

Investment vs Catalyst: A Design Ethnography of Documentation in Creative Practices

Leave Authors Anonymous
for Submission
City, Country
e-mail address

Leave Authors Anonymous
for Submission
City, Country
e-mail address

Leave Authors Anonymous
for Submission
City, Country
e-mail address



Figure 1. A selection of documentation artifacts from interview participants. From left: A stack of old file folders containing archived information (Stylist). A notebook containing a mixture of sketches and notes (Industrial Designer). A template for making violin scrolls, which is both a tool for carving the wood and a record of the specifications of the design (Violin Maker). Cones of thread used by a tapestry weaver, which are both materials and active documentation of available materials, colors, and physical qualities (Tapestry Weaver).

ABSTRACT

Documentation enables communication, discovery and innovation by transferring knowledge across time and between people. However, common perceptions of documentation are narrow and negative: it is seen as formal documents meant for external consumption, a chore to create, and often unhelpful. We adopt a broad definition of documentation, encompassing artifacts generated during a creative process for reasons beyond future-focused communication. These artifacts shape creative process, provide emotional support, allow exploration, and enhance traditional documentation records. We performed semi-structured interviews with 14 diverse creative practitioners. The findings from the interviews present a rich and complex view of the ways that people create and use documentation. From the frame of design ethnography, we operationalize these results to provide new insights into designing novel and improved documentation tools and systems, through two lenses: *Documentation Dimensions* and *Lifecycle Model*.

Author Keywords

Documentation; Artifact; Creativity Support Tools.

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for components of this work owned by others than the author(s) must be honored. Abstracting with credit is permitted. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee. Request permissions from permissions@acm.org.

DIS2020, July 06–10, 2020, Eindhoven, NL

© 2020 Copyright held by the owner/author(s). Publication rights licensed to ACM. ISBN 123-4567-24-567/08/06...\$15.00

DOI: http://dx.doi.org/10.475/123_4

CCS Concepts

- Human-centered computing → Empirical studies in HCI;
- Applied computing → Arts and humanities;

INTRODUCTION

The ability to communicate information across enormous timescales and distances is a key enabler of discovery, learning, and innovation. Documentation can communicate both an end result for others to build on, as well as insights into the creative process. Yet capturing and documenting these types of information is often seen as a chore: wasted effort at best and antithetical to the creative process at worst. Much work has been done to reduce the burdens of creating documentation, by generating it automatically instead [5, 10].

However, the act of generating documentation plays an active and important role in the creative process. Consider the inventor’s notebook, overflowing with sketches and inspiration, or the moviemaker’s storyboards, planning out shots and scene progression. In this paper, we use design ethnography to engage with multiple creative domains. This broad view of documentation allows us to identify new opportunities in the design space, and synthesize a conceptual framework that can be used when designing.

Defining Documentation

“Documentation” is an overloaded term. In programming, “documentation” is often thought of as primarily text-based, digitally stored, externally facing content meant to explain how something works, for example READMEs, APIs, tutorials, or example code. Several of our participants who are programmers framed “documentation” as requiring deliberate,

intentional creation, in a form understandable by others, and contrasted this with “notes” or “scratch work.”

In our interviews, we found many more artifacts that capture aspects of process, history, and behavior than the definition above. Moreover, we found that a broader definition enhanced our understanding of tools and how to support creative processes through history-keeping.

Here we will consider documentation to include *any and all artifacts produced by a creator, intentionally or incidentally, during their process that contains information about the project*. For example, this also includes scratch notes, sketches, photographs, and the final goal artifact itself. In our interviews, participants also described a wide range of motivations to creating, reusing, and maintaining documentation. Artifacts may even have multiple motivations or serve multiple roles at the same time or at different times.

Contribution

We performed semi-structured interviews with 14 creative practitioners across design, performance, craft, programming, science, and art. From our qualitative data, we identify five specific dimensions of variation that define the possibility space in which documentation can be categorized: *Audience, Timescale of Use, Generative Process, Completeness and Purpose*. We find that conceptualizing a given artifact as lying along these dimensions helps us articulate associated costs and benefits. Artifacts that lie on the extreme points along every dimension can be categorized into two genres:

- *Investment documentation* is typically intended for other people, focused on long-term use, deliberately created, meant as a final document, and records information for future reference. Investment documentation is valuable, but incurs costs when created of time, effort, or productivity. It might include a recipe for violin varnish, a how-to guide for implementing a system upgrade, or API documentation.
- *Catalyst documentation* is focused on the needs of the creator in the moment, short-term and spontaneous, created incidentally to the process, used while still in-progress, and meant for assisting in thinking or creation now. It is naturally generated throughout the progression of a project and often joyful. Catalyst documentation might include notes scratched on a napkin, a whiteboard diagram of a database, or a printed out paper draft covered in feedback.

Documentation artifacts may evolve through different roles during their lifetimes. We introduce a lifecycle model of documentation, which visualizes the ways an artifact might be thought of by a creator – as a record or a tool, for example – as well as how that artifact transitions between states – for instance, by being archived, revived, or discarded.

Together, the dimensions and lifecycle model reveal new directions for designing documentation systems. Analyzing existing tools with these lenses foregrounds current patterns of use, and examining the values and costs along different paths reveals new opportunities for system design. By engaging with a broad range of creative practices, we find similarities between domains, as well as gaps where fields could learn

from each other. For instance, many of our creative practitioners described the importance of displaying inspirational artifacts: what would that look like in the world of computer code?

RELATED WORK

Documentation is created in many contexts, for many reasons, and through many processes. In this paper, we look specifically at creative practices and computational disciplines.

Thinking through Documentation

Many cognitive processes are supported by methods which generate artifacts. Generating artifacts, such as drawing a concept map or rewriting an idea, has been identified as an effective tool in the active learning literature [3]. Similarly, externalizing thoughts is common during data analysis [8]. Increasing awareness of one’s own process in comparison to other successful practitioners can improve metacognitive understanding and learning outcomes [18]. Documentation can be seen as a way to capture and view ‘fleeting moments’ of progress [6], or to maintain focus [12]. Schön’s notion of reflection-in-action exemplifies a conversational engagement with artifacts and materials [15]. We see these processes reflected in the actions and artifacts of many of our interview participants, and view them as key values of documentation.

Reuse and Sharing

Sharing information allows for increased benefits across wide audiences. Information re-use can be supported by systems which automatically capture relevant information, such as CodeScoop, a mixed initiative system to support the creation of clear, concise code examples [5]. Displaying works-in-progress can promote healthy communities and positive self-conception by sharing insight into process [7]. We restrict our focus to how artifacts support the creator and their personal process, rather than the benefits of sharing, and on the creator rather than addressing the connection to the broader community of practice, but see our results as complementary.

Version Control

Version control is a ubiquitous tool for software developers, and as such it has been heavily studied by the computer science research community. While commit messages are intended to provide helpful documentation about the content of a change, often they are poorly formed or ineffective for that goal [11]. This may be partly because software engineers also have a multitude of rationales behind what they capture in commit messages [14]. Tools to prompt the creation of commit messages scaffold the creation of good commits [10, 2]. We propose that viewing a broad set of roles of documentation can open new opportunities for improving commit messages and provide additional benefits to the programming process.

Known Challenges

Motivation

While working to understand the challenges of deploying a groupware [4] interface that supported the co-creation of shared documentation in an organizational setting, Orlikowski identified the particular challenge of motivating people to

generate documentation [13]. Orlikowski identified the importance of reward structures that reinforce the benefits of contributing to shared documentation. We see the potential to leverage the intrinsic reward creative practitioners may get out of their individual documentation processes. In this work, our goal is to foreground these intrinsic motivations and identify what aspects of the process may translate to other forms of documentation creation.

Translation

Marshall and Brush found profound differences between annotations created for personal notes and those shared with colleagues in a classroom setting [12]. They identified the importance of an effortful processing step that makes personal notes intelligible and shareable with others. They rightly identified that there is ‘no real shortcut’ to creating a system that can automatically generate meaning from personal notes. We agree, and seek instead to create tools and systems that highlight the external benefits in order to enhance the enjoyment of this inherently challenging process.

METHODS

Interviews

We recruited 14 participants (6 women, 8 men), from our professional contacts and reaching out to local creative professionals. Each participant is an expert in their field, with a mean of 20 years of experience (range 5 to 47) (see Table 1 for more details). We sought a wide variety of creative fields, targeting variation across the following dimensions:

- *Type of Artifact:*
 - Physical (ceramics, industrial design, violin-making)
 - Digital (programming, AR/VR art)
 - Ephemeral (physical performance, project management)
- *Extent of Collaboration:*
 - Independent (violin-making, directing)
 - Collaborative (industrial design, stylist, museum curation)
- *Use of Computation:*
 - High (AR/VR art, programming, project management)
 - Low (violin making, ceramics, physical performance)

We performed a 1-2 hour semi-structured interview with each participant. This either took place at their place of practice (8 participants), a neutral meeting place (1), or over video chat (5). The interview focused on documentation artifacts used in their creative process. Interviews were transcribed, then iteratively analyzed using grounded theory [1].

FINDINGS

The interviews with creative practitioners revealed a rich variety of different artifacts, as well as roles documentation played in their process. We found striking similarities across domain boundaries, where artifacts of completely different forms and process served the same purposes and provided the same benefits. We organize the data below into four categories of artifact roles, and at the end, present a particularly interesting category of self-documenting artifacts.

Participant (Main Creative Domain)	Years Experience	Years Teaching
Industrial Designer	23	18
Director	47	30
Physical Performer	22	8
Ceramicist	21	-
Tapestry Weaver	43	-
AR/VR Artist	19	7
Animal Researcher	11	8
Stylist	25	-
Software Engineer 1	10	-
Software Engineer 2	12	-
Software Engineer 3	5	-
Violin Maker	18	-
Project Manager	6	1
Museum Curator	19	3

Table 1. We recruited 14 participants across different creative domains. Here we list their years of experience in their creative domain, and years spent teaching in that domain, if applicable.

Freedom Through Anchoring

Version control systems allow a user to capture a snapshot of a current project at a moment in time. The primary purpose is to save a known good state before making a large, potentially destructive change. This can be thought of as an anchor, recording enough detail that the state can be recreated or remembered clearly. This intentional creation of anchors allows users of version control systems to explore new potential solutions or directions. While commonplace in the world of software engineering, we also found compelling examples of this across creative domains:

The Industrial Designer takes photographs before he makes significant changes to a physical prototype:

Industrial Designer I documented it so I'd have a recording of it, and if all else is ruined I still have the recording of it. I'm allowed to take chances. Like, ok, this is where it's at, let me try something else.

The Physical Performer uses a ‘script’ (a written performance flow, rather than dialogue) as an anchor for exploring new directions through improvisation:

Physical Performer Often times we did go off on tangents and then we came back to the script, and just we “Oh, what we wrote initially was way better than what we'd been playing with.”...[Having it written down] helped me feel more comfortable to just go really far out because I knew that we weren't going to forget what worked in the beginning.

The Violin Maker records by hand the dimensions of each violin he makes:

Violin Maker You always know which is the latest revision. And you can always go back and modify it and get back to where it was good.

This anchoring process allowed for a sense of safety while enabling free exploration.

Supporting Creative Flow

Creative practitioners generated many documentation artifacts whose primary purposes were to assist in the creative process itself. These artifacts captured rich information about decision making, creative development, and techniques, but found their initial value in how they shaped the process in the moment.

Externalizing Artifacts

Externalizing thoughts can improve ideas, reveal alternatives, assist in problem solving (such as rubber duck debugging), and support communication [17, 16, 9]. This process produces artifacts, which contain information about how ideas were generated, refined, and decided.

We observed a variety of externalizing artifacts used by our participants, ranging from informal notes to formal documents like proposals and grants:

Animal Researcher I would say [our research idea] definitely might change direction quite a bit through the process of writing it down.

Software Engineer 1 I was trying to write a short email and that turned into this document where I started going into the details of everything I understood, and as I was writing it I suddenly like got this clarity of how it was supposed to work, even though I didn't really understand it when I started writing the email.

Software Engineer 3 [The whiteboard] is just a way of organizing my thoughts before I start something. I like to write things out. I will reference it some but honestly not that much. It just helps me get my thoughts down in a consistent way.

Externalizing artifacts are not always captured; when they are captured, they may not be re-used:

Physical Performer I did do some writing or drawing pictures or something, but it was a very early phase to try to organize what I was seeing, and then I never looked at it again.

Software Engineer 2 Sometimes it is [captured], generally that's just one of us taking a photo of the board. And whether we transcribe it later or not it's it's really up to us. Most of the time I don't, to be honest with you. I'll take a picture of it, if I need to reference it, I have it in my photos I can look it up again.

Ease Cognitive Load

Visualizing their thoughts helped participants manage complex systems, gain a deeper understanding of a project's timeline and scope, and see their ideas from new perspectives. Artifacts which supported visualizing included butcher paper sheets to lay out a Clown show:

Physical Performer We ended up getting a huge poster-size paper, like really big... If it's on a bunch of little pages I kind of lose track... it gets too mental for me, because I feel like I'm trying to track it in my mind.

Code that had been printed out and taped together into a long sheet for debugging:

Software Engineer 3 When you're on the screen you can only see this one chunk... it's nice just to be able to – with just a flip of your eyes – see “this is here, this is there”.

And videos of performance rehearsal snippets:

Physical Performer We'd tape and review, tape and review... It's hard to tell the person where they need to move their leg, harder than to just videotape it and say “Look! Do you see how your knee is like that? It needs to be like *that*,” and they're like “Oh, yeah yeah yeah!”

Whiteboarding was again a common medium, allowing the programmers to keep track of ideas when discussions got sidetracked (Software Engineer 2), or capture details of the debugging process (Software Engineer 3).

In these cases, documentation provides benefits in the moment: it reduces cognitive load by providing a reliable storage mechanism for thoughts and details, and reveals patterns that would be difficult or impossible to see if only kept in one's head.

Reframing through Mode Switching

When documenting, participants purposefully switched between mediums to gain new insights, new perspectives, and reshape their ideas. Reframing produced new artifacts, which each retained information about prior states and changes. Participants often found value when one of the mediums was not their “primary” form of creation, such as switching between physical performance and writing:

Director [My mentor] would say “Here's the scene, try it,” and then I would do it... he would not let me write it down in rehearsal. [He would] say “write the scene up tonight,” on the theory that whatever I remembered was worth keeping from the scene. Which I found incredibly frustrating. But it works.

Physical Performer For me, there's a time for different things. It's almost like a switch: different channels are open. So there's the improv, physical playful channel and then there's the observer, gleaner of info channel.

Inspiration

Some participants displayed artifacts for the purposes of inspiration: generating new ideas and positive emotions. These artifacts were not necessarily created with this goal in mind, but took on a new role when they were put up for display.

The Violin Maker's studio was filled with posters documenting famous violins with pictures and measurements; documentation of his own violins through paper templates, sketches, and measurements; photographs of inspiring curves and shapes from his daily life. These artifact passively and actively shaped his perceptions:

Violin Maker I don't like to just do anything out of nothing. In violin making, I feel like everything needs to be referenced.

Violin Maker My whole house is covered in [painted tiles]. Just like dragons and birds and stuff you know, and it's all these curves that, I guess when you grow up seeing stuff like that, eventually you're going to [make] something like that.



Figure 2. From Left: The Violin Maker records the gradations of a violin's body in a notebook. These gradations store information about the thickness of a violin's front and back plates for reference when making another violin. Glaze test tiles are mounted on a wall in a ceramics studio, showing the colors after firing, with instructions for how to mix each glaze on the paper to the right. These tiles and recipes are 20 years out of date, as they document a heavy metals process that this studio no longer uses. The Director hand-drew stick figure representations of acrobatic tricks in a binder. The note at the bottom says "There is much more – some I don't know + some I can't draw - the end".

The Tapestry Weaver also surrounded herself with objects that she found inspirational to her own process:

Tapestry Weaver There are things all over the place visually which stimulate me...all these different things in here are just reminders of design things that really turn me on, and in some way will influence me, I don't know how.

She also displayed her own work, as examples of technique, completed pieces that she found unsatisfying, and experiments that she was still figuring out what to do with:

Tapestry Weaver It's not something that I've left it's just something that I will come back to.

The Director hung artifacts around his workspace as a way to keep memories present. Some were relevant to current projects, such as a picture of an event he had attended:

Director The book I'm working on right now has that as part [of it] – so that's why that one's up.

Others were memories of past shows or friends that he viewed in a more nostalgic light. These shaped the affect he felt in his working space:

Director I know that they're behind [the backdrop] and it makes me feel good.

Keeping these pieces in an open, visible location helped them to serve as inspirational artifacts. Each artifact records a history of its creation and use, and has the chance to influence future creation.

Emotional Support

While documentation is often considered to be a dry and rational subject, we found our interviewees experienced their relationships with documentation in an emotional manner, whether highly positive or highly negative.

Celebrate Prior Success

The decision to save artifacts from projects was often related to emotional experiences. Artifacts allowed interviewees to revisit past moments in their lives, brought joy, prompted nostalgia, and were reminders of past skills and successes:

Physical Performer [I keep it because] I want to hold on to that moment in time, I suppose. I'm attached to it in some way.

Software Engineer 2 Sometimes it's fun to go back and go, "ah, yeah, I did do that," or it just triggers things. It's nice.

Industrial Designer [Revisiting prototypes is] like old photographs, going through a shoe box. You pass through these key things, you have this emotional recollection, this emotional component to that. And you feel very strong.

Saving a notebook full of technical details from a complicated process she never plans to repeat provided the animal researcher with professional satisfaction:

Animal Researcher [It is] proof that I actually did it.

These emotional benefits are enough reason for participants to save artifacts, regardless of whether they have practical use:

Physical Performer There's sentimentality to it! So I keep it, but it's not because I'm going to use it in art-making.

Stylist I don't need them anymore, but I probably will always keep them, but just because I like them.

Discarding artifacts was pleasurable and cathartic when the objects were associated with bad memories or frustrations:

Industrial Designer So that was the startup I was involved in...It was a bad breakup, so that's why I threw [the prototype parts] away, after all those years.

Museum Curator I deliciously enjoyed throwing [filing tags] away even though I had spent hours handwriting them all. And it felt really good to be like "and we're never going to do that again!"

Mediate Frustration

Negative emotions were a powerful motivator for creating documentation, especially when that documentation provided information that would help avoid future negative experiences:

AR/VR Artist I've been in those situations where it's like: [*frustrated sigh*] I know I found the solution to this four months ago and I didn't write it down, and that's why I'm struggling now



Figure 3. Living Tools – Left: the Violin Maker uses arching templates to encode the contours of a violin back. These templates are handmade to match a specific violin design, and can be reused many times to carve new violin backs to those specifications. Right: The Tapestry Weaver uses paper templates to create spacing in a tapestry design. When the paper spacers are removed, the vertical warp threads are pulled to create the curved shape shown at right. Paper templates encode details such as dimensions and pattern shape, as well as supporting a specific weaving technique.

to get past this certain point... I don't want anyone to feel that way if they can help it.

Software Engineer 3 So I have the port number for the LIDAR sensor [written on the board] just because it annoys me for some reason, trying to find that.

Conversely, negative emotions can also stymie the creation of documentation, when the creator does not feel like they are gaining any benefit or providing benefit to others:

Software Engineer 2 I never liked documenting stuff... I feel like a lot of times you write documentation people don't actually use it, or read it, so it almost feels like a waste of time.

Inherent Value in Records

The emotional benefits of saving objects persisted even in cases where participants never reused or never expected to revisit their saved artifacts. Potential future reuse was a rationalization for keeping them; the primary benefit was just 'knowing they were there':

Software Engineer 1 Honestly usually I don't go back to it at all. It's more peace of mind that I wrote the information down if I need it.

Software Engineer 3 Maybe there's an off-chance that I can find it useful in the future...[Interviewer: Has that ever happened?] Not really, no. It's like information pack-ratting.

Stylist I get such joy out of taking an image out of a magazine and then do I refer back to it? Probably not.

When asked to articulate why they would keep things, participants were initially unsure, before emphasizing the emotional benefits, and minimizing the costs of saving:

Stylist I don't know...there's definitely some beautiful pictures in there, that I would never see again if I throw them out. And they remind me of a time... They're images that I can't replace... They're just beautiful inspirational images, that I wouldn't get rid of just because – why, because it's like *this* much paper?

Software Engineer 3 Information is power? I don't know. If they're not annoying me and they're not taking up much space... I don't think about them much and they don't cause problems.

Some participants tried to rationalize keeping artifacts with practical reasons, even as they were aware that those reasons were not the whole story:

Software Engineer 2 I have drawers full of stacks of paper cuz I'm always scared that I'm going to need it... as soon as you get rid of it you know you need it. It's not taking up much space it's just a sheet of paper there, I can just leave it. But honestly the majority of that stuff you could probably just throw out right away; it wouldn't matter.

Animal Researcher [Keeping hard copies] preceded the [particular] study where we had the equipment problems. So I think it more justifies my keeping of the hard copy stuff rather than preceded it.

Even if participants couldn't always articulate or justify why they kept things, these saved artifacts played an important role in their creative process, protecting them from distress, and providing a sense of safety.

For Future Use

Documentation for future use is what is often meant by the term "documentation," especially in engineering contexts: a document created for future reference, that contains information and context to explain a system or tool for someone using or modifying it later on. This category of documentation includes "design docs", READMEs, and tutorials. Many of our participants created documentation for future use.

The violin maker kept a notebook he called his "Bible," in which he recorded topographic diagrams of the gradations on the violin body, recipes for varnish, the densities of the wood used, etc. These records are mostly for his benefit, but would also serve as a way of communicating instructions to an apprentice:

Violin Maker That notebook I try to keep as clean as possible, because if I ever had anyone helping, every shop has like a Bible. You know it's like, "Here: this is how we do things".

Onboarding is also important for programmers, who extensively generate documentation for future use:

Software Engineer 2 One of the things we're actually doing is going to be printing a packet for new engineers, so when they come on we can sort of just "here's a small book, or this is the place to look," this is all the information you need from A-Z, on how to get the code running locally, to how you set up a server, to how you do XYZ. All the tools.

In the ceramics studio, a display of hand made glaze test tiles shows recipes and results for students to reference when learning to make glazes (Fig. 2). Programmers often bemoan how quickly documentation becomes obsolete, and these test tiles suffered from the same fate: they were 20 years out of date, as they document a process involving heavy metals that this studio no longer uses. Obsolescence and the labor of updating is a common issue with Future Use documentation, and a source of frustration for users and creators alike.

Self-Documenting Artifacts

Certain artifacts can be considered "self-documenting," in that they contain valuable information about the creative process embedded within their physical form.

Living Tools

Certain tools are an example of self-documenting artifacts. For instance, the arched shape of violin backs is key to the resonant properties of the instrument. This shape must be hand-carved, and it is important to be able to recreate a successful shape. The Violin Maker creates templates from a successful violin back; these templates implicitly encode the complete definition of the arching profile. They are also used as an active tool for carving new violins (Fig. 3).

The Tapestry Weaver cuts shapes out of tagboard in order to hold space in her warp for a specific technique that requires precisely patterned gaps. These paper templates are used directly in the weaving process, and also encode the dimensions and shape of the pattern (Fig. 3). Similarly, a paper template for a violin scroll encodes the shape, and is attached to the raw block of wood as it is carved (Fig. 1).

Materials

Materials can also self-document. The Tapestry Weaver kept both her larger collection of dyed wool, and those colors chosen for a specific project, visually accessible in her studio. The cones of threads behaved as documentation, encoding what materials she had, how much of each, and their visual and tactile qualities. By grouping selections, she could see how they might work together in a particular piece, and she cut small pieces to store in a notebook with the sketches of the tapestry they were used for. Similarly, the Industrial Designer maintained a "material library", which is:

Industrial Designer A collection of different materials — plastic, metal, natural — that have different surface finishes.

He used these samples to explore material choices and communicate with clients, and also sometimes stored selected samples with other documentation from a project.

The Thing Itself

The final artifact may also be self-documenting. For example, the ceramicist saw his work through this lens:

Ceramicist I could bury that in the backyard, I could put that down in a hole and in a thousand years somebody digs it up and nothing will have changed with that. And if the person knows [ceramics], they should be able to tell how it was made.

Similarly, violins are to an extent self-documenting, since one can re-measure any existing violin to find out much of the information that the Violin Maker deliberately captures in his notebook. The programmer too saw his work in this light:

Software Engineer 2 If you have good code, it's sort of self-documenting.

Sometimes, self-documenting objects can save labor; for example, readable code removes the need for detailed explanations. But there can be important information that self-documenting objects do not capture, such as the reasoning behind a particular decision, or the results of failed experiments that informed a successful approach. Cultural norms can also prevent effective self-documenting, such as in the case of companies that like to have "clean" git histories:

Software Engineer 3 I think it's obviously better to have the intermediate [commits], but I think some people don't like seeing so many commits. So I kind of smooch them together.

Undocumentable

While many artifacts are self-documenting, certain others resist documentation in any form. The Director used drawings to try and capture some acrobatic choreographies for future reference. But some things he just "can't draw" (Fig. 2). He also was deeply frustrated by trying to capture the magic of physical performance in text:

Director My plays do not sit nicely on a page. I've gotten in real trouble with commissions when they said "this is not what we hired you for, this is not literature." And I'll say "No, no you're absolutely right. That is a guide for actors to go make magic."

The Performer expressed a similar feeling:

Physical Performer The worst feeling is sitting down at a laptop trying to write a script of a non-verbal physical theatre show.

While attempting to document the undocumentable can provide value to the process, complete records may be impossible.

Multi-Purpose Artifacts

The roles identified above are not exclusive, indeed highly successful artifacts often serve multiple purposes at the same time. For example, the Industrial Designer has a technique for prototyping enclosures (Fig. 4):

Industrial Designer A lot of times I'll take the motor or the actuator, and the power, and the control board, and I'll lay them out in different ways, and take a picture of that ...and play around with it, and then I'll basically print those out on paper...turn down the opacity, and sketch right over them, and

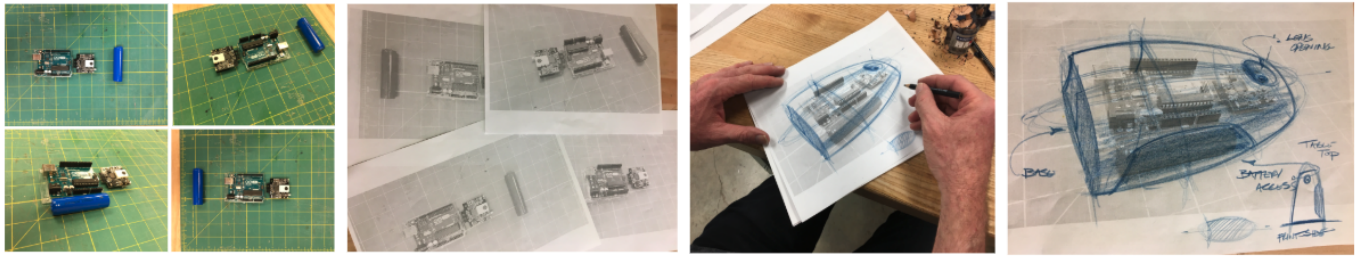


Figure 4. From Left: The Industrial Designer arranges internal components of a device in the real world, and snaps quick pictures of alternate layouts. The Industrial Designer then prints these out at low opacity, and sketches directly over the picture to explore alternate form factors for the enclosure.

develop some forms over them, and play around like, well if I did have it this way, how would I ever get the battery out?

Photographing the components provides *Freedom through Anchoring*, as new arrangements can be explored without forgetting old possibilities. The sketches are *Externalizing Artifacts*, enabling design directly around the components. Multiple layouts and designs can be viewed together, which *Eases Cognitive Load*. The Industrial Designer saves these sketches to "show the history of the project," which allows him to later *Celebrate Prior Success*, as well as supporting the *Inherent Value in Records*. The sketches are also *Self-Documenting*, naturally capturing motivations behind the design, the current state of the layout, and details under consideration.

A FRAMEWORK FOR DOCUMENTATION

The findings from the interviews present a rich and complex view of the ways that people create and use documentation. From the frame of design ethnography, we operationalize these results to provide new insights into designing novel and improved documentation tools and systems. Below we describe two lenses for this purpose: *Documentation Dimensions* and *Lifecycle Model*.

Documentation Dimensions

While synthesizing the interview results, we identified 5 main dimensions along which creators' *intentions* for artifacts vary: *Audience*, *Timescale of Use*, *Generative Process*, *Completeness* and *Purpose* (Fig. 5).

These dimensions help distinguish artifacts based on the intentions and motivations behind their creation. For example, recording a video of yourself performing a dance routine could be done for a variety of *Purposes*, which might each involve a different *Audience*, *Completeness* level, and expected *Timescale of Use*. An audition tape would likely have a higher completeness level than something created to critique the dancer's form, as well as a longer expected *Timescale of Use*. Additionally, the audition tape is specifically created with an external audience in mind, whereas the personal recording is likely considered ephemeral with no expected future use.

Artifacts that Span Dimensions

During the interviews, participants shared that the most effective documentation artifacts were those that cover multiple positions on a single dimension. For example, you might write a Q&A forum post to get an answer for *you*, *now*. However, taking future answer-seekers into account while writing this

post provides benefit to *others* in the *future*, and may also help you effectively externalize your thought process. This can help you get a better answer, as well as enable "epiphany" moments and self-reflection.

We also noted that exceptional documenters were often aware of this duality in their practices, and intentionally leveraged it to help themselves. For example, the Industrial Designer creates sketches and prototypes to assist his own process in the moment, but is also actively thinking about how they might be useful as teaching aids for his students in the future. The Tapestry Weaver keeps every unsuccessful piece, reframing it from 'current failure' to 'potential future design'. Similarly, the process described in the Multi-Purpose Artifacts section generates artifacts which span multiple potential points on these dimensions.

When examining the five dimensions, we note that several types of documentation cluster to either side (Fig. 5). We find these two clusters to be a meaningful and useful distinction:

Catalyst Documentation: On the left we find documentation that tends to be *for the creator*, *short term*, *incidental*, *in-progress*, and *for thinking*. For example, roles such as Externalizing Artifacts, Ease Cognitive Load, and Reframing through Mode Switching. We call this genre "Catalyst Documentation," as it enables the creative process and can change the output of the process through direct use.

Investment Documentation: On the right, we find documentation that tends to be *for others*, *long term*, *deliberate*, *final*, and *for recording*. For example, For Future Use documentation. We call this genre "Investment Documentation," as it requires a cost of time and effort now, but provides significant benefit in the long term.

These categories represent the creator's primary intent when initially generating the artifact. However, artifacts can serve many purposes over time. We capture this dynamic aspect in the next section.

Lifecycle Model

Though artifacts begin their existence with certain purposes, they commonly have many uses throughout their lifetimes. Often the most valuable artifacts are the ones with many uses over long timelines. For example, the Tapestry Weaver hung tapestries on her studio walls that she had made, but which she considered unsuccessful:

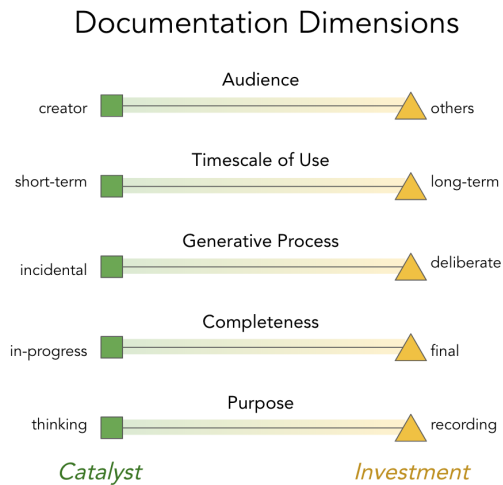


Figure 5. Five Dimensions for categorizing the intentions people have when creating documentation artifacts.

Tapestry Weaver This one I have on the wall, which I put up last night not because I like it (because I don't personally), but because I keep on thinking at some point I want to go back to the pieces that I don't think were that successful, so that I can start playing with it.

In this case, the artifact began as a product, became an ambient inspirational piece that she might learn from, and may eventually be incorporated into a new product in the future.

In order to help visualize these multiple states, we created a lifecycle model for artifacts (Fig. 6). This model can be thought of as an explicit representation of a person's implicit mental state: how they currently think about the artifact.

We walk through an example from the Stylist: "magazine tears" are clippings taken from fashion magazines of inspirational pictures. First, the tear is generated:

Stylist I'll tear something out of a magazine that I just think is a great image.

The tear begins in the *Tool* state, since the Stylist is using this image as inspiration. In the *Tool* state, the tear is *active*, i.e. currently on her mind or in use. After some time, it gets archived:

Stylist Eventually it will make it into my bin, maybe 3 months later, sitting downstairs in a stack.

Archiving the tear in a bin moves it to the *Limbo* state. The tear is no longer directly in the Stylist's mind. *Limbo* is a *passive* state, where the Stylist knows that she has the tear in case she needs it later. She may *revive* the tear by going through the bin and refinding it, which moves it to the *Reference* state, where she uses it for inspiration and to provide joy:

Stylist I won't remember it right, but I have it, so when I go through them it's like, "oh, God, that image, it's so amazing."

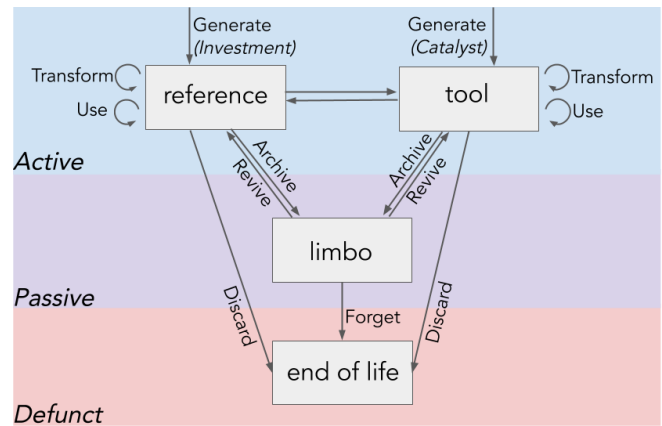


Figure 6. A model of the lifecycle of a documentation artifact.

If she doesn't need it, she may eventually decide to discard it. At which point, the tear will follow the *discard* path from *Reference* to *End of Life*, and become *Defunct*.

A project may have many artifacts; each artifact should be understood as having its own lifecycle. Some artifacts may be nested; consider a git history, which is itself an artifact, but also consists of commits and snapshots of code, which may each be considered an artifact with a lifecycle.

DISCUSSION

The Dimensions and Lifecycle Model we have presented are meant as design tools, to enable new ways of thinking about documentation. To showcase this potential, let us consider version control, specifically git, from the perspective of the Lifecycle Model and the Documentation Dimensions. First, we might note that traditionally "good" git commit messages are good Investment documentation: They are created *deliberately*, in their *final* form, and intended as a *record*. In contrast, "poor" git commit messages focus only on the *creator* and think in the *short term* by assuming current context will always be available.

A poor commit message like this is behaving as Catalyst documentation, when the system it is created in expects Investment documentation. This suggests the need for a tool that leverages the benefits of Catalyst documentation in commit message behaviors in appropriate ways. Consider an entirely new git command — say, git catalyze — that that specifically encourages thinking out loud, capturing additional context, and articulating the thought process for future reference. This leverages the creator's instinct to focus on current benefit to self, while also lowering the cost of the later commit message. The git catalyze command is formatted to consider both the creator and others, and provide both short- and long-term value. It is created and used while in progress, but scaffolds a final output. It assists both thinking and recording.

The Lifecycle Model helps us consider different stages of artifacts over time. For example, consider the *discard* path from *Reference* to *End of Life*. The cost of discarding is much higher than the cost of *archiving* to *Limbo*, which occurs naturally with the passage of time. The low cost frequently led

our participants to maintain many artifacts in the *Limbo* state. *Limbo* can be valuable: it enables safety-blanket behaviors; it allows long-term storage of artifacts while reducing active clutter; the longer an artifact remains in *Limbo*, the more joy and surprise can be found in reviving it. However, *Limbo* also supports excessive saving behavior, and having too many things in *Limbo* may make it harder to *revive* a specific artifact.

Using the Lifecycle Model, designers can see opportunities to change existing tools and systems by adding or removing friction. For example, there is benefit in not remembering something for a long period of time: when you come back to it, you may have new perspectives from when you initially created it. This is a common technique in writing – setting aside a piece until you can read it as it really is, not how you remember it. This can also be valuable in design, by allowing an idea to evolve from the original conception. Adding friction to the *revive* path, or even preventing it for a set period of time, can add value. A "lock" feature can encourage exploration of new ideas, while still supporting *Freedom through Anchoring*.

FUTURE WORK AND LIMITATIONS

While we believe that this paper presents a useful lens on documentation, it does not encompass every aspect of documentation. In our interviews, we noted fascinating behaviors around *mediums*, tensions and contradictions between approaches to *physical* and *digital* forms of documentation, and *social influences* on documentation behaviors. We hope to explore these more fully in the future.

Documentation behaviors were also tied strongly with senses of self-identity and personality. It may be interesting to untangle how personality and identity affect documentation in a more formal manner, especially with a consideration of how systems might adapt to individual needs, strengths, and weaknesses.

Implementing and studying new documentation systems developed using the Dimensions and Lifecycle Model may reveal new insights into the effectiveness of this approach, or about documentation practices in general. We hope to develop several exemplar applications in order to study how documentation tools might be designed to work with multiple creative practices.

CONCLUSION

We presented a set of 14 interviews of creative practitioners, performed using design ethnography, which revealed spontaneous, productive, and emotionally charged methods of producing documentation.

We identified several compelling documentation behaviors and categories, including *Freedom Through Anchoring* and *Emotional Support*. From these insights, we developed the five Dimensions of Documentation, and the Lifecycle Model, as well as identifying two genres of documentation, Investment and Catalyst, that provide a useful perspective from which to approach design. We demonstrate how these can be applied to the analysis and design of documentation tools. Documentation is extremely valuable to the growth of human knowledge and individual creativity; we hope that perspectives presented

here can inspire new approaches to designing effective and joyful interactions with documentation.

ACKNOWLEDGMENTS

REFERENCES

- [1] Kathy Charmaz and Linda Liska Belgrave. 2007. Grounded theory. *The Blackwell encyclopedia of sociology* (2007).
- [2] Marco D'Ambros. 2010. Commit 2.0: enriching commit comments with visualization. In *2010 ACM/IEEE 32nd International Conference on Software Engineering*, Vol. 2. IEEE, 529–530.
- [3] Logan Fiorella and Richard E Mayer. 2016. Eight ways to promote generative learning. *Educational Psychology Review* 28, 4 (2016), 717–741.
- [4] Jonathan Grudin. 1994. Groupware and social dynamics: Eight challenges for developers. *Commun. ACM* 37, 1 (1994), 92–105.
- [5] Andrew Head, Elena L Glassman, Björn Hartmann, and Marti A Hearst. 2018. Interactive extraction of examples from existing code. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*. 1–12.
- [6] Jonathan Hook, Rachel Clarke, John McCarthy, Kate Anderson, Jane Dudman, and Peter Wright. 2015. Making the Invisible Visible: Design to Support the Documentation of Participatory Arts Experiences. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*. 2583–2592.
- [7] Joy Kim, Maneesh Agrawala, and Michael S Bernstein. 2017. Mosaic: designing online creative communities for sharing works-in-progress. In *Proceedings of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing*. 246–258.
- [8] Yea-Seul Kim, Nathalie Henry Riche, Bongshin Lee, Matthew Brehmer, Michel Pahud, Ken Hinckley, and Jessica Hullman. 2019. Inking Your Insights: Investigating Digital Externalization Behaviors During Data Analysis. In *Proceedings of the 2019 ACM International Conference on Interactive Surfaces and Spaces*. 255–267.
- [9] Scott R. Klemmer, Björn Hartmann, and Leila Takayama. 2006. How Bodies Matter: Five Themes for Interaction Design. In *Proceedings of the 6th Conference on Designing Interactive Systems (DIS '06)*. Association for Computing Machinery, New York, NY, USA, 140–149. DOI: <http://dx.doi.org/10.1145/1142405.1142429>
- [10] Mario Linares-Vásquez, Luis Fernando Cortés-Coy, Jairo Aponte, and Denys Poshyvanyk. 2015. Changelog: A tool for automatically generating commit messages. In *2015 IEEE/ACM 37th IEEE International Conference on Software Engineering*, Vol. 2. IEEE, 709–712.

- [11] Walid Maalej and Hans-Jorg Happel. 2009. From work to word: How do software developers describe their work?. In *2009 6th IEEE International Working Conference on Mining Software Repositories*. IEEE, 121–130.
- [12] Catherine C Marshall and AJ Bernheim Brush. 2004. Exploring the relationship between personal and public annotations. In *Proceedings of the 4th ACM/IEEE-CS joint conference on Digital libraries*. 349–357.
- [13] Wanda J Orlikowski. 1992. Learning from notes: Organizational issues in groupware implementation. In *Proceedings of the 1992 ACM conference on Computer-supported cooperative work*. 362–369.
- [14] Khadijah Al Safwan and Francisco Servant. 2019. Decomposing the rationale of code commits: the software developer’s perspective. In *Proceedings of the 2019 27th ACM Joint Meeting on European Software Engineering Conference and Symposium on the Foundations of Software Engineering*. 397–408.
- [15] Donald Schön. 1938. The reflective practitioner. *New York* 1083 (1938).
- [16] IM Verstijnen, C van Leeuwen, G Goldschmidt, R Hamel, and JM Hennessey. 1998. Sketching and creative discovery. *Design Studies* 19, 4 (1998), 519 – 546. DOI: [http://dx.doi.org/https://doi.org/10.1016/S0142-694X\(98\)00017-9](http://dx.doi.org/https://doi.org/10.1016/S0142-694X(98)00017-9)
- [17] Dhaval Vyas, Dirk Heylen, Anton Nijholt, and Gerrit van der Veer. 2009. Collaborative Practices that Support Creativity in Design. In *ECSCW 2009*, Ina Wagner, Hilda Tellioglu, Ellen Balka, Carla Simone, and Luigina Ciolfi (Eds.). Springer London, London, 151–170.
- [18] Lisa Yan, Annie Hu, and Chris Piech. 2019. Pensieve: Feedback on coding process for novices. In *Proceedings of the 50th ACM Technical Symposium on Computer Science Education*. 253–259.