# A Design Archival Approach to Knowledge Production in Design Research and Practice

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## ABSTRACT

In this paper, we develop the notion of *design archives* to understand how different forms of knowledge are systematically accumulated and shared in and across design processes. Drawing on philosophy and media theory, we present a working definition of design archives as more than documentation. Through an interview study, we investigate how various archives systematically inform design work and govern the way design processes are represented and reflected upon. The study provides insights into an abundance of tools used to access, record, store and share information. We highlight the difference between personal, shared, and public archives, different archival barriers for sharing, how prototypes act as (an)archival conduits of design potentials, and how information (and people) tend to get lost in the archives. Finally, we discuss how a design archival approach might help identify power relations in design while also facilitating a move from 'dead' to 'living' archives in design work.

## CCS CONCEPTS

• **Human-centered computing** • *Human-centered computing~Interaction design process and methods* • *Human-centered computing~Interaction design theory, concepts and paradigms*

## KEYWORDS

Design archives, documentation, digital support tools, design knowledge, design processes, design research, design theory

## 1 Introduction

A recurrent theme in Human-Computer Interaction (HCI) and Interaction Design (IxD) research in recent years has been an investigation of the kinds of knowledge contributions that can be derived from documenting and reflecting upon design processes [1, 2, 8, 29, 38]. Höök et al. identify the documentation and scrutinising of design processes as one of five core challenges for framing knowledge derived from research in interaction design [21]. Binder and Redström present design research as a venue for knowledge creation and outline "exemplary design research driven by program, experiment and intervention" as a frame and foundation for conducting this type of research [3].

An inherent challenge in design research and practice stems from the fact that 'knowing' in design is both theoretically and practically oriented and informed. Rather than being mutually exclusive, however, these ways of knowing come together to prepare the designers for action by informing their design judgment [35]. Knowledge can be accumulated or manifested in the actual crafting of a design, but also be acquired through the exploratory investigations carried out as part of the design process. Knowledge is produced through the creation of the design things [4], design materials [19] and design artifacts [23] that populate the design process. And it is produced on a number of different levels, as discussed by Höök and Löwgren who in particular call for the investigation of new forms of intermediate-level knowledge, i.e. knowledge that plays a direct role in the creation of new designs [22].

A question emerging from these investigations into the framing of design knowledge concerns the nature of the knowledge acquired throughout the design process and what form this knowledge might take - and how we might document, accommodate and express these forms of knowledge in design research and practice. Further, we may ask how this relates to the design of interactive systems, and the construction of a design repertoire [32] - understood both as the continued development of a designer's practice, but also as a formulation of design themes or programs working across design processes and ecologies [3, 15].

To better unfold these themes, this paper introduces the notion of *design archives* to account for the ways in which externalised

knowledge is systematically accumulated and shared in and across design processes. We argue that a design archival focus can further the understanding of how knowledge is produced and preserved in design, since a focus limited to documentation does not encompass the complex structures that support and restrict knowledge mobilisation in and across design processes. Building on an archive theoretical foundation from Foucault [14], Derrida [10] and Ernst [13], we argue that focusing the analysis on archive formations in design processes allows us to better account for the various sources of knowledge that inform design work over time, and how representations of design work are formed and transformed according to the archives they are inscribed into. Rather than denoting a static repository documenting activities in the design process, a design archival approach opens a conceptual path for rethinking existing archival practices in design processes based on an active exploration of digital materials and tools to support more systematic, creative and collaborative forms of archiving. Further, it emphasises the structural distributions of power that influence how knowledge is produced and reflected upon across design- and research processes.

The paper is structured as follows: first, we present related work on design documentation and knowledge accumulation in design processes. Following this, we build on a conceptual understanding of the archive to present our notion of design archives focused on design specific themes and domains. We then present the results from an interview study carried out with eight designers and design researchers from academia and the industry. Finally, we discuss these findings in relation to the concept of design archives and outline potential themes and trajectories for further investigation.

## 1 Related Work

Within HCI, research into technologies and practices of archiving is by no means a new area of interest. These studies range from looking at how people organise their desks and desktops [20, 28], over medium-specific approaches to personal storage of e-mails and documents [5, 12, 37], to more general studies of archiving as practice [25, 36]. While such research is valuable in terms of understanding and developing means of archiving, this paper takes a more meta-approach in studying the very processes from which these technologies are conceived.

With no knowledge of former research done within this area, this paper builds on a continued interest in processes concerned with design documentation as a key concern for understanding knowledge creation in interaction design research [8, 21]. Asking how we frame IxD knowledge, Höök et al. argue that "(...) the field (RtD, Research-through-design), is still struggling with how to express knowledge and insights that concern aesthetics, design skills, designerly knowledge, politics, values, and other intangible ingredients in IxD practice." [21]. This section outlines current discussions within design research and Research-through-Design (RtD) focused on the relation between knowledge creation and different formats for documenting, distributing and accumulating design knowledge. We also focus on the current use of digital support tools to facilitate this work.

### 1.1 Knowledge Production and Design Documentation

According to Brandt and Binder the point of emphasis in design research can indeed be framed as how designerly engagement can become a relevant vehicle for the creation of knowledge [6]. A challenge stems from the fact that design research points both to a particular aspect of design as a professional practice as well as a more general notion of practice-based research. As a consequence, "... design practice may involve research and design research practice may involve design, without the present-day discussion giving any formal or practical handles to distinguish between research in the former and the latter case" [6]. From this follows a need to construct a rigorous methodological framework for identifying what constitutes *knowledge* and *knowing* in design - and, hence, what constitutes *appropriate repositories* to support the creation and dissemination of this knowledge. In relation to the idea of knowledge creation in design research, the authors state that it must be produced in a form accessible and arguable among peers. To achieve this, the knowledge contribution in experimental design research must take a form that "... involves a traceable genealogy, an intervention in the world and the articulation of an argument for others to engage with" [6].

According to Bardzell et al., RtD processes continuously embody the aggregation, disaggregation and reaggregation of different kinds of documents (images, texts, videos/animations) that act directly on the design process: "*documentation is itself an act*-an RtD act. Documentation is not merely serving in an *instrumental* capacity to report on facts and findings; it is also *generative* in that it "talks back" to us as designers and researchers" [1]. This echoes Schön's ideas about the 'situational backtalk' of the design situation, extended to its representation as documentation [33].

When considering different forms of design documentation and expression in RtD processes, Gaver has offered the notions of 'workbooks' [16] and 'annotated portfolios' [17] to supplement more traditional forms of text-based documentation. Workbooks are collections of design proposals and other material investigating options for design during the design process whereas annotated portfolios are tightly connected to design artifacts in an attempt to extract and communicate research findings. This also relates to Jarvis et al.'s argument for detailed annotations of a design process through photo essays as a way of describing the material exploration in design [24]. In addition, there has also been a growing focus on design objects as vehicles for knowledge creation, both for the people that design them and encounter them [2]. Importantly, this focus on critique and sustained interpretation of the design community at large is an extension of the capacity for knowledge creation ascribed to the design objects; design annotations should mark the beginning, not the end, of the articulation of a design's contribution to knowledge.

### 1.2 Digital Support for Design Documentation

In the field of software development, the benefits in well-documented program code and decision-making is widely recognised and has been so for a long time [18]. However, as noted

by Löwgren and Stolterman: "Everybody knows the importance of good documentation, but when a deadline approaches, documentation is not a priority compared to the production of working code." [27].

In a design research context Dalsgaard and Halskov [8] have presented a tool for design documentation and reflection to meet the challenges associated with interaction design researchers doing RtD, facing both the practice of doing design and the practice of doing research at the same time. The Process Reflection Tool (PRT) is presented as a shared tool for continuous process documentation of and reflection on the ongoing work of practitioners in design processes. The system predominantly provides means for reflection, without leveraging the performative aspects of design documentation, as stated by the developers of the software themselves in [2]. Similarly, Dove et al. present an approach and a tool to facilitate reflections upon the design space that "supports revisiting design choices, highlights connections in co-varying dimensions, and helps to identify disregarded opportunities" [11]. The authors argue that reflecting upon the dynamic design space during and after a project may provide valuable considerations on choices and constraints and reinvigorate design potentials.

In an exploration of the potential for real-time technology to offer distributed access and immediate feedback, Rasmussen et al. [30] present Co-notate, a tool specifically aimed at capturing immediate responses to design work through collaborative, real-time documentation of design processes. The system enables an automatic synthesis of audio/video recordings and textual tags captured simultaneously by multiple people, which provides instantly searchable recordings. This real-time annotated documentation is argued to bridge between knowledge generated in situ and the mediated representations of such situational knowledge, and to thus better inform retrospective analysis and reflection upon design work.

The related work points towards a general interest in exploring appropriate repositories for the many different forms design documentation might take in the creation of knowledge in design processes, as well as for better harnessing the performative aspects of this kind of documentation. Design documentation *acts* in the design process - and it continues to act after the design process, through the sustained interpretation of the design object as a source of collective critique and appreciation. A point that needs further investigation is how documentation must be seen as *integral* to the design process and the actual crafting of the design object. In the following, we will explore how the notion of design archives can be instrumental in furthering this line of research.

## 2   Towards Design Archives

A point of departure for presenting the notion of design archives is what has been identified as an 'archival turn' [34] in the arts and humanities. This turn is explicitly concerned with developing new archival conceptions and practices due to new possibilities offered by technology and the changing conditions of increasingly digitised societies.

Media theorist Wolfgang Ernst [13] argues that the read/write paradigm of digital technologies has entailed a shift in the archive's function from static representation of the past to permanent transfer and regeneration. Among other things, this means that documents and materials recorded digitally are automatically stored (and sometimes shared) and can be instantly accessed and shared from multiple places at once. Ernst defines an archive as "a rule-governed, administratively programmed operation of inclusions and exclusions" [13]. This points to the highly *selective* operation in archivization, where certain objects and memories are preserved for the future, while others are omitted and forgotten.

Similarly, philosopher Jacques Derrida [10] points to the necessity of leaving things behind to prevent information overload. In order to highlight the archive as a place of sociocultural production, he introduces the notion of the 'anarchive' as a force of forgetting which is co-constitutive to the archive's push to remember. The anarchive encompasses that which was not deemed worthy for future recollection and thus denotes the potential for counter-memories to break with, critique and supplement the archive's construction of a certain narrative. In addition to its selective character, *access* is another key term in archival terminology. Derrida argues that political power is defined by "the participation in and the access to the archive, its constitution, and its interpretation" [10]. This is due to the fact that there will always be someone (or something, e.g. algorithmic agents or AI) controlling what is selected and deemed worthy for future recollection, how it is represented and ordered, and how this material is accessed and utilised.

To further this understanding of the relation between archive and power relations, we also build on philosopher Michel Foucault [14] who describes archives as omnipresent systems of discourse formations in which networked statements survive and undergo changes. Foucault defines archives as "systems of statements (whether events or things)" that function as "a practice that causes a multiplicity of statements to emerge as so many regular events, as so many things to be dealt with and manipulated" [14]. He argues that all statements – verbal and nonverbal – belong to a series or network of other statements, thus acknowledging that all enunciative actions must in one way or another take their point of departure from somewhere. As such, the archive can be defined as *systems of relationality* effectively affecting how we think and act according to externalised memory.

In sum, the archive is much more than a mere storage of the records contained within it; these materials are systematically selected and organised based on the archive's programmed operations. As such relational patterns are composed between the recorded material, which presents the reader with a particular narrative, thus influencing how we remember and understand the *past*, the way we think in the *present*, and how we envision the *future*.

### 2.1   A Working Definition of Design Archives

Based on the above, we will in the following define design archives as *systematised accumulations of different forms of externalised knowledge produced and collected throughout a design*

*process that creatively and reflectively inform design work.* Designers organise these documents and materials in one way or another according to a subjective categorisation (e.g. level of importance, usability issues, experience qualities), thereby producing more or less structured archival formations that act on the design process by filtering, representing and organising knowledge for future use. These archives are both visionary and grounding; they are simultaneously a collection of data on the past and present condition of the design domain while offering visions for possible futures within the design space.

Importantly, and in line with [2], design archives are not deliberate extractions from the process in which they have been conceived. Rather, they must be seen as an integral part of any design process, facilitating design moves and design arguments. In this way, design archives should not promote a feverish need to document and archive everything, but enable an exploration of the design space, as also argued by [11]. In the following, we will make a general distinction between three different archival formations pertaining to the design of an interactive system, *before*, *during*, and *after* a design process.

Before, relates to the existing knowledge, materials and workflows that are part of the *designers' archives* and the *domain-specific archives* of the place of design intervention. The designers' archives can be more or less formalised and relate to the idea of design ability [27] or the designer's repertoire or appreciative system [32], where the latter fundamentally shapes what is noticed, valued and appreciated in the conversation with the material in a design situation [9]. These archives prepare designers for action in different ways and can take the form of portfolios, digital or physical folders with books and papers, collections of notes, material exemplars and prototypes from previous projects or online resources such as ACM Digital Library or technology blogs.

The designer's archives meet other designers' archives as well as the domain-specific archives pertaining to the design situation (i.e. stakeholders, users, contextual knowledge), during the design process. Here, two categories present themselves based on the purpose of production: materials made *in* the process and those made *on* the process. Materials made in the design process are what Hansen and Dalsgaard term collaborative design materials which operate by "involving participants, transforming the design space, suggesting design ideas, documenting design moves and decisions, and provoking reflection." [19]. Collaborative design materials may take many forms and can function as a common ground for exploration of the design situation. Materials made on the design process are the outcome of reflective documentation of the design process (e.g. photographs, recordings, and diagrams) that, according to Dalsgaard and Halskov, might work as both valuable insights in the design work and as future material in design research [8].

Design archives after the design process are the *post-processual archival systems* emerging from the design objects produced through the design process, as well as the formalised archives for distributing the results of the design work. After the design process, the design object will continue to generate knowledge taking different archival forms; from video documentation of prototypes, to academic papers, to presentations, and so forth. Often the formats of this post-processing will be adapted to fit into archival formats that accommodate the kind of knowledge contribution from the design process - in a research setting, such archives will pertain to publication outlets (ACM, Springer etc.); in a commercial setting knowledge outcomes might be stored in in-house repositories for re-use of methods, techniques and code, adding value to the overall organisation.

In practice, the temporal distinctions and divisions we have used to present different dimensions of design archives are difficult to uphold since they intermingle across design projects, and hence cannot be contained in any formalised understanding. However, they serve the purpose of a first way of structuring the conceptual and empirical investigations presented in this paper. In the following, we further refine this conceptual outline through an interview study with designers from academia and the industry exploring how a design archival approach can shed light on the dynamics of knowledge production, accumulation and sharing in design processes.

## 3 Interview Study

We conducted an interview study to test and refine the conceptual frame outlined in the previous section. The study was carried out with eight designers, four from academia and four the industry. Rather than setting up a comparative study, the aim was to gain insights into potential cross-pollination across divergences and similarities focused on the presence and use of particular archival repositories and tools.

### 3.1 Interviewees

For this interview study, the interviewees were recruited using snowball sampling and chosen to represent the diversity in interaction design, comprising interviewees with backgrounds in fields such as computer science, architecture, and anthropology. Interviewees from academia were from three different universities (A1 and A3 from the same department) and all had tenure at the time when the interviews were conducted. Interviewees from industry were hired or partners (I1 and I2) in three different companies, one large multinational and two medium-sized national companies (I3 and I4 from the same company). Seven interviewees are native to the Scandinavian country in which the interviews were conducted, and one comes from a comparable Northern European background. Five interviewees were male and three female, all having a minimum experience of five years working within the field. The interviewees will be referred to respectively as belonging to Industry (I) 1-4 and belonging to Academia (A) 1-4 to keep an anonymised overview of who said what.

The fact that findings in this paper is based on an interview study with eight interviewees working within a Scandinavian context means that our aim is not to claim any generalised truths. Instead, we wish to offer a preliminary understanding of how design archives can be understood in both theory and practice, so that

the subject matter may be further developed and inform related discussions.

## 3.2 Interview Guide

We devised an interview guide [26] addressing the primary aspects of design archives as presented in the previous section. We centred our questions around a somewhat idealised chronological timeline of the temporal mobilisation of knowledge before, during, and after design processes. A particular focus was on different information repositories and (digital) tools relative to the different stages of the process. The questions themselves were not phrased using the notion of design archives since our aim was not to focus on the concept itself. Instead, the interview guide included questions that prompted interviewees to reflect on tools and practices used to access, record, store, and share knowledge, and to plan and manage design projects.

## 3.3 Data Collection and Analysis

Each interview lasted approximately one hour, and except for one (I2 via Skype), they were all conducted face-to-face in the domain of the interviewee. Mobile phones were used to record audio from the interviews, and the files were shared among the authors via Dropbox. Subsequently, the interviews were transcribed, the data was coded and a thematic analysis was collaboratively performed in line with [7]. Except for one interview (A4), all quotes used in this paper are translated into English by the authors.

The thematic analysis focused on identifying different types of design archives as well as different practices through which these design archives were formed and transformed. The analysis was primarily data-driven, since we did not attempt to neither confirm nor dismiss our theoretical outset and hypothesis. The following presents the overall themes distilled from the interviews.

## 4 Findings

The findings from the interview study are divided into three major themes concerning the *abundance of tools* accounted for, how archived material is *accessed*, and the *selection criteria* when recording and preserving design work. Additionally, four related subthemes are presented.

### 4.1 An Abundance of Tools

A common theme that immediately caught our attention when we read through the transcripts was the sheer number of different technologies (analogue and digital) that had an impact on how the design process was informed, documented, presented and shared. We counted no less than 58 different tools, systems, and repositories that the interviewees accounted for as part of their design work. In varying degrees, these technologies all structure the flow of information, and thus how knowledge is produced and mobilised in and across design processes.

In order to gain an overview of the broad range of different technologies, we divided them into categories based on whether they work to *access*, *record*, *store*, or *present* information (see figure 1). However, the automation of digital media complicates a strict
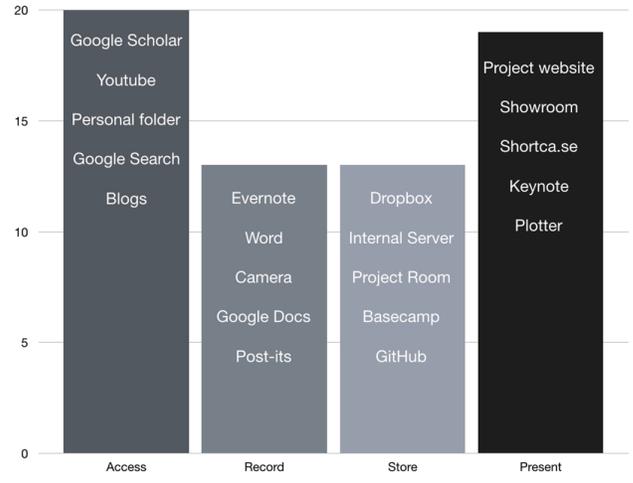


**Figure 1. Categorisation of the technologies used to access, record, store, and present information. Some serve multiple functions, e.g. both record and store. Examples are shown in each category.**

distinction based on functionality, since e.g. some recording tools automatically and immediately place the recorded material into archival storage (this differs from the distinctive act of consigning an analogue document to a physical archive). For instance, the individual notes created in Evernote automatically become part of the application's archival system, and e-mails as a communication's tool both records and stores information and are used to tracking down decision-making throughout the design process.

Interviewees from both academia and industry mention a number of archives that play a formative role in the inspirational phases of the design process, both before and during the process. A natural distinction occurred between the two groupings in terms of what was drawn in as primary sources to inspire or position a project. In academia, related work in the form of conference proceedings or journals is accessed through the ACM Digital Library or via Google Scholar (A1). Although interviewees from academia also mentioned tech journalism and websites as sources of inspiration (A1, A4), new technological trends and products were primarily reported by interviewees from industry as stepping stones early on in projects (e.g. via Google Search, Pinterest, Vimeo, Youtube and TED). Additionally, interviewees from industry mention the use of documents from client repositories (I2, I4), and textual descriptions and videos of methods, processes, and products from previous projects from their own website (I1) and shortca.se (I3).

Although all interviewees accounted for a large number of different digital tools used to continuously record and store outcomes of design work, emphasis was put on the importance of physical co-presence around whiteboards, in dedicated project rooms or in open office landscapes. Photographing notes and drawings made on whiteboards and sharing these digital files in via e.g. Dropbox (A2, I1, I3, I4), Basecamp (I2, I3, I4), e-mail (A1, A3, I1, I2), custom made repositories (A3) or Slack (A1).
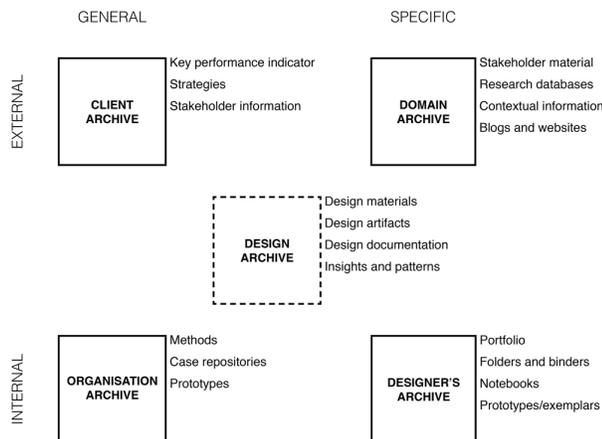
**Figure 2. Diagram of types of archives that may inform a design process, including a temporary design archive.**

In industry, especially Word and Keynote are used to present clients with insights and outcomes from the design process. Additionally, video recordings captured during the design process are edited into project films and made publicly available on the company's website as part of their organisational portfolio (I1, I4).

## 4.2 Accessing Archived Material

Another theme that emerged was that of access to archival material, both internally within an organisation, and to external resources. All interviewees from the industry highlight the importance of being able to tap into the client's archives as a way of establishing a common ground in any project. Here, the client facilitates access to potentially useful material (e.g. visions, strategies, KPI, etc.) that might be used to inform a project's point of departure. This information is drawn in from sources *external* to the designers' organisation, i.e. the company. In addition to utilising knowledge attained from gaining access to the client's archives, the initial phase of a project is largely informed through desk research, where "you sit down and google away for days" (I3, 8:48); this goes for both academia and industry.

Interestingly, our findings indicate that drawing on experience from prior work seems to be more systematised in a commercial setting, where online platforms such as shortca.se (I3) and internal servers (I1; I2; I3; I4) function as case repositories for previous projects for *internal* use (including information about clients, purpose, methods, various documents and with contact details). However, all interviewees from academia mention the use of different forms of archived material either accessible in custom made personal systems such as PRT (A3) and Webstrates (A1) or on personal or research websites (A3). These websites take on a dual role; both as a post-processual presentation of the research, and as an inspirational archive for future research. The material here includes text/descriptions, videos, images, article collections (e.g. on Dropbox, A1). A4 explicates how former prototypes are also used in this phase. All interviewees stress the importance of knowledge sharing among colleagues here as well, mostly in-situ

but also via mail, Slack and other digital communication infrastructures.

Different from information that is either transmitted from external sources (e.g. materials from clients) or drawn and used internally to the design organisation, A3 highlights the value of having a showroom, where new and potential collaborators can gain direct access to the tangible outcomes of previous projects. In this sense, collaborators also get a look into past productions of the organisation, instead of only letting the design team tap into to their own resources.

Even though no legal or ethical concerns were in the way of reusing material from previous projects, interviewees from academia reported that this was rarely done. Apart from multiple iterations on the same system (A1) and the occasional transfer of code (A4) and methods (A2), a pattern emerged where researchers start from scratch in new projects with nothing else than theoretical frameworks. In industry, a different stance is generally taken, where interviewees report of a desire to utilise concepts, insights, materials, etc. that have not been realised or used in previous projects, or even produce spinoffs from archived projects. Often, however, contract clauses and copyright infringements stand in the way (I2; I3). Of course, there is a commercial driver in this, but also a frustration over things ending up in some "directorate limbo" (I2, 31:03). A position implicitly or explicitly taken in most interviews, however, is well articulated by I2, saying that it is a matter of finding "that balance between getting lost in the past and focusing on the future." (I2, 22:48).

Reflecting on the above, we have sketched out a range of different archives being accessed throughout the design process (figure 1), thus informing design work in one way or another. Some relate specifically to the contextual domain or to the designer's repertoire, while others are more general formulations of an organisation's workflows and values; some are readily accessible as internal resources, while others are drawn in via external sources. An interesting point to consider here is how these archives are accessed: who or what grants access to an archive, to which extent and in what manner? In this regard A2 highlights the importance of setting up and maintaining good relationships with key stakeholders in the domain, since they act "like the spider in a big network" (A2, 31:57) with the key to unlock access to crucial information on e.g. contact details.

## 4.3 Selection Criteria When Archiving Design Work

Another crucial aspect when working with design archives is to consider the inevitable selection of some memories and materials over others. Paraphrasing A4, this selection occurs because "[y]ou can't mobilise everything all the time, so you must constrain yourself in that sense. [...] [A]nd do you want to mobilise it?" (A4, 24:31) Following this means to consider which aspects of the design process are included for future use, and which are excluded, and how are they represented.

All interviewees reported of a pervasive feeling that they were in fact not doing a very good job of preserving knowledge and materials generated in the design process by documenting and archiving projects. Of course, the focus in the interviews on

particularly documentation has prompted a specific reflection on this topic, but we are nonetheless curious to find out where this self-assessment comes from. What is the "right amount of documentation"? How do you select between in-situ appropriate forms of capture? Will you ever be "good"? Who puts up this ideal that they feel they cannot obtain? And what parameters guide what goes into the design archive and what does not?

In both academia and industry, meeting minutes are reported to be rarely recorded, and if they are, the procedure is in no way structured and formalised (A2; A3; I1; I2; I3). Minutes are regarded as a form of writing that will somehow wedge itself in between people (A2), although it might actually prove to be useful as a project management "tool" (I1). Well aware of the stereotypical image of interaction designers as creative practitioners, I2 elaborates on this stance saying that meeting minutes tend to "kill the agile process you are forced to have if you have to talk to each other" (I1, 42:13). Beyond meeting minutes, A4 also highlights the "energy floats" and "levels of excitement" in design processes as a key problematic in terms of documenting design activities, since you need to refrain from being carried away and forgetting to document. A question emerging from this is how one knows what to preserve for the future; what activities to document and what materials to put into storage?

Here, a clear distinction between academia and industry emerges. Interviewees in academia all report that their selection criteria are generally based on whether or not documentation and materials are expected to contribute to the post-production of research publications. Unpacking this, A1 points to the research publication as a framework for documenting research projects, where there are "some formal requirements and some quality requirements that you need to abide by. At the same time there is also a limit on how much material is admissible and relevant, and there might be all kinds of data and considerations and pictures and video recordings that […] fall into the cracks" (A1, 6:34).

In this sense, the format of the research publication, which is governed by the publication outlet (e.g. specific conferences or publishers such as Springer or ACM), becomes a determining force of what can be included into the field's shared body of knowledge, and thus also what is excluded. Beyond the post-processual selection of what goes into an article, this also underlines the influential position publishers hold when design researchers perform a selection of what to preserve during the design process.

Interviewees from industry report that the selection criteria of what is kept for the records is, not surprisingly, co-determined by the client on a specific project. For instance, I2 explains that "we document the things we know are going to be difficult for the client to accept or not, e.g. exceeding budgets or that […] concepts have taken another turn" (I2, 42:13). In addition to the ad hoc documentation of insights and changes in a project, the planned deliverables in a project also perform as documentation [I3].

Following this focus on accountability in the design process, I1 stresses the importance of producing documents that fit the systematised order of the client's archive, so that they may be used beyond the project: "[I]t is a form of delivery and a language that you have with e.g. a municipality and something by which they maintain the city and govern it, so you need to deliver a drawing [blueprint, ed.] in their formats that they can put into their systems" (I1, 23:22).

During the design process, the criteria for what is preserved, and how it is recorded, is thus highly influenced by requirements of archival formations exterior to the project; this goes for industry as well as academia. However, nearly all interviewees explain how they also go through the archived material and perform a selection after a project has ended. This can be to present a project to the public on websites (I1; I4; A1; A2; A3), for personal portfolio (A4), or to share a project internally in the organisation or group as a source of inspiration or method repository (I3; I4; A3).

## 4.4 Personal, Shared, and Public Archives

Related to the previous notion of access, the interviews show clear differences in how information is archived for *personal* use, for *shared* use in design teams or between designers and clients, and for *public* use. A1 makes an interesting point when referring to the use of GitHub as code repository in the design team: "[E]very time we make something new, it is *publicly available*, but whether it is *publicly applicable* is a different question" (A1, 9:32, added italics). A1 remarks that tutorials are produced to support the applicability of the published code; or in archival terms, to support the interpretation of the archive. Different from publishing more or less raw data (i.e. code) on GitHub, making information available to the public on project or company websites is a more controlled way of granting access to certain parts of the design archives via e.g. project activity logs (A2) and short project films (I1; I3; I4; A3).

When deciding whether or not to share unprocessed notes from field work with clients, I4 raises a concern similar to A1's pertaining to the uncertainty of how data is made sense of: "If they [clients, ed.] are not used to reading qualitative data, I fear for how they use it, and then I will rather give the report." (I4, 15:03). Such translations of preliminary findings into processed reports may decrease the risk of over- or misinterpreting the data. I2, however, argues that these documented "findings they are of course also coloured by what our process towards our field work has been, but this does not always appear 100 percent evident." (I2, 27:56).

Through a design archival lens, this transformation of data from a designer's personal archives into forms accessible to others is an attempt to safeguard the data collected in the design process, from the designer's point of view. We find that such translation and communication of results to present design arguments are dynamic operations in need of more attention in future research, since it is crucial to understanding the exchange between individual and collective making in these kinds of processes.

## 4.5 Archival Barriers in Creative Work

The interviews showed an abundance of means to share and create information between involved parties in a design project. A common trait is a desire to generate mutual understanding by facilitating a shared space, whether analogue (e.g. dedicated project rooms (A2)) or digital (e.g. Dropbox, Google Docs). However, the use of digital tools and systems are generally not

regarded as productive for the creative process. Rather, the tasks of uploading documents (often to multiple platforms and servers) and attending to project management tools (e.g. Slack, Trello, Basecamp) are perceived as integral part of a design process, but a tedious part that does not generate new insights and thoughts (A2, A4, I1, I2, I3, I4). Such disregard of systematisation of workflows through digital tools is especially evident with designers and design researchers where members of the design team are co-located in either a dedicated project space or in small-scale open office environments, exemplified by I1: "When designers, who know each other well, are together it's nicer to just talk together [...] You shouldn't pin down each other in systems" (I1, 57:58). A2 likewise stresses the importance of co-location and face-to-face conversations and argues that archived material must travel into particular spatial distributions to be acted upon.

A1 explains how the use of a collaborative note-taking tool spurred unexpected insights into possible sources of problems in collaborating on collecting and recording notes and materials, that are not only technical but "highly sociotechnical". According to A1, "there are barriers between us which make us vain in sharing and cooperating, and there are also sources of conflict that are just different structural or aesthetic preferences" (A1, 31:18). From a design archival perspective, these barriers that limit and restrict the possibilities for the production, accumulation and sharing of knowledge are highly interesting points of discussion.

## 4.6 The Prototype as (An)archive

A2 and A3 report of recurrent use of previous prototypes as tangible mediators between the design team and new collaborators through their materialisation of previous projects. In this regard, A2 articulates such a prototype as a common object that "does not close but on the contrary opens up for you to start drawing on the project together" (A2, 14:40). Though they are not archives as such, prototypes can be viewed as vehicles or conduits that are able to contain traces from a design space and transfer its potentials into new domains.

From a developer's point of view, A4 expands on this notion of the prototype as a vehicle of knowledge, which is "more of an archive than for example my Dropbox," (A4, 31:45). Interestingly though, A4 not only perceives the prototype as a container that prompts recollections of what actually happened in the design process where it was concretised; to A4 the prototype also reminds him as a designer of the alternative paths that were not taken in the process of developing the thing: "Yeah, it's an archive [the prototype, ed.], but it's also a non-archive of all the things you did not archive." (A4, 31:03). This conception of the prototype as a conduit of *discarded* and *disregarded* insights, ideas, values, and perspectives from the design process that for one reason or another were not deemed worthy for future recollection is extremely interesting in terms of leveraging the particular ways of knowing in design.

## 4.7 Lost in the Archives

A recurrent theme across the interviews is frustration over seemingly pointless archaeological work when trying to dig out

information from various archive formations. Several interviewees report feeling frustrated and anxious over the amount of time and effort put into searching for information that may or may not resurface in digital archives. This frustration often comes from a lack of systematised procedures for migrating information from temporary repositories used during the design process (mostly Dropbox) to long-term storage on other platforms and servers. Especially within industry, the necessity to find certain documents means that it becomes a matter of "who first finds it in one's mailbox, or who will find it first on Google Drive, or on the server" (I1, 41:16). I2 reports how this frustration sometimes also extends to the other side of the table, when clients are unable to present designers with useful documents.

The abundance of tools and practices for recording and storing information is another source of frustration, where e.g. A1 recounts how members of the design team use different tools to take notes, which means that you are never sure where to look for plans and ideas. In addition, A1 is frustrated over searching a growing body of Slack conversations to retrace the origin of ideas. In order to overcome the disappearance of such information, A4 argues for the importance of safekeeping things in one's lived environment, "because things in Google Drive disappear [laughs]... we know that! Dead archives, yeah." (A4, 13:27)". Even though things are recorded and preserved in the archive, they tend to disappear somehow and be forgotten for some reason, but according to I1, this is not necessarily bad, since designers "are damn disorganised, but that's also what makes you flow on different forms of production and sensations." (I1, 51:32). Picking up this notion of 'dead archives', we might conveniently ask how to imagine an archive that supports a capture, reactivation, and continuation of disorganised flows of production and sensations across formats and modalities; what could conveniently be called a *living* archive.

## 5 Discussion

The findings show how knowledge production and documentation is a dynamic and complicated area of inquiry in design in both academic and commercial settings. An archival approach to accounting for this complexity demands critical reflections on how memory represented, structured, accessed and activated. The proposition to understand design archives as a key concern in HCI and IxD aims to raise awareness and prompt reflections on how the particular forms of knowledge in design are structured through a variation of sources and repositories that inform how design work is understood and practiced. The discussion emphasises two key points that go across the findings, and points in the direction of future studies and experiments within the proposed sketches of a design archival framework.

## 5.1 Archival Ownership and Control

We find that the feeling of agency, the feeling that one can act upon and contribute to design archival formations, is crucial to the development of a shared understanding in a design project. However, various barriers and constraints complicate engaging in

constructive cooperation through digital systems. In this sense, participation in the formation and transformation of the design archive is not only technically controlled through the aesthetics and limitations attributed by the system; they are also to a great extent socially governed through dominant positions, e.g. based on structural or aesthetic competencies. In this regard, annotations of design work [30] and of design objects [17] open up new paths for collective critique and appreciation of the knowledge outcomes from design processes closer to their source of origin. Building on such contributions, we argue that practical and conceptual development of design archives may offer ways of affirmatively working with the sociotechnical dynamics that systematically govern how the particular types of knowledge are made sense of in and beyond a design project.

What our study further indicates is how a design process unfolds as a nexus of different sources of knowledge and information that are drawn in to scaffold the understanding of the design domain and to inform the design space. Different - more or less formalized - archival formations are accessed by designers during the design process, e.g. to search for related work and products, and different people participate in the making and interpretation of archived material. In this regard, an interesting concern, which is beyond the scope of this paper, is how the algorithms in search engines, such as Google, and other media platforms influence the way information is accessed and distributed. Similar to how key stakeholders act as *gatekeepers* to domain archives, tech corporations are the de facto gatekeepers of online information. In particular, Google seems to take a powerful position in this regard, as their systems are used by designers from both academia and industry to access, record, store, and share information (through Search, Scholar, Drive, and Docs).

In addition to a focus on the power relations pertaining to such gatekeeping, the focus in our findings on what is deemed worthy for future use and selected for the archive brings attention to the idea that design research and practice is deeply enmeshed in power relations. This is because the inevitable selection of some memories and materials over others influence how the design process is represented, and thus how it prompts reflective and creative thinking. In this regard, the selection criteria seem to follow the operational program of the archives for which the work is to be processed for and inscribed into; this is research databases in a scholarly setting, and client's archives in a commercial setting. While it is natural that designers in a commercial setting form and transform their data and insights in accordance with their client's needs and requests, it is somewhat problematic if the accumulation of knowledge within academia to a large degree is governed by corporate publication outlets with commercial interests as their primary concern. While the forms of knowledge produced in a commercial design project is in principle owned by the client, we see a clear tendency for designers from industry to systematically abstract accumulated knowledge from projects (as trends, methods, cases, etc.), so that it may be transferred to other projects and shared internally among colleagues. This does not so seem natural within academia, where a drive to produce novel ideas (encouraged by management and oneself) can stand in the way of reinvigorating thoughts and materials from the past.

## 5.2   On the Production of Value

As shown in section 2, developing means of representing, sharing and reflecting upon the particular kinds of knowledge generated in design processes is a growing concern within HCI and IxD. While concerns pertaining to documenting design work is not in themselves novel [2, 8, 21], we argue that this regard for the documentary practice should not stand alone but will benefit from an overarching concern for the archival systems into which these documents and materials are inscribed and organised.

Our study emphasises how the use of an abundance of different digital tools and repositories to record and store documents and files can indeed become a hindrance to carrying out the actual design work, e.g. due to the lack of routines in migrating information from one repository to another. The study further indicates that design work is primarily documented and archived for purposes beyond the design processes from which the materials originate. Beyond the scope of documentation, this highlights how different *temporalities* are at play, and in potential conflict, in design practice, where the future value of producing forms of knowledge for archives external to the design process (e.g. publication outlets, personal CV, client's archives, organisation webpages) suppress the immediate value of producing for a design archive. In this sense, what aspects of design work is selected for future use, and how it is represented, becomes a matter of what *value* it potentially produces (for the designer, the client, the organisation, the professional community), which is often measured through bibliometric and economic systems.

The point is not that designers and design researchers ought to be better at archiving and streamlining documentary practices. What we wish to emphasise is that most design processes will utilise a multiplicity of archival technologies and sources of knowledge, which adds to the complexity and messiness of the design situation at hand. We believe a design archival approach may shed light on how these eclectic resources inform design work and how archived material might be (re-)activated to produce new value to present and future design situations.

As our study indicates, a particularly interesting problematic is how to cultivate a better understanding and support of the situations and dynamics that are not easily captured in archival formats (atmospheres, feelings, affective intensities, appreciative values, etc.). In this regard, we believe the notion of the 'anarchive' might provide a valuable entry point for experimenting with two related trajectories, where one works with capturing that which is difficult to capture but still plays an important role in design processes, and the other focuses on creative forms of reactivation of design archival material. The former is concerned with means of studying and supporting the things that are rejected, not easily recognised or outright resist or escape archivization; this might be memories, feelings, attitudes or atmospheres that have been disregarded or overseen and are thus not represented in the archive. The latter is concerned with means of reactivating what is already part of the archive in creative ways that inject design potentials with new life by

breaking with chronological and thematic orderings of the archive and allows for new patterns to be generated.

Drawing on [31], we might thereby ask how moments of qualitative change and bifurcation in a design process can be recognised, captured and relayed in a vivid and productive manner? Which archival platforms and practices exist that may support the particular ways of knowing in design, and which ones might be envisioned? How can we imagine means of archiving that work with and across creative tensions in design work and not in a mutually exclusive manner?

## 6 Opportunities and Future Work

In our work towards developing design archives, we have recorded a number of thoughts and ideas into our own archives that have either been discarded or are waiting to be actualised. The following will outline a selection of ideas and themes that might be explored to help support and further an understanding and development of design archives.

First, we would like to reiterate that the initial study presented in this paper with eight designers from both industry and academia obviously cannot lead to any generalisable insights. Scaling up and conducting a series of comparable studies would thus be a natural next step. Since a design archival approach deals with very concrete repositories and workflows, we believe a more hands-on approach to studying how designers archive their work and utilise archival material can complement such interview studies. This can be done through observations of workflows supplemented by in-situ interviews or by probing designers to actually show and tell about archival procedures and material in their workspace.

We also want to encourage a more exploratory engagement with existing technologies and a development of new tools and methods that are specifically aimed at supporting and leveraging the creative potential inherent to the particular ways of knowing in design. As a concrete example, the work in this paper has to a large degree served as the groundwork for the development of Co-notate [30] as a means of infusing mediations of design work with multiple sources of immediate knowledge. We believe there is a great potential in furthering this line of research to create tools that make it easier to build on existing designs and insights towards new creative work in both academia and the industry.

While the notion of the archive is tightly coupled with that of temporality, this paper has only touched briefly upon this matter. In general, we believe there is a great potential in paying more attention to the temporal aspects of design processes in IxD and HCI. In particular, this might lead to insight on how technological mediations and configurations of time (e.g. mapping, representing, planning, managing work- and information flows) directly or indirectly influence our experience of the past, present and future. Additionally, a temporal focus can contribute to a better understanding and development of processes and products that are attuned to how we produce and share knowledge, individually and collectively.

Finally, we believe a design archival approach might hold the potential to be extended beyond IxD and HCI and into similar fields of research and practice that also work constructively between creative and reflective thinking and doing (e.g. architecture). The development of concrete archives to support particular workflows would need to be customised to the specific field of practice, but studies of how archive formations influence creative work is – more or less – directly transferable.

## 7 Conclusion: Towards Design Archives as Living Repositories of Knowledge

In this paper, we have developed the notion of design archives to account for the ways in which forms of knowledge are systematically accumulated and shared in and across design processes, and the influence these archival practices and technologies have on how design work is performed and perceived. Our working definition of design archives draws on theoretical conceptions of the archive from media theory and philosophy, emphasising the archive as creative site of power. Beyond the scope of documentation, a design archival approach thus situates the production of knowledge in immediate relation to the dynamic systems (technical and organisational) into which representations of design work are inscribed.

In order to further develop our theoretical conception of design archives, we carried out interviews with eight designers from academia and the industry. Key findings from this study emphasise the sheer complexity of an abundance of tools, systems and repositories used to access, record, store and present information before, during and after a design process; an analysis of how design work is informed by a variety of different archives that are accessed throughout the design process; and an analysis of the selection criteria for what is documented and preserved for future use. We found that there is a lack of routines regarding the way design work is documented and archived, which can lead to designers getting lost in 'dead' archives trying to recover important information. Additionally, we found that there are various sociotechnical barriers and constraints that make it difficult for designers to systematically and creatively share information and cooperate on knowledge production.

Concluding on these insights, we find much potential in further studies and in experimental explorations of the complex structures that support and restrict knowledge mobilisation in and across design processes. In particular, we encourage future developments of creative means of preserving design knowledge beyond purposes of reporting that might reactivate and reconfigure design potentials.

## REFERENCES

[1] Bardzell, J., et al. Documenting the research through design process. in Proceedings of the 2016 ACM Conference on Designing Interactive Systems. 2016. ACM.

[2]   Bardzell, J., S. Bardzell, and L. Koefoed Hansen. Immodest proposals: Research through design and knowledge. in Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems. 2015. ACM.
[3]   Binder, T. and J. Redström, Exemplary design research. 2006.
[4]   Bjögvinsson, E., P. Ehn, and P.-A. Hillgren, Design things and design thinking: Contemporary participatory design challenges. Design issues, 2012. **28**(3): p. 101-116.
[5]   Bondarenko, O. and R. Janssen. Documents at hand: Learning from paper to improve digital technologies. in Proceedings of the SIGCHI conference on Human factors in computing systems. 2005. ACM.
[6]   Brandt, E. and T. Binder, Experimental design research: genealogy, intervention, argument. International Association of Societies of Design Research, Hong Kong, 2007. **10**.
[7]   Braun, V. and V. Clarke, Using thematic analysis in psychology. Qualitative research in psychology, 2006. **3**(2): p. 77-101.
[8]   Dalsgaard, P. and K. Halskov. Reflective design documentation. in Proceedings of the Designing Interactive Systems Conference. 2012. ACM.
[9]   Dalsgaard, P., et al. Supporting creative design processes in blended interaction spaces. in Proceedings of the 2015 ACM SIGCHI Conference on Creativity and Cognition. 2015. ACM.
[10]  Derrida, J., Archive fever: A Freudian impression. 1996: University of Chicago Press.
[11]  Dove, G., N.B. Hansen, and K. Halskov. An argument for design space reflection. in Proceedings of the 9th Nordic Conference on Human-Computer Interaction. 2016. ACM.
[12]  Ducheneaut, N. and V. Bellotti, E-mail as habitat: an exploration of embedded personal information management. interactions, 2001. **8**(5): p. 30-38.
[13]  Ernst, W., Digital memory and the archive. 2013: University of Minnesota Press.
[14]  Foucault, M., The archaeology of knowledge: Translated from the french by AM Sheridan Smith. 1972: Pantheon Books.
[15]  Fritsch, J. and O.S. Iversen, Designing for experience: Scaffolding a design ecology, in Enterprising Initiatives in the Experience Economy. 2014, Routledge. p. 226-244.
[16]  Gaver, W. Making spaces: how design workbooks work. in Proceedings of the SIGCHI conference on human factors in computing systems. 2011. ACM.
[17]  Gaver, W. What should we expect from research through design? in Proceedings of the SIGCHI conference on human factors in computing systems. 2012. ACM.
[18]  Grudin, J., Evaluating opportunities for design capture. 1996, Lawrence Erlbaum Associates, Hillsdale, New Jersey. p. Hillsdale.
[19]  Hansen, N.B. and P. Dalsgaard. The productive role of material design artefacts in participatory design events. in Proceedings of the 7th Nordic Conference on Human-Computer Interaction: Making Sense Through Design. 2012. ACM.
[20]  Henderson, S. How do people organize their desktops? in CHI'04 extended abstracts on Human factors in computing systems. 2004. ACM.
[21]  Höök, K., et al., Framing IxD knowledge. interactions, 2015. **22**(6): p. 32-36.
[22]  Höök, K. and J. Löwgren, Strong concepts: Intermediate-level knowledge in interaction design research. ACM Transactions on Computer-Human Interaction (TOCHI), 2012. **19**(3): p. 23.
[23]  Iversen, O.S. and C. Dindler, Sustaining participatory design initiatives. CoDesign, 2014. **10**(3-4): p. 153-170.
[24]  Jarvis, N., D. Cameron, and A. Boucher. Attention to detail: annotations of a design process. in Proceedings of the 7th Nordic Conference on Human-Computer Interaction: Making Sense Through Design. 2012. ACM.
[25]  Kaye, J.J., et al. To have and to hold: exploring the personal archive. in Proceedings of the SIGCHI conference on Human Factors in computing systems. 2006. ACM.
[26]  Kvale, S., Doing interviews. 2008: Sage.
[27]  Löwgren, J. and E. Stolterman, Thoughtful interaction design: A design perspective on information technology. 2004: Mit Press.
[28]  Malone, T.W., How do people organize their desks?: Implications for the design of office information systems. ACM Transactions on Information Systems (TOIS), 1983. **1**(1): p. 99-112.
[29]  Pierce, J. On the presentation and production of design research artifacts in HCI. in Proceedings of the 2014 conference on Designing interactive systems. 2014. ACM.
[30]  Rasmussen, S., J. Falk Olesen, and K. Halskov. Co-notate: Exploring Real-time Annotations to Capture Situational Design Knowledge. in Proceedings of the 2019 on Designing Interactive Systems Conference. 2019. ACM.
[31]  Rasmussen, S. and J. Frich. Defining design events. in Proceedings of the 10th Nordic Conference on Human-Computer Interaction. 2018. ACM.
[32]  Schön, D., The reflective practitioner: How professionals think in action. 1983: Basic books.
[33]  Schön, D.A., Designing as reflective conversation with the materials of a design situation. Knowledge-based systems, 1992. **5**(1): p. 3-14.
[34]  Simon, C., Introduction: Following the archival turn. Visual resources, 2002. **18**(2): p. 101-107.
[35]  Stolterman, E., The nature of design practice and implications for interaction design research. International Journal of Design, 2008. **2**(1).
[36]  Whittaker, S. and J. Hirschberg, The character, value, and management of personal paper archives. ACM Transactions on Computer-Human Interaction (TOCHI), 2001. **8**(2): p. 150-170.
[37]  Whittaker, S. and C. Sidner, Email overload: exploring personal information management of email. Culture of the Internet, 1997: p. 277-295.
[38]  Zimmerman, J., E. Stolterman, and J. Forlizzi. An analysis and critique of Research through Design: towards a formalization of a research approach. in proceedings of the 8th ACM conference on designing interactive systems. 2010. ACM.