walking syntax standardization, are discussed and tested, serve as boundary objects across user communities of information professionals, technologists, domain experts, WMF staff and others. However, further community work and development is necessary before SPARQL endpoints to multiple decentralized Wikibase installations can function as boundary infrastructures for federation, or selective defederation, where working arrangements are in place even in the absence of consensus. Negotiations surrounding the question of openness and federation highlight the interdependent relationships between user communities, information architecture and backend infrastructure. Paying close attention to this interdependency, while participating (and intervening) in cross-community discussion and collaboration, was a further manifestation of the critical standpoint established by the MDI framework, which enabled data modeling to be critical and reflective, rather than 'transparent'.

LOD can be a powerful component in the infrastructure of cultural heritage knowledge management, but it must not be implemented uncritically or considered the only necessary step in achieving a working infrastructure that can serve diverse communities of practice. Rhizome is one of the first institutions to pilot the use of a stand-alone instance of Wikibase and to critically explore what openness and federation might mean in the context of a cultural collection (Fauconnier et al., 2018). Because every Wikibase installation requires a custom configuration of its data model, as part of the redesign fieldwork, it was possible to develop a custom data model around the specific requirements of the ArtBase, its artworks and Rhizome's custom access policies. Moreover, this work was not done in isolation. Within the MDI framework, it involved understanding and participation in the socio-technical processes of classification, maintenance and use that are entangled in the Wikibase project, its data architecture and adjacent communities.

6.2 Data modelling in Wikibase

The primary advantage of using Wikibase as a backend to the ArtBase, over other knowledge management systems, is that there are no pre-set hierarchies or ontologies. New entities and relations can be created within the database on an ongoing basis, as

the data contained in the database expands in size and variability. What is more, these can be added by a designer, a data curator, or a conservator. There is no need for a programmer to set all the entity or relation meanings in advance. As part of the redesign fieldwork, discussions with users within the ArtBase network, and members of the broader Wikibase community, contributed to the development of the data modelling process (Rossenova et al., 2019; see PhD Portfolio, Report #4).

6.2.1 Knowledge representation

The core syntax of RDF, which structures data into subject-predicate-object triples (Schreiber and Raimond, 2014), translates to item-property-value in terms of Wikidata/Wikibase syntax (Wikidata, 2014). The data descriptions are structured as statements consisting of claims and references (Fig. 6.1). Statements are composed of properties associated with items and their respective values. For example, (the item for) an artwork record can be connected to (the value of) the artist name through the property 'attributed to'. Statements can have references, too. For example, the attribution of an artwork to an artist can be referenced from a publication, such as a catalogue, or the artist's own website, among many other possible information sources. Without a reference, a statement is simply a claim. Claims can also have qualifiers. These are sub-properties which can add additional detail about a claim, for example, what time period the claim relates to.

The machine-readable schema of Wikibase cannot represent the full nuance of spoken or written natural language semantics, but it can at least offer answers to relatively complex queries concerning the links between concepts or related agents, temporalities, and references (Rossenova et al., 2019). At the moment, Wikibase can function as an ontological sandbox and space for experimentation (Fauconnier et al., 2018). As long as federation principles across Wikibase instances remain flexible, there is no need to follow the prescribed standards or conventions utilized by other organizations, even Wikidata. Each institution hosting an independent Wikibase database can develop experimental models for information structuring and change/update these as needed over time. Cataloguing digital art in a traditional content management system, in comparison, would not allow this level of flexibility.

The key feature of traditional relational databases, which are the backbone of most standard collection management systems, is the formal separation between schema and content (Dourish, 2014). The schema being "the set of tables and the columns of the table, along with the types of data (such as numbers, dates, and text items) that each column will contain" and the content being "the actual data that gets stored in each table" (*ibid.*, p.11). This formal separation makes relational databases efficient. A pre-defined set of operations, such as filtering, can be done very quickly, because the schema for the entire content is the same and the operations that can be executed upon the content can be standardized for efficiency. But formal separation is also a weakness. While the content can be malleable, the schema is rigid, once defined usually during development, before the software is ever in use—it cannot be changed (easily). Thus, organizations using such software have limited choices. They can either fit content as best as they can into pre-defined categories, or choose to willingly put the 'wrong' content into a category not strictly designed for it, usually a miscellaneous 'notes' field, or leave certain fields blank. This rigidness largely limits the usability of the data and the operations that can be performed with it, in the context of complex and heterogeneous data sets like the ArtBase.

In contrast, the knowledge representation schema of Wikidata and Wikibase, uses a flexible system of claims, references and qualifiers, which take advantage of the networked capabilities of graph databases. In his analysis of the materiality of databases and knowledge representation models, Dourish (2014) elaborates on why the "network model"—another term for the representation of knowledge in graph databases—is far less restrictive than others such as relational, tree or hierarchical models:

In a network model, data objects are connected to each other in arbitrary structures by links, which might have a range of 'types.' [...] The result is a network of interrelated objects that can be navigated via links that describe relationships between objects and classes of objects. [...] links have no predefined meaning; just as database programmers create a series of objects that match the particular domains they are working with, so too do they develop a set of appropriate link types as part of their modeling exercise. (pp.9–10).

In the network model there is no technical separation between the structure of data and 'content'. The separation is only conceptual in deciding the meaning of links, but this can evolve and change to suit the requirements of the content. In the case of the ArtBase, as the material components of the artwork assemblages change, or new agents or processes become involved in preservation activities, the schema of the archive database can evolve accordingly: new items can be added, as well as new properties which link items, or the meaning of existing properties can be adapted to new contexts. Moreover, because the shape of the database is a non-hierarchical network, each item can link to multiple other items via the same property, while two items may be linked directly or indirectly via different properties.¹⁷⁷ This is a facility of graph databases that allows for a plurality of data relations to co-exist, without being pre-determined by the overall schema of the database. For the ArtBase redesign, this is an opportunity to perceive the archive not as a set of individual, invariable statements, but a complex network of overlapping, potentially contradictory or ambiguous assumptions.

6.2.2 A plural, non-neutral archive

In addition to the flexibility of the data modelling process, the possibility to account for plural data statements is another key reason for Rhizome to run a pilot installation of Wikibase. This is facilitated by each property's capability to hold multiple values at the same time, by means of qualifiers which add further details to each item-propertyvalue triple, and references which provide source information to support each triple's claim (Vrandečić and Krötzsch, 2014). For example, an artwork (and its variants) can be dated with multiple values, and the different sources of information can be recorded easily as part of the corresponding claims. The proposition that knowledge can be represented as *claims* and *statements*, rather than *facts* and *truth*, is not only a technical facility of Wikidata's underlying graph database, but also a conceptual choice. Wikidata is a multilingual and crowdsourced public platform. All data there can be considered to be 'plural', whether because a particular piece of information may be unknown, poorly understood, contested, or because an editor willfully or

¹⁷⁷ For example, one artwork can link to all of its variants via the property "has variant". These variants are all indirectly connected to each other via this property. However, two individual variants may share other types of relations too, a derivation relation for example, and so a direct link can be established between the two via the property "derived from". See Chapter 7 for illustrations.

unwittingly contributed misinformation. As stated in an article written by one of the architects of the principal Wikidata data model:

It would be naive to expect global agreement on the "true" data, since many facts are disputed or simply uncertain. Wikidata allows conflicting data to coexist and provides mechanisms to organize this plurality. (Vrandečić and Krötzsch, 2014, pp. 79, 83).

During different stages of the ArtBase's history, including the open submission phase, and the development of the net art field as a whole, artists operated with a DIY spirit and artworks often changed in parts or in full, while institutions did not canonize the information. Therefore, Rhizome have decided to work with the fact that the archive data is unlikely to ever be consistently complete or unambiguously "true" (see PhD Portfolio, Report #1, p.71). What is more, there is no need for Rhizome to assume the neutral tone of voice of a traditional museum archive or collection website (see Chapter 3). With the implementation of Wikibase, Rhizome can highlight the variety of ways data has been collected and recorded in the ArtBase over the past two decades, so that users can explore it. Even in cases where curators or art historians are able to contribute fact-checked data about an artwork, or where the artists provided clear instructions regarding a canonical instance of an artwork, the archive could still record additional versions or variations on the data and the artwork instance. An artist's claim about the creation date of an artwork may be factually incorrect, but still worthwhile recording for art historians studying the body of work of the artist (see the SNAD example discussed in the introduction to Part III; Rossenova et al., 2019). Making the pluralistic and/or incomplete state of data in the ArtBase more visible, marks a departure from the paradigm of neutral, or transparent archives and interfaces (see Chapter 3). Plural data statements provide space for ambiguity, nuance, and interpretation (Drucker, 2013) by users who are empowered to be active agents in the archive, rather than a passive audience.

The example of MTAA's *SNAD* introduced at the beginning of this part of the thesis illustrates the need for plurality in the ArtBase particularly well, due to its complex and ambiguous history of temporal variation and derivative proliferation by intervention from various agents including, but not limited to the artists from MTAA.

Representing nuance and complexity around artwork data in the new LOD environment, as part of the ArtBase redesign, therefore necessitated the development of a data model (and ontology) which could describe a contextual network of information patterns that connect multiple temporalities, multiple sources, and multiple agents acting within, and interacting with the archive.

7 A provenance-driven data model for the ArtBase

The process of developing a new data model for the ArtBase and implementing it within an LOD environment, as discussed in this chapter, articulates a key strategy of the MDI framework towards infrastructural inversion in the ArtBase. It sets out patterns for connecting information which can account for the temporal dimensions of net art works and their records respectively, involving development, deterioration and/or various acts of preservation enacted by different agents (human and/or technical) over time. The overarching conceptual basis is not any particular metadata standard, but the principle of archival provenance.

I propose to use the term *provenance* as the summative expression of a data model that can represent the pluralistic context and history around metadata in the ArtBase. The term is appropriate when an expanded notion of provenance is taken into consideration as advocated by postmodern archival science scholars Brien Brothman (1991), Terry Cook (2001), and Geffrey Yeo (2013), among others. The archival record in postmodern archival science is no longer understood to be a static, value-neutral entity, but rather a dynamic process of production and interpretation, which is carried out by multiple agents, including the author(s), archivist(s), within the larger cultural context of memory institutions. Given the theoretical developments around the perception of the archival record as a process consisting of dynamic relationships, rather than a 'thing', archival scholars have recognized the need to expand the definitions—or even redefine—core archival concepts such as context and provenance, particularly in relation to born-digital artifacts in digital archives (Cook, 2001; Hurley, 2005). As mentioned in Chapter 5, this is the reason why I followed the classification of provenance standardized among communities of archival practice, rather than art history or museum studies scholars, when developing prototypes for workshops during the Design Exploration fieldwork. In this chapter, I propose a practical LOD application of the conceptual principles embodied in an expanded definition of archival provenance and context. Furthermore, I test this application within Rhizome's Wikibase instance, in order to draw out the interdependent relations between the conceptual data model and the materiality of the software

environment: its specific database structure, user interface and existing provisions for user access and interaction.

7.1 Expanded provenance and context in digital archives

Digital artifacts and their records are created, managed, and used in the same environment. Traditionally, the development of archival standards and management systems has focused on the management of the separations between objects, their descriptive surrogates and the creation of finding aids (Hurley, 2005, p.7). But these finding aids help researchers to locate paper records stacked in a specific order in boxes on shelves, they do not help to provide context, and consequently meaning, around digital artifacts and their records. And ultimately, recordkeeping should be about supporting the meaningful use of records (*ibid*.). A fuller view of the context surrounding a born-digital artifact which can support discovery as well as meaningmaking, should include information about the processes and agents of formation (i.e., creation), function (i.e., operative role of the artifact or object within the context of creation), (record) management and use (Hurley, 2005, p.9; Duranti and Franks, 2015, p.151). Expanded provenance provides the necessary conceptual framing for such a view. However, it challenges traditional relational database systems and their information architecture models, which separate schema from content and depend on fixed vocabularies and categorizations (see Chapter 6).

Australian archivist Chris Hurley has theorized the need for new archival management infrastructures and data models suitable for use within an integrated environment. In such an environment, where there are no clear boundaries between record creation and record keeping, a sophisticated articulation of contextual relationships can support ambiguity and multiplicity:

The contextual meaning of recordkeeping entities must not be built into the captured view of them. It follows that contextual meaning must be documented not in entity description but in the crafting of relationships. (2005, p.40)

In effect, Hurley is advocating for a post-custodial approach to archival management, another concept developed by postmodern archival science theorists alongside expanded provenance and context (see Chapter 3). Hurley develops his arguments

from the perspective of a business environment where the introduction of networked computers and collaborative workflows makes traditional delineations between creators, record-keepers, users and associated workflows less clearly delineated, and therefore less easily represented by single descriptions bundled with single records. What is more, traditional standards of archival description cannot account for scenarios where two or more entities are involved in the creation or management of a record simultaneously, particularly when this involvement has the potential to change over time. However, this is precisely the challenge for the net art archive, which is why the post-custodial approach is relevant to the context of the ArtBase, too.¹⁷⁸ As the previous example with MTAA's artwork *SNAD* illustrated (see Part III Introduction), there are often multiple entities—artists, archivists, files and file systems—involved in the creation of an artwork and its various manifestations over time. The data model for the ArtBase's redesign, therefore, needed to provide information architecture patterns capable of expressing relationships between entities without dictating fixed terms of archival record description.

To specify the entity–record relationships within the MDI framework for the ArtBase redesign further, I also draw on the concept of "parallel provenance" as articulated by Hurley (2005). Parallel provenance within archival records accounts for: 1) multiple entities involved in a single activity related to a record (e.g., creation), and 2) multiple entities involved in different kinds of actions surrounding records (e.g., reperformance) (*ibid.*, p.39). An LOD application of parallel provenance in the case of the ArtBase can utilize patterns of data relations which define how or when an artist or an archivist was involved with a particular instantiation of the artwork, without necessarily fixing the terms of their involvement. What is more, there is capacity for simultaneous multiplicity. To use the MTAA example again, the model pattern for

¹⁷⁸ The concept of the "record continuum" as developed by Frank Upward and Sue McKemmish (Upward, 2005) is also relevant in this regard. Upward and McKemmish, as well as Hurley (2005, p.5), speak of the limitations of the life-cycle model for paper records and the necessity to perceive of electronic records within a continuum, i.e., a continuous process of "formation" and "becoming": "...the continuing addition of process metadata means that the archival bond, the links between records are constantly being remade within spacetime. There are no end products in an archival institution, no settled and stable beings... Recordkeeping objects are marked out by their process of formation and continuum, with no fixed end products in an archival institution, is a part of the post-custodial paradigm in postmodern archival science.

describing artwork creation can link a particular variant of the artwork (the archived copy of *TIME*!® hosted on Rhizome's server) to an agent (the artists, who submitted the archived version to the archive), and add a date to that statement (2002). The same pattern can also link the artists to other variants of the artwork (*TIME*!® hosted on the artist's server) at a different time (1998), while still linking the artists to the single GIF file variant of *SNAD* and its retrospective dating (1997). All of these individual, yet linked data statements comprise the artwork record's parallel provenance. In addition, the different sources of the provenance statements can be articulated within the *claims* and *statements* model of the Wikibase database. Hurley's view of parallel provenance stresses the importance of being able to preserve ambiguity and plurality in terms of provenance sources or ambiance (2005, pp.39-40). Ambiance is understood here, as the context of provenance. In the case of the ArtBase, ambiance may be intentionally obfuscated by the artists (MTAA, 1999), but other contexts, or "points of view" (Hurley, 2005, pp.39-40) of the provenance of a record can still be described within the LOD environment.

Provenance description and authorship in the net art archive need to be reconsidered not only because the artifacts are digital and networked, but also because of their community-specific cultural context, which emerged with the mainstream spread of accessible network connections in the late 80s and developing further into the 90s and the beginning of the 21st century. This culture is quite different from a traditional, Western archival and curatorial culture, where the artist/author is understood as a sole creator of a unique object, while the archive or museum can become the custodian of such objects for perpetuity. Multiple contributors with different roles and levels of contribution (including artists, programmers, archivists, and users, in the case of participatory online projects) as well as multiple variants of the artworks (involving all or only some of these contributors), complicate more traditional readings of authorship, provenance and custodianship, and the way such readings are manifested in archival or collection management systems.¹⁷⁹

¹⁷⁹ Other archivists following the postmodern archival tradition have also worked on frameworks that aim to expand beyond a single (Western, colonial) point of view of provenance and authorship in recordkeeping practices (Nesmith, 2006). Record authorship itself is a culturally-constructed practice, which is why one specific framework arguing for expanding archival methods and practices proposes a participatory model (Shilton and Srinivasan, 2007). Citing research with Native American communities,

In 2005, Hurley concluded that integrated records management systems capable of facilitating the conceptual framework of parallel provenance did not exist yet for two reasons—design and organizational culture (p.5). Currently, linked data models and graph databases are capable of meeting the design requirements of such a system. But developing organizational culture to a point where such systems can be accepted as the norm, remains an open issue within the digital cultural heritage community. Rhizome's interest in adopting a post-custodial approach across their entire preservation program (see Chapter 3), and their intention to establish communities of practice around their tools and preservation methods through community events, summits, and participating in open source software development (see Chapter 5), highlight the possibility to create cultural change within the digital preservation field. The critical standpoint established with the MDI framework to redesigning the ArtBase played a significant role in facilitating cross-community enrollment in the context of Rhizome's broader efforts. Activating prototypes as boundary objects and running workshops and discussion sessions encouraged user participation in the development of the model which adopts an expanded, parallel provenance paradigm in the ArtBase. This paradigm embraces plurality over a single-point-of-view understanding of the context around the records. In addition, Rhizome's implementation of a functional record-management environment (Wikibase) allowed me to move the development of patterns for relating data in the ArtBase from the Design Exploration to the Specification Phase in the fieldwork. Wikibase provided a concrete LOD infrastructure to test how conceptual ideas drawn from archival scientists like Cook (post-custodial approach) and Hurley (parallel provenance), as well as STS scholars like Star (boundary objects and boundary infrastructures) could be applied in practice (or not) towards the development of the new, provenance-driven data model for the ArtBase in a process which also involved users as active agents.

Shilton and Srinivasan (2007) argue for the adoption of participatory design methods, i.e. greater community involvement throughout the whole archival process: from appraisal through to the creation of archival description, establishing provenance and determining the ordering principles in the archive. The data in the ArtBase already exists and there is no scope within Rhizome to rewrite the records completely, so the participatory approach cannot be applied to the appraisal or data creation stages. But it can be applied to the decision-making process of establishing the relationships (or patterns of relationships) between archival entities, by using participatory design methods as part of the reflective practice fieldwork.

7.2 Developing a model for net art provenance

During the Specification Phase of the fieldwork, I focused on the development of a new provenance-driven data model, and a custom net-art-specific ontology,¹⁸⁰ which moved away from the description of siloed objects towards establishing patterns for describing the relationships between concepts, entities and agents. The model proposed an expanded understanding of what constitutes the provenance, or the context of the net art works, while the ontology was specific to the needs of the ArtBase, taking into account the varied ways that artworks entered the archive and the ways the preservation team have acted upon the works and their records since.

Considering the varied state of available data in the archive (see Chapters 1 and 6), the ontology did not aim to encompass every possible piece of data that may be available for a particular artwork. Instead, the principle method for developing the ontology, and patterns for connecting its different categories via the data model, was to first look at the questions ArtBase users (including Rhizome's internal staff as well as external user communities) might try to resolve via a database of machine-readable data. To do this, I analyzed the findings from the Discovery Phase of the fieldwork (see PhD Portfolio, Reports #1 and #2). Only then, was it possible to develop the necessary property and item categories in Wikibase and ensure the return of useful results. For example, a researcher studying the use of Adobe Flash among artists in the 00s might want to locate all the works in the archive that were developed using this software. Equally, a conservator restoring works which depend on Adobe Flash for their performativity, would also need a facility to easily retrieve all relevant works in the archive. Both questions could be answered by running a simple query, but users would need to know the correct format to pose their query—in this case, looking for artworks associated with the property 'browser plug-in' and the entity 'Adobe Flash'. Even questions that are highly specific to the ArtBase archive could be approached differently by different user communities, operating in different contexts. Finding an efficient way to represent data that could serve results to various, more or less similar

¹⁸⁰ As well as a conceptual framework, implementing a specific data model in the infrastructure of an information system requires an ontology. Ontologies are usually domain-specific, and as discussed in Chapter 2, there are no established net-art-specific ontologies yet.

questions required detailed understanding of the community of archive users, as well as the conventions they might be accustomed to. Therefore, the user studies and community enrollment strategies described in Chapter 5, as well as the establishment of a critical standpoint within the MDI framework, involved looking beyond the Wikidata ecosystem, to other community- or domain-specific metadata standards that might be familiar to, or in use by, ArtBase users.

At the same time, the established metadata schemas or ontologies from archival or museum institutions, which are familiar among the communities of practice I engaged with, focus overwhelmingly on the description of physical objects and are therefore not readily applicable to the net art case study. Many of them are designed to operate in siloed environments and still conform to a narrower, limited conception of provenance, authorship and context around records. Examples of limited utility which have already been considered in previous instantiations of the ArtBase database include Dublin Core or CDWA¹⁸¹ (see Chapter 2). Even models developed to take advantage of the affordances of linked data, such as CIDOC-CRM, focus predominantly on physical objects and the events that bind them in their physical environment.¹⁸² Only recently, more work has been done to develop extensions for digital objects within CIDOC-CRM, but this does not include objects of born-digital art (Bruseker et al., 2017).

In contrast to traditional cultural heritage standards, models and ontologies from the field of digital preservation and web standards, which are in use among communities adjacent to Rhizome's preservation program and to the ArtBase's network of relations, have focused on the description of processes and relations for some time already. PREMIS is an event-based standard for describing digital preservation metadata, which can be expressed as linked data and is widely used in the digital preservation community (PREMIS Editorial Committee, 2015). However, the level of event

 ¹⁸¹ The Categories for the Description of Works of Art (CDWA) is a list of categories and definitions for works of art and architecture maintained by the Getty Research Institute (Baca and Harpring, 2019).
¹⁸² CIDOC stands for the International Committee for Documentation of the International Council of Museums and CRM for conceptual reference model. CIDOC-CRM is a formal metadata standard intended to "facilitate the integration, mediation and interchange of heterogeneous cultural heritage information" (Crofts et al., 2011).

abstraction in PREMIS is only slightly more useful to managers of digital asset repositories, who monitor checksums and file format validation, than to the curators and conservators at Rhizome who are concerned with artistic and historic integrity of the artworks in the archive, as well as technical integrity (Rossenova et al., 2019, p.4). In contrast, PROV, a model developed by the Provenance Working Group at W3C specifically to express the provenance of digital data on the web, provides an efficient approach to representing data at a variety of scales: from single graphic files to entire websites (Moreau and Groth, 2013).¹⁸³ With a limited ontology of properties and entity categories, but highly abstracted patterns for relating concepts and entities, PROV provides the flexibility needed for modelling heterogeneous, non-standardized digital artifacts including net art works, while avoiding the complexity of a vast and overly detailed schema.¹⁸⁴

7.2.1 The PROV model

At its most abstract, the PROV model can be described as a network of relationships between entities, agents and activities, following a few formal patterns, e.g., "derivation", "generation", "association" (Fig. 7.1). Relationships of derivation can help express the links between multiple instantiations of works in the archive. Relationships of generation can add technical specificity to the processes of creation and custodial care that contextualize the works, while the relationships of association and attribution can provide the accountability of agents and their influence on the archive, which has been emphasized in postmodern archival theory (Cook, 2001; Hedstrom, 2002; Hurley, 2005) and is key to the post-custodial approach to archival classification and maintenance, which Rhizome have been pursuing. Furthermore, PROV also includes a "bundle" feature which enables recording the provenance of provenance (Moreau and Groth, 2013, p.34). In other words, if a specific user adds some metadata to the archive describing the provenance of a particular record, the archive can also record the identity of the user who performed this action. The

¹⁸³ PROV consists of a family of documents, including a data model (PROV-DM) and an OWL2 ontology (PROV-O), which allows expressing PROV-DM in RDF (Groth and Moreau, 2013).

¹⁸⁴ CIDOC-CRM has 90 entities and 149 properties only in its main specification, excluding all of its domain-specific extensions. (Crofts et al., 2011). In comparison, PROV-O contains 10 core entity classes and 25 properties (this excludes the qualified relationships, which derive from the core entities and properties) (Groth and Moreau, 2013).

possibility for such meta-provenance record-keeping facilitates a practical implementation of Hurley's (2005) conception of provenance ambiance. Metaprovenance can also help make more visible some of the traditionally "invisible" forces that structure archives and other forms of classification (Bowker and Star, 1999). This is an important strategy towards opening up processes of classification, maintenance and use to collaboration and interpretation across the ArtBase's multiple user communities as part of MDI's framing of infrastructural inversion.

Provenance as expressed via the PROV model resides in the relationships, or links, between entities, not in elaborate descriptions, or extensive controlled vocabularies of fixed terms. As such, the relationships may follow formal patterns of connection, but their interpretation is not prescribed by the PROV Working Group. They can be adapted to different domains and contexts, without losing their meaning in a networked environment (Moreau and Groth, 2013, p.5, 101). A derivation relationship between two entities may be interpreted in one way in the context of data journalism (one of the original case studies for the development of the model), or another in the context of born-digital art, but querying for the PROV derivation pattern via SPARQL will return consistent results across any linked data database.

Bearing this domain-agnosticism in mind, in a research case study project together with art historian Dr Karin de Wild, carried out between 2018-2019 during the Specification Phase of my fieldwork, we tested the applicability of PROV to the case of net art. Unlike other provenance standards which focus on a single entity (the art object) and its history of ownership, PROV describes "the people, institutions, entities, and activities, involved in producing, influencing, or delivering a piece of data or a thing" (Moreau and Groth, 2013, p.3). Therefore, we argued that several key characteristics of the PROV data model make it particularly well suited to the needs of net art:

The PROV model not only captures the creation of the artwork, but also how various actors contribute to or influence the work over time. For instance, these may include individuals or institutions, who commission, acquire, transfer or modify the work. Furthermore, PROV-DM can capture the different variants of a single artwork, even when these are preserved

across various institutions. A single Internet artwork can be included in multiple (museum) collections, (Web) archives, whilst being part of the live Web. (Rossenova et al., 2019, p.2)

As part of the research case study, we applied the PROV model to a specific artwork from the ArtBase: *untitled[scrollbars]* (2001) by artist Jan Robert Leegte (Fig. 3.6). In this application, we were able to trace the authorship of the artwork and several of its variants in the ArtBase, the connections of derivation among the variants, and the modes of generation of the variants by different agents (Fig. 7.2). The loose coupling of entities, agents and activities in this case study application provided the basic building blocks for the new provenance-driven data model for the ArtBase. During the Specification Phase of the fieldwork, I expanded the model from describing provenance data, such as relationships of derivation or association, to a range of other contextual processes related to the classification and maintenance of artworks, variants, or software entities in the archive.

7.2.2 An expanded application of PROV in the ArtBase

I developed the new data model and ontology for the ArtBase adopting the majority of properties and concepts provided by the PROV ontology, but also including a range of custom properties, which extended the technical domain of the model towards the specific preservation activities performed at Rhizome. Within the context of an LOD environment, the PROV model can be extended with other ontologies as needed, provided all the data is structured following RDF principles (Moreau and Groth, 2013). The custom properties and entities in the new ArtBase data model accounted for the technical or media resource dependencies of the net art works, as well as the environment and/or interaction patterns required for their reperformance. What is more, the context (or provenance ambiance) surrounding these entities in the archive can also be described, because every browser plug-in, operating system environment, and archival activity carried out by Rhizome are each recorded as separate entities, or nodes, in the network model of the database—connected, in turn, via appropriate sets of relations to other entities or nodes in the database (Fig. 7.3). I expanded the data model further by also allowing for the description of exhibitions and other events, related to the artwork, or a particular variant, as these could also play a role in the restaging of specific reperformance and preservation actions by archivists (Fig. 7.4).

All of these extended data relationships drew on findings from the user studies, which outlined the types of archival data users were most interested in accessing or working with (see PhD Portfolio, Report #2, pp.32–38). The possibility of fully customizing the data model and ontology used within Wikibase, while still conforming to RDF standards, allowed me to use the PROV model as a foundation, rather than a fixed schema to conform to. On this basis, I developed an LOD application of the concept of expanded provenance further, in line with the requirements of the networked, performative properties of net art, as well as the requirements of various ArtBase user communities (see PhD Portfolio, Data models).

Developing the application of the new ArtBase data model for a functional LOD environment, such as Wikibase, confirmed that following established cultural heritage metadata schemas and standards, for example PREMIS or CIDOC-CRM, is not only theoretically insufficient for representing the ArtBase data, but also impractical. Even standards that offer greater flexibility, such as PROV, cannot fully encompass all the particularities of the ArtBase. Gaining familiarity with specific models and standards was critical for understanding what terminology or patterns of data structuring may be most familiar and recognizable within certain communities as part of the reflective practice fieldwork, but these standards cannot be directly applied without regard for context. Instead, the strategy I developed as part of the MDI framework of the redesign, takes into account the technical possibilities and limitations of the chosen infrastructure (Wikibase), and adopts design methods including prototyping and user studies in order to devise a model that is informed by established standards, but not limited by them.

7.3 Implementation in Wikibase

In order to explore the possibilities and limitations of implementing a custom data model in Wikibase further, as part of the Specification Phase of the fieldwork, I once again used the research case study of Jan Robert Leegte's *untitled[scrollbars]* and added its provenance data to the actual record page for the artwork in the ArtBase. Owing to
its legacy ties to Wikimedia software,¹⁸⁵ Wikidata and Wikibase are very good at representing data about things, e.g., Wikipedia pages, but less good at representing 'events', which is a core modelling concept among LOD standards, including PROV. The *untitled[scrollbars]* case study demonstrated what this means in practice by comparing an 'ideal' application of PROV and how the data can be represented in Wikibase (Fig. 7.5) (Rossenova et al., 2019, p.5). What is referred to as 'data flow view' in PROV, i.e., the relationships of derivation among individual instantiations of the artwork, and 'responsibility view', i.e., the relationships between the artwork and the various agents acting upon it over time, can be represented both by a canonical PROV application and through practical implementation in Wikibase (*ibid*.). However, the 'process flow view', i.e., the relationships between various activities and other agents and entities in light of specific 'qualified relations', such as time period or type of activity, are not easily represented in Wikibase. Technically, a complex model for mapping qualified relations to statements with qualifiers in Wikibase could overcome this limitation.¹⁸⁶ However, the practical value of this wouldn't justify the added complexity to the system, both in terms of maintaining such data mappings and in terms of accessibility of the system via a graphical user interface (GUI).

7.3.1 The limits of event-based modeling

Event-based data models aim to build up a rich context around any entity in the database by making every possible semantic conjecture explicit and hence machine-readable and searchable (Oldman and CRM Labs, 2014). For example, an artwork is an entity made by the event of 'creation': one semantic triple connects the artwork entity to the event, while a separate semantic triple then connects that event to an artist. In

¹⁸⁵ Originally, the software infrastructure was not designed as a linked data system. Linked data capabilities were added later to serve the community needs for interoperability with existing linked data sets (Thornton et al., 2017).

¹⁸⁶ Moreau and Groth, 2013, define the "qualified relations pattern" as a mechanism to refine provenance, when a binary relation is not sufficient to describe a situation. The additional information which can be linked via such a pattern aims to support more advanced operations on the data. (p.23) In terms of LOD implementation, qualified relations are secondary semantic triples attached to a primary semantic triple. Technically, the qualifiers built into the default Wikidata data architecture provide a way to express secondary triples in Wikibase, however the RDF syntax produced within the Wikidata infrastructure to describe these is not the same as the canonical RDF syntax implemented by event-based standards, such as PROV. Qualifiers were originally developed in Wikidata for different reasons: the initial property-value pairs used in conjunction with items were "too simple" to represent complex situations, where there was need to account for multiple truths, or versions of the truth, as it evolved over time (Vrandečić and Krötzsch, 2014, pp.82-83; see Chapter 6).

contrast, within Wikibase this would be described with a single semantic triple linking the artwork with an artist. This is a more economical approach for human-readable data, but the event remains implicit within the choice of the property creating the link. Models such as CIDOC-CRM, and even PROV to some degree, tend to be theoretical constructs which aim to describe the entirety of (a human-)perceived reality in the most explicit way in terms of computational logic, using the fewest implicit assumptions that would make sense only to humans. While these models aim to describe a wide range of entities and events using the fewest unique ontological constructs (Crofts et al., 2011), they oftentimes are predicated on an entirely (abstract and idealized) automated infrastructure, with little role for human-driven manual editing or curation. They require the creation of a very large number of unique entities (or items) in the database, a number that is impractical if created by human curation. In practice, such systems are yet to be deployed in an accessible or sustainable way at scale within cultural heritage institutions.

Wikidata presents the other end of the spectrum. Being an open platform, which allows users individually curate the system, often results in poorly documented ontologies for various knowledge domains and an ever-expanding body of ontological constructs, which become difficult to keep up-to-date (see Chapter 6, and Piscopo, 2019). The crowd-sourced data model adds flexibility to data modelling in Wikidata: there are no fixed standards to be followed and the addition of numerous types of relationships, or properties, in the database is theoretically unlimited. The flexibility, however, also makes querying the data significantly more difficult, as it requires detailed familiarity with the data structure of the entire knowledge base and its custom ontology, in order to construct meaningful queries (Thornton et al., 2017).

The implementation of the new provenance-driven model for the ArtBase in Wikibase can take an alternative route. Relevant concepts and properties from external ontologies like PROV can still be used when carefully mapped to Wikibase RDF statements (Rossenova et al., 2019).¹⁸⁷ At the same time, the 'flattening' of events

¹⁸⁷ The ability to map concepts from one schema to another is a fundamental part of LOD by design, in order to account for the likelihood of databases using heterogeneous architectures, and different fields of knowledge developing different schemas (Hyvönen, 2012, p.11). Commonly, such linking is facilitated via the SKOS (Simple Knowledge Organization System) data model. The SKOS property skos:exactMatch is

(Fig. 7.5) can be considered not as a limitation, but an opportunity—to model data in a way that is more economical to the database (fewer explicit nodes to be created and stored) and more straightforward to represent to end-users via GUI. Considering the potential limitations of Wikibase, which does not easily accommodate event-based data models and requires additional data mapping, through the lens of how users access LOD via a GUI and make meaning from explicit or non-explicit data statements, opens up the final set of challenges for the ArtBase redesign. These concern the relationships between data model and interface that could render the underlying data structure more visible and open to interpretation by users.

7.3.2 The relations between data model and interface

LOD is an already complex concept to convey in visual language, due to the continued dominance of relational databases and users' naturalization to spreadsheet-style patterns of interaction with database content (Destandau, 2019). Wikibase arguably flattens the full potential for expression in LOD databases, but its default GUI utilizes familiar interaction patterns, such as individual web pages for every data node and tabular listings of properties and values. In the case of the public database, Wikidata, the GUI amongst other default collaborative features of the wiki software lower the barrier to access and allow for multiple communities of practice-not just the programmers of the database—to collaborate on the data model and negotiate its ontologies (Allison-Cassin and Scott, 2018; Piscopo, 2019). Across Wikidata communities, different styles of index tables and dashboards for project pages dedicated to specific knowledge domains have been developed to visualize data and data models (Fig. 7.6, 7.7). While these aim to render the overall model visible, there remains a great deal of expert knowledge and decision-making which may be preserved only on individual talk pages, and requires extended research or platform ethnography to retrieve and potentially engage with (Thornton et al., 2017). Perceiving the structure of the whole graph database from the tabular presentation of

already implemented in Wikidata as a standard way of matching a concept from one schema with another ('Property talk:P2888', 2019). PROV-O properties can be mapped to properties in the custom data model of the ArtBase by using an exactMatch property in Wikibase, which is in turn mapped to skos:exactMatch. This process is yet to be standardized across the Wikidata/Wikibase ecosystem and is part of the ongoing discussions around federation ('Federation input', 2019).

a single record page or even a group of records remains a challenge, particularly with large databases and ontologies. What is more, the plurality and multiplicity afforded by graph databases is rarely managed by humans alone. Users in a machine-readable graph database environment can be human, but oftentimes are also human-machine collaborations. For example, the bots programmed by Wikidata empower users to automate the execution of specific tasks on the graph; these require both human understanding of the evolution the graph and human consent from the community to allow the bot to perform specific operations (Piscopo, 2019). Community consent can only be meaningfully granted if the community has sufficient understanding of the rate, scope and type of agents performing edits to the graph database, and their ability to gain up-to-date overview as these vectors change over time. In other words, the community of users should have access to data, the provenance of data, and the provenance ambiance.

The development of the new provenance-driven data model for the ArtBase and its practical implementation for a case study artwork in Wikibase demonstrates that it is possible to facilitate expanded provenance descriptions for complex born-digital art artifacts within an LOD environment. At the same time, simply describing detailed provenance data in semantic triples and providing a GUI to the database, which utilizes familiar user interface metaphors, does not automatically result in an archival system in which user communities can effectively collaborate and intervene. The default interface of Wikibase cannot readily express all the variations, or the nuance of both implicit and explicit data relationships made possible via a custom data model. Therefore, the final set of problems for the Design Exploration and Specification Phases of the ArtBase redesign concerned the visual representation of nonhierarchical and networked data relations, which were not pre-determined by a fixed model or a standard ontology. New user interaction pathways in the ArtBase interface were needed to account for the expanded provenance of digital records, Rhizome's repertoire of preservation tools and methods, and the variability of the works expressed via the LOD statements of the new provenance-driven data model.

8 Redesign of the ArtBase interface within the MDI framework

Part II established that MDI's critical standpoint enables design for infrastructural inversion across multiple user communities, defined as: the act of making visible the underlying data structures and processes for structuring which normally remain transparent, or invisible to users (see Chapter 5). In Chapters 6 and 7, I explored the possibilities and the limitations of working with the not-yet-widely adopted technology of LOD databases, specifically Rhizome's installation of Wikibase as LOD infrastructure. I discussed the role of the provenance driven-data model in describing heterogeneous contextual data and maintenance processes surrounding the preservation and presentation of net art in the ArtBase. In Chapter 8, I turn to the user interface wherein the relations between the material conditions of the backend— including the specific set up of the LOD database and its custom data model—and the archive's user communities, are made manifest. With this chapter, I conclude Part III of the thesis and show how designing for infrastructural inversion becomes the main organizing principle that weaves together all areas and processes entangled in the MDI framework.

The design prototypes and data visualizations developed throughout the Design Exploration and Specification Phases of the fieldwork, address the areas of intersection between 'backend' and 'frontend' in the MDI framework by:

- presenting the new database model and ontology in a visually explorable way, which helps to make classification processes more visible;
- presenting temporal and performative context around net art works, which helps to make maintenance and preservation processes more visible;
- and lastly, presenting the data interconnections enabled by the new LOD structure, which opens new possibilities for user interactions in the archive.

In this chapter, I discuss the practical implementation of these strategies in the context of the ArtBase redesign in order to outline how an MDI framework could be applied to other contexts, too. I also consider the overall scope of the design problem

within the situated practice at Rhizome, reflecting on how a reframing of the designeruser-stakeholder relationships affects the wider application of MDI. Lastly, I point to possible areas for further study. MDI's move away from the ideology of seamless, transparent interfaces and user-friendly interactions, towards infrastructural inversion, and the (re)distribution of agency across the boundaries of user, designer, and stakeholder communities embodies its own ideological agenda. I argue that further research with/in communities of practice in the fields of open source software and cultural heritage could help interrogate the question of openness and user agency further and could benefit the ongoing development of MDI as a critical, conceptual and methodological framework for reflective design.

8.1 Strategies for infrastructural inversion

In contrast to the transparency of window-like interfaces, the new strategies of the MDI framework focus users' attention not only on 'content', but also on the ways that 'content' is woven together into particular narratives surrounding the works in the archive. The narratives embody specific forms of classification, particular policies and procedures towards data and software maintenance, and privilege certain user interactions over others. In most information systems, such narratives tend to be determined by designers and institutional stakeholders. But as the ArtBase's history shows, users often play important roles in the processes of classification, maintenance and access to an archive (see Chapters 1 and 2). The MDI framework invited users to once again actively participate in these processes through its strategies for infrastructural inversion and user enrollment in the network of the archive. These strategies involved developing data models and interface prototypes to describe and visualize the work of previous agents who had been involved in the archive's development (be it staff or users), as well as the negotiations carried out with/in different user community throughout all phases of the redesign fieldwork.

The following sub-sections hone in on specific prototype components across the three areas of backend–frontend intersection outlined in the introduction.¹⁸⁸ These

¹⁸⁸ The prototype visuals used as illustrations here, purposefully did not focus on visual style, but more on function and layout. Style-wise they leave multiple options open for possible for implementation by Rhizome. As discussed in Chapter 3, Rhizome could choose to keep the default Wikibase interface and

components illustrate how MDI strategies establish pathways for new forms of user interaction by combining findings from the research sessions with user communities (see PhD Portfolio, Report #2); knowledge of existing patterns of information structuring and visualization familiarized across specific communities (see PhD Portfolio, Report #3); and lastly situated knowledge of the default Wikibase software (see Chapters 6 and 7).

8.1.1 Presenting the new database model and ontology in a visually explorable way

For users to become active agents and contribute to processes of classification within the archival information system requires knowledge and understanding of the data model structure and ontology, and of their development over time. However, current systems, even those intended to be open and accessible to users, tend to represent models and classification standards via abstract UML diagrams¹⁸⁹ or other types of static graphic representation, such as the tables and dashboards used by the Wikidata communities (see Chapter 7) which are challenging to negotiate. These types of representations have limited utility in giving users an accurate and detailed view of the dynamic community-driven processes which result in the evolution of classifications and ontology categories. Instead, presenting the contextual data links enabled by the new database model and ontology for the ArtBase and making them accessible directly via explorable pathways in the prototypes (and eventually the live web interface), transforms the prototypes into boundary objects. Thus, users from different user communities would not require expertise about the technical infrastructure of the LOD database, in order to be able to engage in informed discussions around these data connections, translate new and unfamiliar categorizations across communities, or participate in the process of classification by providing feedback about the expansion of the ontology in new directions. Informed

lightly customize it; they could develop a separate application for displaying and interacting with the data from Wikibase, for a more branded approach; or they may even choose to maintain multiple interfaces, possibly partly developed by other members of the community, too.

¹⁸⁹ UML stands for Unified Modelling Language, a common standard used in the field of software engineering to visualize the data model underlying a specific system architecture ('Unified Modeling Language', 2020). Within complex systems, however it can quickly become difficult to visualize the entire system's ontology and structure as a single diagram without losing visual readability, or reducing the full possible range of expressions only to what is possible to fit on a computer screen. The limits of using such diagrams as communication tools is illustrated in Fig.4 in Kräutli and Valleriani (2018).

by users' requests for a glossary of new terms introduced via prototypes and other tools used during workshops and evaluation sessions (see PhD portfolio, Report #4, p.35), the MDI strategy for making classification processes more visible involves producing glossary-like data entries and linking across ontology definitions as pathways to infrastructural inversion.

A glossary of the data model

In Wikibase, the properties and items that structure the data into triples are simply nodes in the flat, non-hierarchical network of the graph database. This means that any entity (i.e., any item), as well as any concept that links entities (i.e., any property), becomes a 'clickable' element in the database, and the hyperlinks lead to full pages in the database interface. Instead of retaining this as a purely backend or administrative feature, the frontend user interface could also make use of this native capability and develop these pages into glossary entries. The prototypes for property and item page templates, developed in the Specification Phase of the fieldwork, included clearly written and succinct explanations, similar to entries in a glossary, of all significant concepts used in the semantic triples to describe net art provenance relationships. Custom metadata elements developed for these page templates enhanced the possibility to explore the LOD structure in a visual way. For example, property page templates contained 'Associated values'¹⁹⁰, while item page templates contained 'Associated properties' (Fig. 8.1, 8.2). Entries into these fields serve as controlled vocabularies, and their structure is explicitly visible to all users. In addition, the templates for item pages, such as the generation activity 'Webrecorder capture', could be contextualized further if a text description and associated properties, alongside other associated metadata were supplied too, for example 'Associated archival plans'¹⁹¹ (Fig. 8.3). Of all the possible archival plans implemented by the preservation program at Rhizome, only some would apply to the specific process of 'Webrecorder capture'. Recording such contextual data and making it visible in the frontend user interface, and not only as a specification of the data model in the backend, can provide

¹⁹⁰ Values are typically other items in the database. For more details on how the semantic triples in Wikibase are constructed see Chapter 6.

¹⁹¹ Archival plan is a new addition to the ontology of the ArtBase data model, based on an equivalent property in the W3C PROV standard for expressing provenance. For details on how a plan relates to the events, agents and entities in the PROV model, see Moreau and Groth, 2013, p.31-32.

an overview of plans which have been used in the past for specific generation activities. As well as being useful to in-house staff reviewing their own past activities, this additional interface component makes manifest a layer of contextual relationships in the database enabled by the design of the custom ontology and data model.

Linking out to other ontologies

Furthermore, the ArtBase is not a siloed resource. The custom ontology, while developed with the specific needs of the ArtBase in mind, relies on other, existing standards and classification principles. A richer context around the value- and knowledge-production entangled within the classification system of net art variants and data provenance can be made accessible to users via direct links to those standards' authority control databases. For example, 'generated by' is a property based on the PROV ontology, and even if a particular property requires adaptation within the ArtBase, it can still be mapped to its general specification on the W3C website via a data statement in the ArtBase.¹⁹² Creating visible links to the authority control databases of other standard ontologies—both for properties, and for items—facilitates user encounters with alternative interpretations of how certain entities or entity links may be scoped and conceptualized across different communities. By exposing and actively encouraging the proliferation of links between nodes in the ArtBase and other specialist resources, the database interface acts as a hub for translation and negotiation across multi-membership user communities. This fulfils the potential for LOD to enable connections across heterogeneous databases, and crucially, enables the ArtBase to act as a boundary infrastructure where different community standards can intersect, but working relations are maintained even in the absence of total consensus.

As net art's contextual description, or provenance, is not yet fully standardized across different stakeholder communities (see Chapters 2 and 3), and Rhizome's methods and tools for preservation are still in the process of being naturalized across ArtBase user communities (see Chapters 3 and 6), the ArtBase interface cannot rely on any single ontology or set of interface metaphors to facilitate informed user interaction. Instead, 'glossary entry' pages, category descriptions and clickable metadata elements can

¹⁹² Such mapping is a standard expression and core organizational feature of the RDF standard underpinning linked data databases (see Chapter 7).

create visual routes that guide users across the custom patterns connecting different categories of data, and even towards other authority databases. These visual routes are a necessary strategy for community translation and enrollment within the MDI framework of the ArtBase redesign. Crucially, this strategy is not exclusive to the LOD environment of the ArtBase. Many of these interface features could also be activated in relational databases. But such databases would not render the data machinereadable and accessible via SPARQL queries, thus limiting some of the potential for linking to external databases. However, these principles of designing a data model and associated ontology so that they are visually explorable could have wide application across archival or collection management systems, wherever there is institutional interest in involving users in classification processes. This would require willingness within the host institution to make its own processes of classification visible and open to external influences and interpretations. Rhizome's case study highlights the fact that in born-digital environments it is difficult to consider any data 'canonical' given the variable and performative properties of digital materiality. Therefore, an open, post-custodial approach to data modeling and ontology classification (see Chapters 3 and 7) is not only beneficial to supporting user agency, but to the institution itself, if it intends to keep data relevant and its collection of born-digital artifacts 'reperformable' by external user communities.

8.1.2 Presenting temporal and performative context around net art works

Net art works change and evolve over time, requiring (re)performance in order to be experienced by users. Reperformances, such as emulated or web archived instantiations of the artworks, result in the generation of new variants. To understand the range of processes involved in variant-generation and subsequent maintenance, users need access to an explorable data model and ontology, which has the capacity to grow and develop over time in response to new threats of obsolescence and new preservation measures. The glossary entries and links to external databases address this need to an extent. However, the ability to directly access individual artwork variants and understand the context around each variant requires additional interaction pathways without precedent in existing online collection interfaces (see PhD Portfolio, Report #3).

During the fieldwork studies, references to the term "variant" and related entities in the ArtBase ontology, such as "access state", "archival copy", "web archive", "emulated variant", proved unfamiliar and oftentimes confusing to users who were not members of Rhizome's community of practice (see PhD Portfolio, Report #4, p.55). Part of the challenge was a lack of means to articulate and meaningfully express multiple instantiations of an artwork as both 'the artwork' itself and simultaneously as individually distinct entities within standardized museum registrar information systems (Rossenova et al., 2019). The application of the PROV model as adapted for the ArtBase had the capacity to describe relationships between individual variants and the artwork as a whole but still required a concrete manifestation within the frontend interface. Several iterations of the new interface prototypes developed during the Design Exploration Phase gradually refined the visual components of individual access points to each variant presented within an artwork's record in Wikibase (see PhD Portfolio, Report #4). These access points communicated which variant the user was accessing (and where) as well as the condition of this variant—whether it was completely inaccessible, partly damaged, or generally functional. In addition, a further pathway to exploring 'all variants' utilized a timeline visualization approach. Instead of the standard timelines typically used to provide an overview of a whole collection, timelines in the ArtBase prototypes were applied more granularly—at the level of the individual artwork record. These visualizations acknowledge that a born-digital artwork is not a fixed entity, but rather a time-based, variable assemblage of multiple components, and provide an at-a-glance view of different variants and their respective provenance statements.

Accessing artwork variants in the ArtBase

The access points to individual variants in the new interface prototypes were initially demarcated as separate buttons with text labels on the artwork record page; each access point leading to the corresponding variant's (re)performance location (Fig. 8.4). Following evaluation sessions with Rhizome staff and other users, the prototype designs added additional visual cues in the form of icons to differentiate between variant types (e.g., archival copy, emulated variant) and access state (e.g., completely inaccessible, partly damaged, or generally functional). The access indicator icons were supplemented with pop ups where each access state, such as 'good', or 'medium', was

briefly described (Fig. 8.5). Furthermore, when users clicked on the buttons, instead of being immediately redirected to the corresponding variant's location, they first encountered an overlay screen—giving them extra information about the provenance of the variant and its technical dependencies (Fig. 8.6). Users commented that while they found some aspects of the different access points to variants confusing, after a few minutes of interaction they were soon able to understand the concepts, particularly when multiple interaction pathways were available and each individual metadata element was 'clickable'—opening up to the glossary page templates described in the previous section (see PhD portfolio, Report #4, p.99).

Timelines and provenance

As well as multiple access points on each artwork record page, timeline visualizations became a key visual and interaction strategy in the ArtBase redesign, which departed from the conventions associated with object-based museum collection records. In the new interface prototypes, dynamic timelines replaced the static method of 'dating' an artwork which had been applied in the ArtBase in the past, and is used in virtually all other institutional digital archives as well.¹⁹³ The new visualizations used conventional interface metaphors and existing UX patterns to display data in a way that users can easily understand based on their familiarity with existing collection interfaces: artwork variants and events were represented by standard surrogates, thumbnails and labels (Greene et al., 2000; Whitelaw, 2015) (Fig. 5.6).¹⁹⁴ Additional visual elements included date lines, icons and pop-ups. The data within these elements could all be displayed by drawing on metadata structured via the new provenance-driven data model, including details such as when the variant was created, who was maintaining it, and what was its current access state. The term *provenance* was not explicitly included

¹⁹³ During one of the workshop sessions, a user commented that the timeline visualization was very useful and represented something that "other museums often ignore, or don't want to acknowledge, or don't know how to represent—the idea that the artwork is not a fixed entity" (see PhD portfolio, Report #4, p.57).

¹⁹⁴ Discussing in detail the politics of timeline visualizations, particularly with regards to the display of uncertain or ambiguous dates and date ranges is beyond the scope of the thesis. In-depth research on these topics has been done already, see Krautli, 2016; Vane, 2019. This thesis proposes the application of timelines as an additional tool for understanding the context of complex born-digital artifacts and does not intend to be an in-depth investigation of styles of visualizing time. In addition, the prototypes discussed throughout this Chapter were intended as boundary objects and tools for discussion, rather than complete design solutions.

anywhere within the timeline interface or the variant access points.¹⁹⁵ Nevertheless, some users, particularly members of communities of archival practice, were able to pick up on the potential of these interface visualizations to serve as provenance research tools (see PhD portfolio, Report #4, p.39).¹⁹⁶

The timeline visualization provided an important new interaction pathway for users albeit one they did not know they needed. Many users tended to request features commonly used in other collection interfaces, such as keywords and tags, or timeline visualizations that feature the entire collection (see PhD portfolio, Report #2, pp.34-35). As the concept of the variant was not something commonly represented across other collections, users simply did not have a reference point for UX patterns involving variants, or provenance representations for multiple variants. The prototype visuals for variant access points and the artwork timeline, delivered on the requests expressed through user stories relating to the preservation history of the works and the maintenance processes carried out by Rhizome (see PhD portfolio, Report #2, pp.36-37), but did so through new interaction pathways. Common interface metaphors made it possible to translate the experience of these new pathways across different user communities even though not all categories or processes were familiar to all users. As a result, users could gain an overview of preservation and maintenance processes in the ArtBase, and engage in meaningful discussions around these processes—not only during user workshops and evaluation sessions with prototypes, but potentially later on, too, once they were using the archive as part of their everyday activities.

Having clear reference points, including the example of the access buttons or the timeline, where different processes and agencies associated with a net art work's variable temporal and performative properties can be viewed at-a-glance, negotiated and updated as needed, is a key strategy of the MDI framework towards infrastructural

¹⁹⁵ While provenance was the conceptual backbone of the data model, it was not a term used in the frontend user interface as a text label or heading, because it received mixed interpretations across different user communities in early testing sessions (see Chapter 6). Instead 'preservation history' was considered a more flexible term, which could be translated across different communities of practice, and could encompass different associated pieces of metadata. (see PhD portfolio, Report #4, pp.39, 52–53).
¹⁹⁶ As some users noted during workshop sessions with the prototypes: "The timelines in the prototype are great provenance tools. It shows the conception of the art and the changes it's been through"; "Loved the timeframe visualization tool: in my various archival work environments this is one of the most basic, yet confusing aspects of understanding a work" (see PhD portfolio, Report #4, p.39).

inversion in the ArtBase. Once again, this strategy is more readily applicable to an LOD environment, where multiple data relations can be expressed as a nonhierarchical and growing network. But timeline visualizations for individual artwork records and access points providing more detail than a simple statement like "View online"¹⁹⁷ could also be added to custom interface applications for various collection management systems, even in the absence of a graph database infrastructure. To effectively combine the material dimensions of backend and frontend with the processual dimension of maintenance, this particular strategy depends more on the willingness of institutional stakeholders to make various processes visible and accessible to users, than on any technologically-determined database structure.

8.1.3 Presenting the data interconnections enabled by the new LOD structure

The two strategies towards infrastructural inversion discussed so far, focused on making the data connections and ontologies used in the ArtBase, particularly those concerning the temporal and performative properties of net art, more visible and thus open to interpretation and interrogation by users. But the question of how users access and interact with archival data in the ArtBase, and furthermore what new interactions can be developed within the MDI framework to support user agency, is also deeply entangled with the specific possibilities (and limitations) of the underlying graph database structure. The graph database accommodates the storage of heterogeneous data and the expansion of ontologies over time in response to the needs of new creation or preservation paradigms, or new classification standards that may develop among ArtBase user communities (see Chapters 6 and 7). Being able to use such a dynamic database environment involves searching for, browsing and understanding a growing network of *indeterminate* connections across artworks and other data nodes in the archive: that is, connections inferred implicitly via the networked shape of the graph database, rather than explicitly via manual metadata entry.¹⁹⁸ In the machine-readable, LOD environment of Wikibase, the capacity to

¹⁹⁷ This is an example of an access statement used by some online collection interfaces observed during the Landscape Review, part of the Discovery Phase of the fieldwork (see PhD Portfolio, Report #3, p.31). ¹⁹⁸ This is in contrast to more traditional information systems based on relational databases, where all relations have to be pre-set as key-value pairs across tables of data (Dourish, 2014). The potential of the linked data database to overcome the limitations of relational databases lies in the ability to store and then query for indeterminate data connections via SPARQL (see Chapter 6).

search, find and display such connections is facilitated through SPARQL queries (see Chapter 6). However, since LOD environments are not-yet-widely used in the cultural heritage field, there are no established interaction patterns for working with SPARQL queries via graphical user interfaces that would be familiar to members of the ArtBase user communities (see PhD Portfolio, Report #3, p.126).

The final MDI strategy developed through design fieldwork, integrated the results of dynamic, real-time SPAROL queries into the visual design of the user interface. The design prototypes showed visualizations of query results which could expose all implicit and explicit connections between any two nodes in the database, such as two artworks. Making use of SPARQL queries in the LOD environment in this case, was not limited to users' individual abilities to write and run such queries from scratch, but rather their ability to navigate and understand the data interconnections made possible by the graph shape of the database. Displaying the results of pre-set queries did not provide users with full agency over the construction of the queries, i.e., over the posing of their own research questions to the database. Even so, it provided ways for users to interact with the queries and gain familiarity with the possibilities of manipulating linked data dynamically, without requiring fluency in SPARQL, or complete knowledge of all ontology categories in use in the ArtBase at any given point in time. The enactment of infrastructural inversion in this case, aimed to expand archival 'use' processes and access practices across GLAM and other cultural heritage community members, including those not yet naturalized to practices common in LOD and data science communities. Several components of the new ArtBase interface prototypes make use of embedded SPARQL query results (see PhD Portfolio, Report #4). Here, I focus on one specific component—a feature to explore artwork relations which highlights some of the key benefits and potential limitations of this MDI strategy.

Relating artworks

Due to the lack of standards for the description of net art works' context, relating a particular artwork to other artworks in the archive, and displaying these relations via a user interface, has proven to be a challenging aspect of the ArtBase interface design throughout the archive's history. In traditional collection interfaces, relationships

between artworks can be based on a common timeframe, common creator, common medium or even common color palette, to name a few (see PhD Portfolio, Report #3). But what should relations in a net art archive be based on when each artwork's date is not a fixed figure; when there are multiple agents involved in the artworks' creation and maintenance over time, but there is no way to describe all their various roles; or when the "medium" or "technology" used to create an artwork can shift and be updated/ upgraded over time? The most recent version of the ArtBase interface had removed the facility to display related artworks on individual artwork pages altogether. Among the reasons cited for this decision, staff mentioned the fact that the selections of artworks displayed as "related" was random and opaque, and so did not reveal the basis for the relations (see PhD Portfolio, Report #1, pp.35–36). At the same time, during the initial user studies a primary concern among members of various user communities was the lack of ways to discover relationships between artworks, which therefore limited the browsability of the archive (Fig. 8.7) (see also PhD Portfolio, Report #2). Building on established patterns of interaction in collection interfaces, many of which feature 'related' items on object pages (see PhD Portfolio, Report #3, section 2), as well as interface examples that improve browsability by providing multiple pathways for users to navigate collections horizontally (Wray et al., 2013) (see PhD Portfolio, Report #3, section 4), the new prototypes for the ArtBase interface proposed a 'Related artworks' feature on all artwork pages. SPARQL queries were used to generate real-time results of non-explicit artwork relations across the database, based on criteria enabled by the new provenance-driven data model ranging from creators, to technical dependencies, archival plans, and more.

The visualization strategies for the query results initially drew on popular approaches in other DH projects using LOD (see PhD Portfolio, Report #3, section 6). One pathway explored in an early prototype featured a 'network graph' visualizing relations across a 'scored field' (Fig. 8.8). At this point, the prototypes were visual mock-ups only: they served the purpose of acting as boundary objects and facilitating cross-community discussions, but did not represent a practical implementation wherein different data ranges could be tested and reviewed. While many users expressed positive reviews of the visualization (see PhD Portfolio, Report #4, p.71), network diagrams could, in practice, easily became unwieldy or uninteresting once users were faced with edge-

cases, which produced too many or too few relations.¹⁹⁹ An alternative approach, which was tested with the coded version of the prototypes developed in the Specification Phase of the fieldwork, was to implement a simpler diagram style in the form of an interactive tree chart. A tree chart organizes information spatially, grouping related concepts together and expanding areas which contain more information than others (Fig. 8.9). In the prototypes which tested this mode of visualization, users could preview a selection of three types of relations—common artist, common citations, and common exhibition history; but they could also choose their own categories via a dropdown menu. Selecting an option would 'run' a preconfigured SPARQL query, but the results would not be pre-determined. Instead, data retrieved would reflect real-time additions to the database e.g., new archival plans, or new dependencies, as classification methods and ontologies for describing net art evolve over time.

The prototypes developed to visualize indeterminate data connections during the research phase of this project remain largely speculative propositions. Although network graph visualizations and tree chart diagrams are staples of data visualization techniques, their use as vehicles to communicate real-time results of SPARQL queries as part of a strategy towards infrastructural inversion in digital archival interfaces, was novel. At the same time, initiating meaningful community discussions about visualizations or artwork relations remained challenging without live access to the actual data or a finished integration between frontend prototypes and backend database. This integration was beyond the scope of the research project and would be possible only after further development work at Rhizome is undertaken. As a result, discussions about the potential to generate indeterminate connections via SPARQL queries during user workshops remained within an abstract, conceptual sphere. This does not mean that the potential for useful insights from such discussions was diminished. Drucker has noted that "the study of the relational features of any material artifact and system puts us squarely into the realm of diagrams and the study of the semantics of relations" (2013, para 27). However, she also notes that the diagrammatic dimension does not rely solely on visual graphical forms, and instead

¹⁹⁹ For more on the practical difficulties of working with graph visualizations see: Perer and Shneiderman, (2006); Shneiderman and Plaisant (2006); Gansner et al. (2005).

relations can operate at various levels of abstraction: logical, mathematical, social, etc. (*ibid*.). Hence, even without visuals of live, dynamic updates of the data in real-time, users were still able to engage in insightful discussions about the possible relationships that the linked data model and new ontology could enable (see PhD Portfolio, Report #4, p.71–74).

Making SPARQL query results explorable without prerequisite data science knowledge is only applicable to LOD environments. Thus, it is not necessarily a required step in all implementations of the MDI framework. But an institution could still adopt the MDI framework as a conceptual and methodological approach to system design, by following the strategies to make their data models and classification processes more visible and by using data visualizations that highlight the temporal and performative properties of born-digital artifacts. 'Glossary entry'-style pages, custom access points and timeline visualizations could be developed even within archival systems which are built upon relational databases.

The technical complexity of LOD environments, the need for in-house expertise to run and maintain graph databases, and the added dependence on external agents and community decision-making processes in the case of an open source project like Wikibase (see Chapter 6), pose challenges to the wider adoption of LOD. Thus, the utilization of all MDI strategies towards infrastructural inversion may not yet be accessible to some institutions. At the same time, instead of perceiving this as a limitation of the MDI framework, I see this as an opportunity to develop the strategies, and impact, of the framework further. LOD environments are not-yet-widely standardized systems, but MDI's conceptualization of infrastructural inversion and its methods to guide the design of data models and interface components can help articulate the need to adopt and further develop such systems across the field of borndigital archives more widely. Strategies for infrastructural inversion, which can support user agency across different institutional contexts, depend equally on institutions opening up their processes to intervention from user communities, and on user communities engaging critically with the infrastructures and interfaces maintained by institutions. LOD environments have the capacity to support such open collaboration quite well at present, but broader adoption could be encouraged if open

source communities established closer working links with HCI designers and DH researchers to collaboratively develop more sustainable and less resource-demanding LOD software. Ultimately, the application of MDI strategies requires more than simply updates to an institutions' technical infrastructure, rather it involves a broader shift in the distribution of agency across the designer-user-institutional stakeholder communities.

8.2 The problem of design problems: evolving designer-userstakeholder relationships²⁰⁰

Developing strategies for the interface redesign of the ArtBase involved consideration of the overall positioning of the archive within the context of Rhizome's organizational and infrastructural policies. The resulting prototype designs, (see PhD Portfolio, Prototypes), were developed within a particular understanding of the past, present and future vision for the archive, derived from my embedded position within Rhizome and conversations with staff (see PhD Portfolio, Report #1). The designs were also informed by discussions with users, and the user stories developed through interviews and workshops (see PhD Portfolio, Report #2), which were, in turn, shared with staff members during iterative discussions on the design brief. The Introduction and Part I, which include discussions of the design methodology and the design brief respectively, established that within a reflective mode of inquiry, the design process is not a linear progression from problem to solution. In fact, it evolves through situated practice and therefore cannot be objectively defined in advance (Dorst, 2003). The significance of acquiring situated knowledge within a specific context in order to iteratively refine the problem-solution space, means that no methodological framework for a reflective design practice should be easily replicable or reproducible. Therefore, I do not consider the fact that MDI is context-specific and not a fixed, easily replicable set of instructions as a limitation of its methods and outcomes. It is instead a valid framework for reflective design practice within a Digital Humanities context (Kennedy-Clark 2013; Coles, 2016, cited in Vane, 2019, p.39). And as the development

²⁰⁰ The title "The problem of design problems" is derived from a paper by design researcher Dorst (2003), which examines the problems and paradoxes of design problems and articulating what reflective design practices entail. Here, I see it as a fitting way to lead into the discussion of some of the limitations, and possibilities, of my proposed design practice method.

of the MDI framework progressed throughout the course of the situated practice fieldwork, I no longer considered the context-specific artifacts, such as prototypes and data models, as sole outcomes of the practice—but began to think of the framework itself as a core achievement of the work. I also recognized the need for a paradigmatic shift in the strict delineation of designer-user-stakeholder relationships. To elaborate on the implications of this, I must circle back to where this project started—the design problem, and consider 'staying with the trouble' of the problem–solution space a while longer.

8.2.1 Limitations of the practice

Proponents of the reflective design paradigm have argued that 'design expertise' is key to understanding the co-evolution of problems and solutions within a design practice, because the designer is always operating within a situated practice from their own particular perspective:

To really capture design, we need to consider the problems as situated problems, as they are seen through the eyes of the designer. (Dorst, 2003) Furthermore, because complex design problems can only be studied, understood and addressed within a specific, subjectively-perceived context, the 'design problem' as such does not exist as an objective entity in the world (Dorst, 2003; Dreyfus, 1992). Therefore, in order to evaluate the applicability, or the limitations, of a particular approach:

The only thing left for us to study is the 'local' network of links that a designer considers while tackling a design problem in the design situation. (Dorst, 2003)

The role of an individual designer, and their level of 'design expertise', within such situations are certainly crucial: the reach of the MDI framework's critical standpoint (see Chapter 5), the range of communities I have encountered and positioned at the intersection of that standpoint, and the 'local' network of relations I have described in this thesis are necessarily limited by my own level of expertise, and skill, as a designer-researcher. One example of this limitation was observed earlier in this chapter when discussing the development of visual strategies for displaying indeterminate data connections. While I was developing the prototypes to represent these strategies, it

was possible to represent them as visual mockups, but not to populate them with realtime data results, because that would have required extensive development work.²⁰¹

Throughout all phases of the practice, I followed the example of other design researchers, mitigating the limits of my own expertise by referring to evaluation activities and close engagement with experts from various user communities (Kennedy-Clark 2013; Coles, 2016, in: Vane, 2019, p.39). These engagements helped move the outcomes of the design practice towards a preferred state, if not a perfect solution (see Introduction). But they also did more than that. The Discovery, Exploration and Evaluation Phases of the practice, involved extensive fieldwork which facilitated the translation of practices and metaphors across different user communities. Part of this fieldwork involved my own enrollment into various communities adjacent to the network of relations in the ArtBase (see Chapter 5). By producing a critical standpoint within this network of relations, I also introduced a shift in the role that the designer and their level of individual expertise might play in the redesign and redevelopment of the ArtBase archive.

Translation across user communities was made possible by the design prototypes acting as boundary objects. I activated these prototypes during workshop sessions by inviting representatives of different communities to attend the sessions, but participants were able to do the work of translation and collaborate without the designer acting on-behalf-of any community or mediating collaboration (see PhD Portfolio, Report #4).²⁰² These workshops and iterative prototyping methods led to the development of the MDI strategies for infrastructural inversion described earlier in this chapter. These strategies aim to make translation and collaboration within the archival interfaces and infrastructures possible even beyond completion of the (re)design process, when user communities are fully engaged with access and

²⁰¹ Although this work would be carried out by the institution at a later point, it didn't align with the timeframe of the design phases of the research practice, nor was I able to carry it out on my own. The visual mockups were sufficient to indicate a preferred state of the design, but were certainly not perfect solutions.

²⁰² The cultural probe methods used during the sessions described in Report #4, p.7, were particularly productive for such cross-community collaboration. In addition, the development of data integration workflow tools (described in Chapter 5, footnote <u>#155</u>) is another example of the type of collaboration in which design methods led to unexpected, but productive results that could be shared across a range of communities.

participation not only as 'testers', but as active agents throughout ongoing cycles of classification, maintenance and use in the information system.

The situated, reflective practice methodology described in this thesis is inevitably limited by the level of expertise of an individual designer, and by the degree to which an individual design can draw up a sufficiently sophisticated network of 'local links' concerning the design's problem–solution space (Dorst, 2003). But the critical standpoint of the MDI framework addresses these limitations by decentering the role of the individual designer and instead initiating processes that facilitate enrollment across community boundaries and instigate a (re)distribution of agency across designers, users, and stakeholders. In conclusion, while it aims to contribute knowledge and expand existing practices in the fields of HCI and UX, the MDI framework is not an approach that can be applied to other contexts simply by adjusting the practice of an individual HCI researcher or UX designer.

8.2.2 The role of institutional partners in evolving designer-user-stakeholder relationships in HCI and UX design practice

The standpoint at the intersection of different processes, communities and networks of relations articulated via the MDI framework, is reliant not only on the researcher's own expertise and understanding of the design problem, but also on the institution's understanding of the necessity of establishing such a standpoint in the first place. MDI's contribution to knowledge and the broader field of digital archiving beyond the disciplines of HCI and UX, is its articulation of the value for institutions to invite both designers and users to become active participants when it comes to addressing the increasingly more "open, complex, networked and dynamic" problems of making information systems accessible (Dorst, 2015).²⁰³

Establishing a critical standpoint in the context of my situated design practice at Rhizome allowed me to notice, observe and intervene in specific relations within the archive network—these included relations of design practice, preservation, data

²⁰³ Open, complex, networked and dynamic are characteristics of contemporary problems examined by Dorst in his publication "Frame Innovation" (2015), wherein he builds upon Schön's paradigm of reflective practice (1983) as well as his own earlier work articulating the problem of design problems (Dorst, 2003) and the co-evolution of problem-solution spaces (Dorst and Cross, 2001).

modelling, use and more. All these relations have concrete material manifestations that can be made more visible and accessible to diverse user communities via the data model, database and interface dimensions of the MDI framework. MDI's strategies for infrastructural inversion, as described in this chapter, operate within these material dimensions, but they also depend on institutional partners moving towards a redistribution of agency across the designer-user-stakeholder relationships. This involves:

- an openness to sharing institutional processes with a wider network of agents beyond internal staff;
- integration of reflective design methods across the entire cycle of development of an information system (i.e., not reducing design to the act of refining a graphical interface only after infrastructural decisions have been implemented);
- and lastly, fostering meaningful collaborations with users (i.e., involving user communities in the processes of classification and maintenance, and expanding interaction patterns with/in unfamiliar environments such as LOD databases).

The thesis has so far discussed *how* infrastructural inversion can be enacted within the ArtBase infrastructure and how this could also be applied to other contexts. The *why* aspect has been explained within functional parameters—it is necessary for users to be able to understand the infrastructure so they can expand their use of it, or collaborate with others. But of course, neither the *how* nor the *why* of the MDI framework are neutral. Like other HCI and UX paradigms,²⁰⁴ MDI embodies an ideological agenda: one that promotes openness within institutional operations and supports a departure from creating silos of knowledge. This agenda privileges users as active agents within the network of relations of the archive, rather than passive viewers. This is particularly appropriate in the context of the ArtBase, wherein many of the artworks explicitly critique interface transparency and require reperformance by users in order to be preserved. Rhizome's own preservation methods and tools, which rely on open

²⁰⁴ There are numerous examples of research in the fields of media studies, software studies, STS, and information science, that have examined the ideologies behind various conventional interface design paradigms. Among many others, examples that have influenced this thesis include: Manovich, 2001; Oudshoorn and Pinch, 2003; Drucker, 2013; Emerson, 2014; Lialina, 2016.

community collaboration and open source software, as well as their post-custodial approach to infrastructure and maintenance in the archive (Connor, 2019; see Chapter 3), have influenced the development of the MDI framework and its explicitly nontransparent agenda. At the same time, considering the potential for a broader application of the framework to other contexts, wherein this agenda may not be appropriate for various ethico-political reasons, opens up new research questions and opportunities for further research.

8.3 Areas for further study

Increasingly curators, conservators and researchers have argued that the challenges of preserving born-digital media are less connected to problems of technology, and digital (im)materiality, and more so to the social structures and networks involved in various maintenance processes around such media objects (Laurenson and van Saaze, 2014; Engel et al., 2018; Dekker, 2018). Similarly, the challenges of broader adoption of some of Rhizome's own preservation tools and approaches (see Chapter 5) and to the wider application of LOD environments within GLAMs (see Chapter 6), are at this point in time, more closely related to issues of organizational culture and the logistics of gathering sustainable community networks around open source projects than to purely technical processes. What is more, as briefly discussed in Chapter 6, simply embracing a post-custodial approach, and expressing a commitment to open data or an implementation of open source software does not automatically resolve longstanding issues within the cultural heritage fields around biased information systems and entrenched colonial values. The idea of openness, as embodied by the open source movement, carries its own ideologies of meritocracy, flat hierarchies, and universal access which can prove problematic (Keyes, 2019). MDI's critical standpoint offers a new position to think with from within institutional or community networks of relations, involved in the preservation of cultural heritage of the development of critical knowledge management infrastructure. This position considers not only the technological, or material dimensions of preservation projects and digital cultural infrastructures, but also the social processes that facilitate (or prevent, when absent) community collaboration, translation and enrollment. Carrying out further studies within cultural institutional contexts beyond Rhizome, or within communities whose preservation goals are adjacent to Rhizome's, such as various open source software

communities, would inform further refinement of the MDI framework, its methods and its ideological position vis-à-vis open knowledge and data sharing.

This thesis only touches briefly on the ethical dimensions of the reflective design practice by problematizing discussions around classifying users into categories, and questioning the extent to which intuition and empathy can (or cannot) play meaningful roles in the designer-user relationship (see Chapter 5). If studies within other contexts are carried out in the future, some further research questions for the MDI framework to explore would be: *who*, when defining the boundaries of different communities of practice, and also how and why different communities choose to engage with processes of classification, maintenance and use, or not. Establishing how engagement with such processes could become more equitable and more sustainable, will require research which addresses further aspects of embodied knowledge and situated practice, including race, gender, and ethnicity, and not simply a professional affiliation delineating a community boundary. Further study in this area could contribute to the development of MDI's methodology in the context of feminist standpoint theories (see Chapter 5), and help to articulate the role that MDI's standpoint could play in the development of more sustainable community networks around digital cultural heritage and open source software partnerships in the future.

Conclusion

Through the research process and its findings, this thesis has articulated a new and original framework for reflective design practice: Model-Database-Interface (MDI). The MDI framework develops new conceptual and methodological strategies to support user agency in born-digital archives through the application of linked open data (LOD) modelling, and new patterns for interaction via graphical user interfaces within an open source software database. The principle behind all these strategies is infrastructural inversion-making invisible structures and processes more visible-so that users are not faced with the binary choice of either interacting with a userfriendly or user-*un*friendly interface, but rather, have the opportunity to do their own interpretations and interventions in the digital archive. The MDI framework also produces a critical standpoint amidst the various communities and processes entangled in digital infrastructures, which instigates a shift in the distribution of agency across designer-user-stakeholder relationships. For designers, this shift offers involvement in a greater range of aspects of an information system redesign than is customary in the design disciplines: for example, involvement in processes related to 'backend' infrastructure, as well as 'frontend'. For users, this shift offers active participation in ongoing processes of classification and maintenance within information system, and not simply end-use. The implications of this shift for institutional stakeholders are related to MDI's potential role in the broader field of digital archiving. MDI argues for closer collaboration between institutional stakeholders, designers and users. Therefore, the wider applicability of the framework is reliant on cultural institutions adopting more open processes and material infrastructures. This relates not only to how institutions recruit and involve information professionals in processes of infrastructural (re)design, but also how they perceive their relationship to user communities and the value of supporting greater user agency.

Development of the MDI framework

In this thesis, I have unpacked the question of how to support user agency through interactions with born-digital archive interfaces as a set of design problems, and have addressed these problems via a situated design practice, using the case study of Rhizome's online archive of net art, the ArtBase.

I framed the case study of the ArtBase redesign as an interconnected set of problems concerning infrastructure, interface and user communities. These interconnections did not lend themselves to straightforward abstraction: they were situation-specific, and involved different fields of expertise (art, conservation, information science, interface design) and different communities of practice (artists, curators, archivists, users). Unpacking the situation-specific entanglements between users, interface and archive database, therefore, did not take the form of a linear journey from problem to end-solution. Instead, the problem-solution space of the redesign was iteratively and gradually refined, throughout several phases of a reflective design practice. The development of this practice followed the general move in the field of humancomputer interaction (HCI) away from quantitative usability-driven research towards qualitative, design-oriented approaches (Bødker, 2015; Vermeeren et al., 2016), such as Research-through-Design, among others. RtD blends design and iterative prototyping with other qualitative methods from the humanities and social sciences in ways that were influential to my own practice (Kräutli and Boyd-Davis, 2016; Gaver, 2012). However, building on insights that emerged from the specificity of the case study, I developed the RtD paradigm further into a new conceptual and methodological framework: MDI.

In the context of MDI, I conceptualize the archive as a network of relations enacted between users (staff, artists, programmers, academics) and digital infrastructure, which includes the *data model* for structuring data, the *database* for storing data, and the *interface* for interacting with data. The data model, the database software and the interface form the material dimensions of the framework. Various data collection policies and data management strategies that have been applied in the archive throughout its history, each play a part in the formation of a 'network'—used here, both in the technical, material sense, and in the conceptual sense of the word (Latour, 2005). In the ArtBase and its embodiment as a technical communications network, artworks and their assembled parts become nodes, while the metadata that connects those nodes must follow specific protocols of communication (classification ontologies, logical models of database architecture, etc.). Relations between nodes and protocols are enacted through a series of processes, which I classify within three primary categories: *classification, maintenance,* and *use.* These categories define the processual dimensions of the MDI framework which have conceptual as well as material implications for the redesign. To address the problems of the case study, the MDI framework involved the development of two core sets of strategies at the intersection of the material and processual dimensions illustrated in Fig. 0.1. These strategies concern the work with/in user communities, alongside the new specifications for the data model, database, and interface of the ArtBase, and set the MDI apart from existing design methodology frameworks.

MDI strategies for supporting user agency

To articulate the first set of strategies, I drew on the social science concepts of boundary objects, communities of practice and classification (Star and Griesemer, 1989; Bowker and Star, 1999), because processes and agents in the archive's network are entangled in socio-technical issues broader and more complex than the discourse of HCI alone can describe and conceptualize.

Working with/in user communities

Researching the history of Rhizome and the evolving position of the ArtBase within a grassroots community, the art world, and the fields of cultural heritage preservation and academia, helped to establish a clear understanding of user communities which are complex and diverse, and therefore do not engage with the archive in a homogenous way. In this context, design methods such as prototypes, wireframes and data visualizations were activated as boundary objects during workshops and discussion sessions, with the aim of facilitating close collaboration across communities of users and institutional stakeholders with different standards of classification and practice. Consensus, or total agreement, was not required for participants to be able to make sense of the interface prototypes, to debate where these aligned with or departed from their own communities' standards and norms, and

whether or not that presented an obstacle to their understanding, translation and possible adoption of these new norms. My practice of working with/in user communities was not limited to hosting traditional user research sessions and workshops. As designer, I myself, enrolled into user communities by learning about and adopting parts of the standard classification and practices defining these communities.

Studying, enrolling in and working with user communities—and the relations that develop and extend community networks—distinguish the MDI framework from other user research methodologies which observe users as 'personas' from an aspiring-to-empathy, but decidedly external position. Such methodologies typically position the designer as a central mediator between users and stakeholders: doing the work of translation *for*, or *on behalf of* user communities, but in this way also regarding users as passive subjects rather than active agents (Bennet and Rosner, 2019). Instead, the MDI framework produced a critical standpoint in the network of the archive, which allowed to pay attention to how systems of classification and practice can develop, overlap or diverge across different communities; and also to make interventions in how community relations operate and distribute agency.

The next set of MDI strategies aimed to further subvert traditional divisions between designers, users and stakeholders. This involved enacting infrastructural inversion across model, database, and interface. Infrastructural inversion is the act of making visible the underlying data structures and processes of structuring data which keep infrastructures "moving along", but generally remain transparent, or invisible to users (Bowker and Star, 1999).

Infrastructural inversion across model, database, interface

Recording and representing the temporal and variable properties of net art works had not been possible in previous instantiations of the ArtBase. Therefore, the MDI framework included the development of a new data model, which uses the expanded concept of archival provenance to make the contextual processes surrounding artworks—involving creation, deterioration and/or various acts of preservation enacted by different agents over time—more visible and accessible to users. This was a necessary step towards collaboration and translation across user communities with

varying degrees of familiarity to the works and their history in the archive. Next, the data model was implemented in an LOD environment, chosen for its capacity to store more complex and heterogeneous data connections than traditional collection management systems. Crucially, the database of this software environment provided the necessary level of flexibility to accommodate the organic growth of the data model and attendant ontology, so that feedback and involvement of user communities in processes of classification and maintenance were not limited to the workshop sessions of the design practice, but could continue in the future. Lastly, the strategies for infrastructural inversion via graphical user interfaces evolved through the iterative development of prototypes, which combined existing visual design metaphors with new interaction patterns. These supported informed user interaction across the unfamiliar structures of the LOD database, and the custom data model and ontology of the ArtBase. The prototypes proposed novel ways of developing LOD ontology glossaries, visualizing the temporal and variable properties of net art works, and exploring indeterminate data connections across the graph structure of the database, without the need for extensive prior knowledge of the categories and classifications used in the archive, or specific data science expertise.

The strategies of the MDI framework were developed within the particular context of a situated design practice at a born-digital cultural organization. However, they could be applied to a variety of contexts wherein a (re)distribution of agency across the designer-user-stakeholder relationships can be beneficial for the preservation of born-digital cultural heritage, and/or the continued development and maintenance of sustainable, open source software. Refining the MDI framework, and testing its wider applicability, would benefit from situated practice and research with other institutions and communities of practice in the future. MDI's current standpoint privileges the blurring of community boundaries and the open sharing of knowledge, data and practice. However, this may not be appropriate in all contexts. In many cases, the agenda for open knowledge as adopted across cultural and open source software communities is deeply rooted in Western, colonial ideologies and should not be perceived as a solution to all problems of cultural heritage preservation and/or knowledge management. MDI's commitment to noticing (and making visible) the entanglements between *data model, database* and *interface* are not strictly tied to LOD

or indeed any specific form of infrastructure. Future studies could explore how MDI's strategies might be developed further and applied to different cultural contexts, across a variety of socio-technical networks and infrastructures.

Appendix: List of figures

Introduction



Fig. 0.1. Diagram of the material and processual dimensions of the Model-Database-Interface design framework. \hookrightarrow \hookrightarrow

Part I: Prologue





FILTER -			SORT BY	MOST RECENT TITLE ARTIST
DATE		ARTIST NAME	TITLE	
FROM	то			
-		Name	Title	
				CLEAR FIELDS

Fig. 0.3. Sorting utility in the latest version of the ArtBase interface, 2015–. [Screenshot: 16 January 2017] \hookrightarrow



Fig. 0.4. View of an artwork in the most recent ArtBase interface: includes only artwork title, date, artist name and a short non-structured text description as metadata.
[Screenshot: 9 November 2017] ↔





Fig. 0.5. Examples of artworks no longer possible to access via the "View Artwork button". Top: Akke Wagenaar's *Animatrix* (1993). Bottom: Thomson & Craighead's *CNN Interactive just got more interactive* (1998). [Screenshots: 5 June 2020] ↔



Fig. 0.6. Example of an artwork with no access button at all. Health Bunting's *Untitled* (splash page) (1995). [Screenshot: 5 June 2020] \hookrightarrow
Part I: 2 Backend infrastructure for net art preservation



Fig. 2.1. (Top) *Form Art* (1997) accessed in a contemporary browser through the link in the ArtBase, 2017. (Bottom) *Form Art* (1997) restaged in a remote browser in the Net Art Anthology, 2017. [Screenshots: 8 May 2017] $\hookrightarrow \hookrightarrow \hookrightarrow \hookrightarrow$



Fig. 2.2. Reperformance of Marisa Olson's *Marisa's American Idol Audition Training Blog* (2004-5) via Webrecorder for the Net Art Anthology exhibition. [Screenshot: 8 May 2017] ↔



Fig. 2.3. View of the links in the web archive of Marisa Olson's *Marisa's American Idol Audition Training Blog* (2004-5) shown in the new interface of Conifer, Rhizome's hosted instance of Webrecorder. [Screenshot: 30 January 2021] ↔



Fig. 3.1. Timeline of policy and design developments in the ArtBase: 1999-2019. (See PhD Portfolio, Report #1, pp.50-51) ↔



Fig. 3.2. Early ArtBase interfaces: Text-based listing layout of the first ArtBase interface, 2001. [Screenshot: 16 January 2017] \hookrightarrow



Fig. 3.3. Early ArtBase interfaces: Text-based listing of excerpts alongside small image thumbnails, 2002. [Screenshot: 16 January 2017] \hookrightarrow

Welcome, Guest LOG	N JOIN forgot passv	vord?	Support Rhizom	vel 🍸 🗉 📾 🚳	SEARCH >
RHIZOM	E ARTE	BASE C	OMMUNITY	PROGRAMS	JOIN
Home / ArtBa	se / Browse	,	EATURED BROWSE TIME	LINE MEMBER EXHIBITION	S ABOUT POLICY SUBMIT
,	,				
BROWSE BY TITLE	BROWSE BY ARTIST	BROWSE BY TAG	BROWSE BY ARCHIVED		
SE	ARCH THE ARTBASE				EARCH
A B C	DEFGH	IJKL	M N O P Q	R S T U V	w x y z
The Famous Sound Absolute Wroader (by Johannes Auer	A Of (OC) E Of CI (200 P Reynald Dr	nouhin	d Because We Are Not Dead (2005) by "B pirusanta	ecause You Asked" (2007) by Alan Bigelow	"Brick" Draulogs (1995) Jim Johnson
"Butterfly Primes -Prejudicial Numbe (2005) by Reginald Brook	Durk Days, WA Terr-" Durk Days, WA A Video Installat Veloc In Nyc Gabriel W	site Nights" (2006) Viner	Jerusalem* (2001) Yalery Grancher	"Outskirt" (1965) by Lacie Garnes	"Poem e_" (acog) by tore terrasi
RhythmEngir "Rhythmengine" (ac bidenori watanat	ne shadouptay Division. Rea (2004) yoshi Sod	"ByJoy The nimated) Comr	Irrepairable Damage Visel/Realisation municated To Another" (2002) By GARRETT LYNCH	"Trails #1 #2" (2003) Bedward Tang	rede Case / a relieb Web D Bygs (suscher "Webpaining" (1997) Walery (Grancher
Whenever I See A Fl Remember The Sime (2002) by Geneo Gulan	ane, I L." Four Sface O Pour Sface O Reginal B	er Mine?") trooks	#1 (2003) by joao Simoes	ar an	CLOR Button'Element With Loeped Click Sound (2000)
EU 2020 2 Ku zozo ? (2005 Myriam Thyes	Laure-Anne	(Thu Jacobs	e Photographic-Diary Project (2001) Poj Jimmy Ocenns	(T) ERROR (T)Error (2004) By Robert Prazmarer	*Scope (2001) # ggp-7
				123436	i o a iu iu 🕨
ARTBASE	EDITORIAL	COMMUNITY	PROGRAMS	ABOUT RHIZOME	YOUR ACCOUNT
- about	- the blog	- discuss	- commissions	- mission	- view your profile
 member exhibitions commissioned essays 	- reatured articles - blog archive	 opportunities events 	- events - exhibitions	- history - orientation	 edit your profile username/password
- artworks timeline	- rhizome news	- jobs	- new media resource	ces - press	- make a donation
- browse	- subscribe	- sign-up	- the rhizome archive	e - staff	
- search		3		- supporters	
 DUUZANE	THENEW				
KHIZUME A	THE NEW M	Policy LS	Adve	rtise. Contact Us. S	ubscribe. Donate.

Fig. 3.4. Early ArtBase interfaces: Move towards an image-based grid with pagination, 2011. [Screenshot: 16 January 2017] \hookrightarrow

WayBackMachine	243	http://rhi	zome.org/artbase/timeline/		أسلامه	SEP OCT DEC 5 5 5 2010 2011 2012	Close 🗙 Help ?
	Welcome, Guest LOG	IN JOIN forgot pas	ssword?	Support Rhizome!	¥ 8 8 8	SEARCH >	
	RHIZOM	E ART	BASE CO	MMUNITY P	ROGRAMS	JOIN	
	Home / Artba	se / Timeline	FEA	ATURED BROWSE TIMELINE	MEMBER EXHIBITION	S ABOUT POLICY SUBMIT	
	1994 199	5 1996 1997 1998	 1999 2000 2001 2	2002 2003 2004 2005 2	006 2007 2008 20	09 2010 2011	
	and the man		1 110 C	ни и и и и и и	о на страна и страна И страна и с И страна и с		
	Nov Dec	2012	Feb Mar	Apr May	Jun	Jul Aug	
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			Indeterminate Hike	s + (03/19/12)			
			All jQuery Effe	acts (03/20/12)			
			The Best is Y	fet To Come (03/21/12)			
			ć 👩	CIRCUIT I (SYSCAPES) (03/24/12	2		
	Timeline copyright, SIM	LE - www.code.google.gor	n/p/simile-widgets/	Aar 25 jAp	1	Apr 8	
	ARTBASE	EDITORIAL	COMMUNITY	PROGRAMS	ABOUT RHIZOME	YOUR ACCOUNT	
	- about	- the blog	- discuss	- commissions	- mission	- view your profile	
	- member exhibitions	- featured articles	- opportunities	- events	- history	- edit your profile	
	- commissioned essays	- blog archive	- events	- exhibitions	- orientation	- username/password	
	- artworks timeline	- mizome news	- jobs	- new media resources	- press	- make a donation	
	- Drowse	- SUDSCIDØ	- sign-up	- the mizome archive	- stall		
	- collection policy		- mailing lists	- the store	- stan blog		
	- averon				- outpoindis		
			MUSEUM				
	RHIZOME A	I THE NEW	MUSEUM	Advertise	. Contact Us. S	ubscribe. Donate.	
			Policy Site	Credits Site Feedback			

Fig. 3.5. Early ArtBase interfaces: Browsing the ArtBase through a visual timeline, 2011. [Screenshot: 16 January 2017] \hookrightarrow





Fig. 3.6. Jan Robert Leegte's untitled[scrollbars] (2001) presented in: Safari 3.2.3 via oldweb.today's legacy browser system (top image); Chrome 76.0.3 (middle image);
Firefox 68.0.2 (bottom image). [Screenshots: 16 March 2019] ↔ ↔



Fig. 3.7 ArtBase alternative interface from the *Alt.interface* commissions: *Starry Night* (2001) by Alexander Galloway and Mark Tribe, with Martin Wattenberg. Image source: marktribe.net. ↔





Fig.4.1. (cont. on next page)



Fig.4.1. (cont.) A selection of major museum collection websites (Tate, MoMA, SFMOMA) all utilizing the metaphor of the virtual white cube gallery with a grid of thumbnail images as entry point to their collections. [Screenshots: 16 November 2018] \hookrightarrow

Part II: 5 User research in the context of the MDI framework



Fig. 5.1 Example user story cards that illustrate the structure of the user story: *As a...* [who is the user?], *I need/ want/ expect to...* [what does the user want to do?], *so that...* [why does the user want to do this?]. (See PhD Portfolio, Report #2, p.32) \hookrightarrow



Fig. 5.2. Selection of user story cards grouped under the themes of: *Motivations for archive use*. (See PhD Portfolio, Report #2, p.32) $\hookrightarrow \hookrightarrow$

66

As a researcher, I want to see metadata on accession details, copyrights, conservation actions, technical components, so that I can gain a better understanding of the context of the work within the collection.

66

As a researcher, I want to see artwork metadata, even if it's incomplete or inconsistent, so that I can assess the work within my understanding of the archive as a collaborative, evolving and imperfect space.

66

As a researcher, I want to see the origin of metadata like keywords, so that I know how it was added to the archive, because I understand some categorisation can be contested.

66

As a researcher, I want to be able to see more provenance or preservation metadata, so that I can better understand the history of this work within Rhizome's collection and how it has been cared for over time. As a researcher, I want to see the metadata added by artists, so that I can also have that context from the original ArtBase.

66

Fig. 5.3. Selection of user story cards grouped under the theme of: *Artwork record pages*, which pay particular attention to metadata classifications, policies and sources. (See PhD Portfolio, Report #2, pp.36-37) \hookrightarrow



66

As an artist, I want to see the archive as a wiki that is open rather than closed and where people can have accounts, so that they may contribute data that they might not normally disclose.

Fig. 5.4. Selection of user story cards grouped under the themes of: *General archive infrastructure and institutional policy.* (See PhD Portfolio, Report #2, p.33) $\hookrightarrow \hookrightarrow$

Artwork title	a 2001- Access via Rhizome archival copy Link health: <u>Kledum – some known desendencies</u> Provenance URL: archive.rhizome.org/example.com Inception: 2003 Attributed to: <u>Attributed to: Rhizome</u> Generated by: <u>Cloning</u>	Access state Access state The following dependencies affect the access state to this artwork:	Access via artist link
	Resort Insue? View Need more data? – Results access.	artwork	
	Caption: Image generation: Image attribution.		

Fig. 5.5. Early version of a low-fidelity wireframe presenting option for viewing access state of an artwork variant. (See PhD Portfolio, Report #4, p.16) \hookrightarrow



Fig. 5.6. View of a clickable online prototype with a timeline visualization indicating provenance of different artwork variants. (See PhD Portfolio, Report #4, p.28) \hookrightarrow

Part III



Fig. 0.7. MTAA, *Simple Net Art Diagram*. Top: First variant released in 1998 as part of *TIME*!®. Image source: mtaa.net. Bottom: Second variant released around 2000, but back-dated to 1997 by the artists. Image source: ArtBase. ↔





Fig. 0.8. A variant of *SNAD*, presented in *The Art Happens Here: Net Art's Archival Poetics*, 2019. Installation view. New Museum, New York. Image credit: Maris Hutchinson/EPW Studio. ↔

Part III: 6 Linked open data and collaborative open source software



Fig. 6.1. Basic structure of a data statement in Wikibase. \hookrightarrow

Part III: 7 A provenance-driven data model for the ArtBase



Fig. 7.1. A general representation of the core entity and relationship types in the PROV data model. \hookrightarrow





SOFTWARE-PRESERVATION-RELATED RECORDS								
EN	VIRONM	ENT	A	PPLICATIO	N	FI		г
property	type	target item	property	type	target item	property	type	target item
instance of	item	environment	instance of	item	application	instance of	item	environment
subclass of	item	environment	subclass of	item	application	format name	string	***
image	media file	***	image	media file	***	format version	string	***
archival access URL	URL	***	archival access URL	URL	***	mime type	string	***
inception	point in time	***	operating system	item		equivalent item	URL	***
emulation on	item	***	programming language	item		external ID [database title ID]	External ID	***
includes	item	***	software version	item		PRONOM file format ID	External ID	***
can run	item	***	capability	item				
equivalent item	URL	***	equivalent item	URL	***			

Fig. 7.3. New ArtBase data model: sections focusing on software components. (See PhD Portfolio, Data models) \hookrightarrow

EVENT RECORDS								
P	UBLICATIO	N		ЕХНІВІТІОІ	N	EVENT		
property	type	target item	property	type	target item	property	type	target item
inception	point in time	***	inception	point in time	***	inception	point in time	***
attributed to	item	personcollectiveinstitution	associated with	item	person collective institution	associated with	item	person collective institution
source	item	source item	location	item	location item	location	item	location item
official website	URL	***	image	media file	***	image	media file	***
			official website	URL	***			

Fig. 7.4. New ArtBase data model: sections focusing on events. (See PhD Portfolio, Data models) \hookrightarrow



Fig. 7.5. A comparison between 1) an ideal application of PROV-DM and PROV-O, and 2) a practical Ĵ Ĵ implementation in Rhizome's Wikibase. See Rossenova et al. (2019).

Describing individual objects [edit]

Data type	description	required
Item	that class of which this subject is a particular example and member (subject typically an individual member with a proper name label); different from P279; using this property as a qualifier is deprecated—use P2868 or P3831 instead	yes
Item	maker of this creative work or other object (where no more specific property exists). Paintings with unknown painters, use "anonymous" (Q4233718) as value.	yes
Commons media file	image of the artist's mark on the work that identify his work	no
Monolingual text	published title of a work, such as a newspaper article, a literary work, a website, or a performance work	no
Point in time	date or point in time when the subject came into existence as defined	yes
Item	depicted entity (see also P921: main subject)	no
Item	secondary features depicted in a work. Use as qualifier for "depicts" (P180)	no
String	Iconclass code depicted in an artwork. For linking Iconclass codes with their corresponding artistic themes or concepts, use P1256 (Iconclass notation).	no
Item	material the subject is made of or derived from	yes
Item	method, process or technique used to grow, cook, weave, build, assemble, manufacture the item	no
Quantity	vertical length of an entity	no
Quantity	width of an object	no
Quantity	extent from one surface to the opposite	no
Item	person or organization that commissioned this work	no
	Data type Item Commons Commons Commons Commons Commons Item Item Item Item Item Item Item Item	Data typedescriptionItemthat class of which this subject is a particular example and member (subject typically an individual member with a proper name label); different from P279; using this property as a qualifier is deprecated—use P2868 or P3831 insteadItemmaker of this creative work or other object (where no more specific property exists). Paintings with unknown painters, use "anonymous" (Q4233718) as value.Commos media filemage of the artist's mark on the work that identify his workMonolingual

Fig. 7.6. Incomplete view of a table from 'WikiProject Page Visual Arts' (2019), outlining a schema for visual arts items in Wikidata. [Screenshot 29 November, 2019] →

All objects	Timeline of Ar	t History	inventory	O Hig	ghlights	O inventory	O issues	Popular works	Other tools
his table describes the complet entities얁 I count얈 I all groupings얁 I i	teness of properties in V without grouping property 중 H	Vikidata for all Mel below threshold (1) 당	t objects (10,000+).	A good reference	e for item structure	e for visual works:	Wikidata:WikiProject_Visual	_arts/item_structure.	Manually updat
Top groupings (Minin	mum 1 items)				Top Proper	ties (used at leas	at 0 times per grouping)		
Name	Count	image (P18) 🕈	inception (P571)	height (P2048)	width (P2049)	creator (P170)	The Met object ID (P3634)	inventory number (P217)	e described at URL (P973)
painting (Q3305213)	8219	64.38% (5291) 4	99.44% (8173) 🔍	76.54% (6291) 4	76.32% (6273)	99.95% (8215)	100.0% (8219) 🔍	100.0% (8219) 🔍	3.29% (270) 🔍
sculpture (Q860861)	343	71.14% (244) 4	90.67% (311) 🔍	13.12% (45) 🔍	10.2% (35) 🔍	51.6% (177) 🔍	100.0% (343) 🔍	99.71% (342) 🔍	2.62% (9) 🔍
drawing (Q93184)	328	60.98% (200) 4	77.13% (253) 🥄	45.43% (149) 4	45.12% (148) 4	80.49% (264)	100.0% (328) 🔍	100.0% (328) 🔍	0.3% (1) 🔍
woodcut print (Q18219090)	170	99.41% (169) •	75.29% (128) 🥄	19.41% (33) 🔍	19.41% (33) 🔍	100.0% (170) •	100.0% (170) 🔍	98.82% (168) 🔍	17.06% (29) 🔍
watercolor painting (Q18761202)	121	99.17% (120)	91.74% (111) 🔍	95.87% (116)	95.87% (116)	100.0% (121) •	100.0% (121) 🔍	100.0% (121) 🔍	0% (0) 🔍
book (Q571)	119	86.55% (103) •	99.16% (118) 🔍	13.45% (16) 🔍	3.36% (4) 🔍	14.29% (17) 🔍	100.0% (119) 🔍	100.0% (119) 🔍	0.84% (1) 🔍
photograph (Q125191)	71	87.32% (62) 🔍	94.37% (67) 🔍	15.49% (11) 🔍	15.49% (11) 🔍	50.7% (36) 🔍	100.0% (71) 🔍	100.0% (71)	4.23% (3) 🔍
urniture (Q14745)	55	80.0% (44) 🔍	94.55% (52) 🔍	5.45% (3) 🔍	5.45% (3) 🔍	29.09% (16) 🔍	100.0% (55) 🔍	100.0% (55) 🔍	0% (0) 🔍
/ase (Q191851)	47	89.36% (42) 🔍	85.11% (40) 🔍	14.89% (7) 🔍	6.38% (3) 🔍	38.3% (18) 🔍	100.0% (47) 🔍	100.0% (47) 🔍	2.13% (1) 🔍
statuette (Q16738862)	45	100.0% (45) 🔍	97.78% (44) 🔍	4.44% (2) 🔍	2.22% (1) 🔍	4.44% (2) 🔍	100.0% (45) 🔍	100.0% (45) 🔍	0% (0) 🔍
print (Q11060274)	41	58.54% (24) 🔍	82.93% (34) 🔍	14.63% (6) 🔍	14.63% (6) 🔍	78.05% (32) 🔍	100.0% (41) 🔍	100.0% (41) 🔍	4.88% (2) 🔍
extile artwork (Q22075301)	41	9.76% (4) 🔍	87.8% (36) 🔍	0% (0) 🔍	0% (0) 🔍	87.8% (36) 🔍	100.0% (41) 🔍	100.0% (41) 🔍	0% (0) 🔍
codex (Q213924)	38	100.0% (38) 🔍	100.0% (38) 🔍	23.68% (9) 🔍	15.79% (6) 🔍	13.16% (5) 🔍	100.0% (38) 🔍	100.0% (38) 🔍	0% (0) 🔍
metal artwork (Q29382731)	29	100.0% (29) 🔍	100.0% (29) 🔍	17.24% (5) 🔍	17.24% (5) 🔍	6.9% (2) 🔍	100.0% (29) 🔍	100.0% (29) 🔍	0% (0) 🔍
ronze sculpture (Q928357)	27	100.0% (27) 🔍	100.0% (27) 🔍	11.11% (3) 🔍	7.41% (2) 🔍	25.93% (7) 🔍	100.0% (27) 🔍	100.0% (27) 🔍	0% (0) 🔍
stained glass (Q1473346)	26	100.0% (26) 🔍	100.0% (26) 🔍	19.23% (5) 🔍	19.23% (5) 🔍	76.92% (20) 🔍	100.0% (26) 🔍	100.0% (26)	0% (0) 🔍

Fig. 7.7. A dashboard tool, using tabular presentation to track property completeness for Met Museum Objects in Wikidata (`Met All Objects', 2019).
[Screenshot 29 November, 2019] ↔

Part III. 8 Redesign of the ArtBase interface within the MDI

framework

RHIZOMEARTBASE	History of the ArtBase	Browse the archive	Curated selections	Keyword search	۹
Access state					
Description Denotes the level of functional access point such as an <u>Artist link</u> or an <u>ArtB</u> access is based on audits carried out aim to be an objective value, but rathu users a degree of confidence in know	s to an artwork via a specific e ase variant access URL. The s by Rhizome archivist and doe r an approximation aimed to ing what they are about to acc	Assoc untry state of give pess. Description: Medium Description:	iated values Access point has not yet been audited by an arch Access point has multiple unsupported or damage Access point has some unsupported or damaged Access point has few unsupported or damaged d	ivist. ed dependencies. I dependencies.	

Fig. 8.1. Sample property page template in the ArtBase interface prototype. (See PhD Portfolio, Prototypes) \hookrightarrow

RHIZOMEARTBASE	History of the ArtBase	Browse the	e archive	Curated selections		Keyword search	Q
Good					Artwo	rks associated with this iten	n
Description			Associ	ated properties			
Access point has few unsupported or d	amaged dependencies.		Access st Description: D such as an ar audits carried rather an appu are about to a	ate Denotes the level of functional access to Itsi link or an archival variant access to out by Phitzome archivist and does not roximation aimed to give users a degree ccoss.	an artwo RL. The st aim to be e of confid	rk via a specific entry point ate of access is based on an objective value, but lence in knowing what they	

Fig. 8.2. Sample item page template in the ArtBase interface prototype. (See PhD Portfolio, Prototypes) \hookrightarrow

RHIZOMEARTBASE	History of the ArtBase Brows	e the archive Curated selections	Keyword search	۹
Webrecorder capture			Artworks associated with this item	
Description		Associated properties		
This process involves the use of Rhizome's web order to create an archival WARC file. WARC file Webenact platform. These re-performances aim of the artwork as possible, but still involve curato the Archival Plan metadata for more details.	archiving software tool Webrecorder in s are re-performed via Rhizome's to be as close to the original presentation rial decisions taken by the archivist. See	Generated by Description: The activity or preservation procedure through which an it may refer to primary source materials supplied by white, such as article undertaken by the archivists and the preservation team at Rhizome in	tem in the ArtBase database has been created. This I links and descriptions. It may also refer to actions order to generate an artwork variant.	
Matadata		Associated Archival Plans		
Tools used: <u>Webrecorder</u> Resources: Live Web: Internet Archive: Re-performance platform: <u>Webenact</u> Dependencies: <u>Webrecorder</u> : <u>Webenact</u> ; pywb:		Exclusion of external links from capture Description: The archivist for curstry has decided to exclude some ex- ether due to link red, or intentional curstion animed at preserving a fou- copyright, potentially sensitive or private data, or for another meason external links restored via public web archive Description: Some of the external links in this archive capture have be	Annal links from the archival capture of the artwork, odde valued of the artwork wildling third-party deemed suitable by the archivist. Captures en restored mongh extraction from public web	
		archives, such as the Internet Archive. This proceedure in necessary in web variant of the artivoris, but suitable resources from the relevant fin Temporal mismatch in some external resources Description: Some of the external links in this archive largeline have be archives, such as the Internet Archive. but due to unavailability of com- resources may have been resource from archival captures laken at dif- or at the discretion of the archivit and amis to preserve temporal fields Social media privace's allowances	occasionally necessary if links are broken in the live ne period can be found in existing web archives. 28 Benestored through extraction from public web plete resources from the same time period, some ferrent points in first. Such restoration work is carried sity as best as possible.	
		Description: Some links in this archival capture may have been disable may not have granted the rights to archiving their data to the artist. Th of social media performance artworks where the privacy of users other honoured.	ed in order to preserve the privacy of third-parties who is archival plan is commonly used in archival captures r than the artist and their collaborators should be	

Fig. 8.3. Item page prototype, including added descriptive elements such as 'Associated archival plans' and additional metadata. (See PhD Portfolio, Prototypes) \hookrightarrow



Fig. 8.4. Variant access points in the ArtBase interface prototype. (See PhD Portfolio, Prototypes) \hookrightarrow



Fig. 8.5. Variant access points in the ArtBase interface prototype with additional information pop-up activated on mouse-over. (See PhD Portfolio, Prototypes) \hookrightarrow



Fig. 8.6. Variant access point in the ArtBase interface prototype with additional information overlay activated on click. (See PhD Portfolio, Prototypes) \hookrightarrow

66

As an ArtBase user, I want to filter artworks by keywords or categories, so that I can gain an overview of what types of things are present in the collection.

66

As an ArtBase user, I want to see a list of all tags used in the archive, so that I can gain an overview of what types of things are present in the collection.

66

As an ArtBase user, I want to see curated lists around specific themes or processes, so that I can explore smaller subsets of the collection focused on a specific topic.

66

As an ArtBase user, I want to interact with a search query interface, so that I can do research into very specific elements of the collection.

66

As an ArtBase user, I want to see metadata about themes or subjects in the archive, so that I can gain an overview of what types of things are present in the collection.

66

As a researcher, I want to have an expanded search capability, including keywords, subject, media, form, etc, so that I can find works in the archive relevant to my research interests.

Fig. 8.7. Selection of user story cards grouped under the theme of: *Archive entry* points and discovery. (See PhD Portfolio, Report #2, p.34–35) \hookrightarrow



Fig. 8.8. Related artworks interface using a network graph visualization style. (See PhD Portfolio, Report #4, p.25) \hookrightarrow

More by the same artist(s) Common citations	Common exhibition history
common exhibition history common tags common dependencies common archival plan	Related Artwork Title Goes Here
lated Artwork Title Goes Here	Related Artwork Title Goes Here
ated Artwork Title Goes Here	Related Artwork Title Goes Here
	Related Artwork Title Goes Here
mon citations ated Artwork Title Goes Here Incention: 2002	Related Artwork Title Goes Here Inception: 2002
ated Artwork Title Goes Here	Related Artwork Title Goes Here
	Related Artwork Title Goes Here

Fig. 8.9. Related artworks interface using a tree chart visualization style. (See PhD Portfolio, Report #4, p.72-73) \hookrightarrow

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