Thoughtmarks:
Re-thinking Bookmarks & the Personal Information Space
by Marcus Ghaly
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Abstract

Bookmarking is one of the main methods by which users store the online information they find valuable. However, bookmarks in their current incarnation suffer from a number of drawbacks which do not support users in their daily routines. Bookmarks are very easy to make, but over time this causes bookmark collections to grow, requiring systems of organization to keep track of everything. Eventually though these systems of organization require organizing themselves. And as time passes the titles of both bookmarks and folders begin to loose their meaning and users find it harder and harder to determine a bookmark’s value or a folder’s contents based on title alone. This leads to the bookmarks themselves becoming stale and unused, making collections that much harder to search through when trying to re-find one’s found, online information.

This thesis proposes to re-imagine bookmarks as visualized information that is easily recognizable, and can help users to predict the information a bookmark links to. In this way it is hoped that bookmarks can become a more meaningful link between users and their found, online information. Furthermore, automated tagging is proposed to assist users when searching for their content, as well as chronological sorting to help users visually scan through their collections and re-find their bookmarks. Finally, non-hierarchical, folder-less bookmarking was also proposed, though in the end this did not map to users’ habits. That being said, visualizing bookmarks would appear to be worth pursuing as it resonated with users, and could be one direction to follow in assisting users with their information collections.
1 Introduction

Given the amount of information on the internet and the central role this information plays in our everyday lives, it comes as no surprise that in order to keep track of the things we find valuable online many people turn to browser based bookmarks or online bookmarking services. Bookmarks remove the mental load of needing to remember everything we have found to be useful online and their associated url's. While Google claims to “organize the world's information,” (Google, N.D.) it could be said that bookmarks organize one's personal information. But the current structure of this “personal information space” (Abrams, Baecker, and Chignell, 1998) has a number of barriers that reduce its effectiveness. Because the act of making a bookmark is very simple, over time bookmark collections grow, but with that growth our toolset's ability to aid us in sifting through our collections and retrieving specific pieces of information offers ever diminishing returns (Cockburn and McKenzie, 2001). The methods for organizing bookmarks, whether through folders or tagging, over time can become barriers as these systems for organization require that they themselves be organized. Furthermore, titles of bookmarks become less and less helpful in assisting us to recall what what information they link back to, and folder names further obscure this process making it difficult for users to predict a folder’s contents (Jones, Bruce, and Dumais, 2001). It would appear that the ease with which users can create bookmarks is at odds with the difficulties of managing, organizing, and retrieving our found online information. Indeed the findings from user interviews conducted for this work mirror almost exactly the findings from these decades old sources. Further, there is an abundance of academic literature on bookmarking from the late 90’s to early 2000’s, yet a subsequent absence in more recent times. And so one must therefore ask where has the emphasis been placed over the past decade in the domain of bookmarking? I would propose that it has in fact been in sharing via online and social media.

The introduction of Delicious in 2003 (2003), Facebook in 2004 (2004), Reddit in 2005 (2005), and Twitter in 2006 (2006), among others, began a new trend in bookmarking which saw them become part of a social dynamic instead of a solitary activity. Sharing bookmarks (links in this context), commenting on links, and posting new links in response, etc. has since become commonplace. There is also the myriad of blogs and other forums that act like miniature online repositories for links and found information.

![Figure 1: Timeline of Online Services](image-url)
Posting links (bookmarks) on Facebook is an excellent way to both share, and be exposed to, new information online. In the case of Facebook this information can perhaps be considered pre-filtered for quality given that your exposure to links is by way of your friends and colleagues. Twitter works in much the same way because if you value the tweets of the people you follow then it is safe to assume you may also value the links they post. Somewhat similarly, Reddit relies on the power of the crowd to identify valuable information and by voting either promote or demote a links “value.” But these services don’t provide a personal information space (Abrams, Baecker, and Chignell, 1998) for bookmarks, or create a coherent, structured way for users to save the things they have found online for later retrieval. They are instead platforms designed for sharing all types information, a subset of which happen to be links (bookmarks). Sharing is obviously an important component of information, but the problem sets and solutions around sharing are quite different from those surrounding information organization.

And this brings us to a very important point which is that as a result of all of these online services, and the subsequent movement of users into the social space, making bookmarks in the browser has been left behind both in terms of design, research, and innovation. I would argue that this shift away from the browser does not signal its demise as a tool for information organization, as many users report actively using bookmarks, but instead affords us the opportunity to consider the browser as something worth returning to, and leaves open the possibility to re-imagine it in a new light. Furthermore the recent emergence of tablet computing in the mainstream could serve as a new architectural program on which we make our break with tradition and begin to re-imagine. In this way the use of tablets as a new vantage point positions us between looking towards potential futures with touch-centric and mobile scenarios while still maintaining our ties to the heritage of information organization research and design.

Let us pause for a moment and consider a quote in relation to the these statements. “By interaction design we mean designing interactive products to support people in their everyday and working lives. In particular, it is about creating user experiences that enhance and extend the way people work, communicate, and interact.” (Preece, Rogers, and Sharp, 2002, p 6) Is it not valid then to reconsider bookmarking as a whole? Surely there must be at least some room in which to reevaluate this topic. Therefore one must ask, how can we readdress the making, organization, and retrieval of bookmarks that support users and enhance their interactions?

2 Related Research

2.1 Information Archiving with Bookmarks

I initially chose a number of pre-year-2000 papers on bookmarking in an attempt to understand the design space historically and reflect on how it has changed over the
years. However there are a number of striking similarities between user perceptions of, and difficulties with, bookmarks taken from research data in the mid to late 90's and the experiments I conducted for this thesis in 2012. The work of Abrams, Baecker, and Chignell (1998) was of particular interest because it provided both quantitative and qualitative research. Their work studied why people made bookmarks, and how bookmarks are created, organized, and used, and finally they concluded with recommendations for filtering bookmarks including “time-based visualizations with automated filters, the use of contextual information in representing bookmarks, and [...] hierarchy formation.” Their study touched on a number of areas where bookmarking appears to have much more in common with meaning making than just listing links. First, and perhaps most relevant to this paper, was their claim that “users create their own personal information space for the web by making bookmarks, structuring the resulting collection, and managing its growth.” They noticed that users would organize clusters of information with bookmarks, and then use those bookmarks as a way to jump between clusters. With regards to organization their user research found that, “bookmarks are unstable if they are not kept in meaningful categories, which takes a lot of time.” They also identify problems with organization in that bookmarks are by default ordered chronologically, but if users manually rearrange their bookmarks into different categorizations they lost the ability to sort by date.

2.2 Keeping Found Things Found on the Web

A study conducted by Jones, Bruce, and Dumais (2001) explored the use of folder based hierarchies and identified a number of text-related downsides to this method of information organization. They noted that, “folders can obscure as well as organize [...] In efforts to locate a bookmark after creation, users reported difficulty in determining which folder a bookmark was in.” Furthermore, bookmark recognition was found to be difficult as their titles were often not descriptive enough for users to recall what they linked to. But users did not only have difficulty finding their information. Folder creation was also viewed as difficult because folders had to actually be organized, named, and created in the first place. This led to another problem in that the time required for organization was identified as troublesome because users sometimes found that their previously titled and arranged hierarchies became stumbling blocks for future data retrieval. Temporal problems further extended into folder naming as well because, “subjects also reported difficulties determining a folder’s contents and purpose from its name after some time had elapsed.” Interestingly many of the people I interviewed gave responses almost identical to this decade old research.

That said, while files and folders in their desktop incarnation require names, have locations, and are organized into strict hierarchies, there are no rules mandating that bookmarks follow this same model. Therefore we might consider that in the bookmarking context folders themselves could be changed or modified, or they could even be done away with and a different paradigm used in their place. It is at least worth considering given that this work is reevaluating bookmarking on the whole.
2.3 Characterizing Browsing Strategies in the World Wide Web

The work of Catledge and Pitkow (1995) is also worth considering when comparing much older research to modern day findings. They attempted to study behavior patterns as users browsed the web by capturing and logging user events for students, staff, and faculty at Georgia Institute of Technology's College of Computing. They logged the patterns of 107 participants and divided up their users' actions into eight categories with a percentage of use for each category. They found that clicking hyperlinks and pressing the back button consumed 92.5% of all user activity within their browsers (51.9% and 40.6% respectively). Hotlists, Mosaic's term for bookmarks, consisted of only 2% of browser activity.

Now, one cannot assume that behaviors and statistics taken from users in Mosaic from 1995 would map perfectly to behaviors and statistics taken from users today. And in fact the above mentioned test would need to be recreated today to draw any such conclusions. It is instead worth noting the similarities between the interface for, and interaction with, bookmarks when this test was conducted and the modern day equivalent. The image below shows a progression from Mosaic's Hotlist (left) (National Center for Supercomputing Applications, N.D.), to the Advanced Hotlist Manager (middle) (Niall Kenedy, 2006), and to the Bookmark Manger from Firefox 12 (right) (Mozilla, 2004). Note that the “->” in the Hotlist denotes a “sub-list,” or a “folder” by today's nomenclature.

![Figure 2: Evolution of Bookmarks - Hotlist (left), Advanced Hotlist Manager (middle), Firefox Bookmark Manager (right)](image)

Given the similarities in the above three examples, it is perhaps worth considering that we reevaluate at least some parts of our current toolset and the thinking around making, organizing, and retrieving bookmarks.

2.4 What Do Web Users Do?

Given that bookmarks and history are the two main ways by which users revisit websites, it is worth asking how often users actually go back to websites so as to understand the value of these tools. The work of Cockburn and McKenzie (2001) attempted to address this. They conducted a 119 day study which used browser log data to track 17 users who visited “a total of 84841 [web] pages.” They found that,
previous studies have shown that revisitation (navigating to a previously visited page) accounts for 58% and 61% of all page visits. Our study shows that page revisitation is now even more prevalent, accounting for 81% of page visits when calculated across all users.” This rather large figure requires some context because they also found that the top three pages most viewed by their participants accounted for an average 24% of all page views. Still though, this would appear to strongly suggest that revisitation is an important element of user habits. They also identified bookmarking, history, website design, and navigational controls like forward and back as suggested areas for improvement noting that, “it is clear that any minor interface inefficiency in supporting revisitation will result in massive productivity losses when multiplied across millions of users.” Finally, with regards to bookmarks they concluded that “our study reveals that users build very large bookmark collections, and that the current interface schemes tend to become unwieldy.”

Comparing these last two quotes together, and in light of such statistical data, perhaps the case for reconsidering bookmarking has more weight to it. They also identified “visual histories,” where website image previews are incorporated into browser history, as one possible approach that could aid with website revisitation, though no mention of “visual bookmarks” is made. If adding visual elements to history is worth consideration, so to could visual elements for bookmarks. But before we go too far down this path, let us first consider visualization in general and return back to bookmarks afterward.

2.5 Löwgren & Pliability

Löwgren (2007) introduces the concept of pliability, and defines a pliable interaction as, “one where the user is drawn into a sense of shaping the digital information with his/her fingertips, even though the actual artifact might employ standard, non-tactile interaction techniques such as mouse, keyboard, and display monitor. Pliability is a sensuous quality, having to do with how it feels to use the artifact in the here-and-now of the use situation, and as such it plays a role in understanding the aesthetics of interaction.” He elaborates on this notion with several examples and comparisons between pliable and non-pliable interactions. His first example compares a traditional database with that of a movie database called the FilmFinder (Ahlberg & Shneiderman, 1994). With the traditional database, all the information it contains is essentially hidden from the user, and only when a search is performed does “relevant” data appear. This type of interaction is perhaps lacking in functionality in that if the data the user wants lies just outside of the current search criteria there is no way for the user to know this and venture outside their current search accordingly. Therefore either they see what they want in the returned list of items, or they don’t, with nothing more to go on. But this leads one to view the interaction as lacking pliability because there is no real way to manipulate the result, refine the criteria skillfully, and compare these various outcomes other than simply start the search over again with at most a few added key words. FilmFinder takes the opposite approach. Instead, the full contents of the database are presented to the user at the beginning of a search, and as the search criteria are changed the data-points outside the adjusted criteria are removed.
from view. Furthermore, the data is presented in a graph with the movie’s release date along the x-axis and its popularity along the y-axis. So the combination of seeing the data as well as seeing how adjusting criteria affects the data makes for both powerful and informative interactions. The ease with which the data can be manipulated, as compared with traditional database searches, creates an elegant sense of pliability, and the correlations and insights gained from this create what Löwgren calls “serendipitous discoveries.” As an example, if the lower end of the movie-length slider is increased, shorter length movies are removed from the graph. As such one can see that movies on the left side of the graph are removed first, leading to the realization that movies were shorter in the earlier days of film. This type of insight would simply not be possible in traditional database interactions.

Figure 3: The FilmFinder

The second example that influenced my design process was the notion of direct manipulation as considered in a comparison between two mapping programs, Eniro (2000) and Google Maps (2005). Eniro was similar to many mapping programs of the day where if one wanted to move the map view left they would click the left arrow, wait for the next map section to load, and then compare what they remembered from the previous frame with the new frame of map and extrapolate the difference to regain their bearings. If however one wanted to move the map view left with Google Maps, they would simply click and drag the map horizontally and watch as new portions of the map came into view. This direct manipulation model in Google Maps maintained one’s orientation and, as Löwgren put it, “facilitates view reconciliation.” Finally map data
could be mixed with satellite photography, furthering one’s comprehension of the data presented. This example concludes by pointing out that the model of direct manipulation in Google Maps was subsequently adopted by the other map engines soon after its introduction. This connection between action and result, cause and effect, greatly increases the quality of the user experience and moves the user that much closer to the information they wish to interact with. To this end, let us consider for just a moment the case of the bookmark as it stands currently in the image below.

![screenshots](image.png)

Figure 4: Screenshots of Terminal (left), OSX (middle), Safari on iPad (right)

Moving from left to right is the terminal window, a folder and its contents from the desktop, and a set of bookmarks from the iPad. If we reflect for even the briefest of moments on the concept of pliability while considering the command line which has not significantly changed since the teletype machines of the 1950’s, the file browser GUI which also has changed little since the Alto of the 1970’s, and the bookmarking menu of the iPad from 2012, there is perhaps cause for concern. Why should the iPad’s bookmarks of today look so much like the command lines from decades ago? Yes, one can tap on a bookmark to open it instead of typing its name on the command line. Yes, one can directly manipulate the list of bookmarks by dragging their finger up and down on the screen to scroll instead of the wheel mouse on the desktop. And yes, thanks to Steve Jobs the font is nicer on the iPad than the command line. But does this really represent the best that design has to offer? The answer must surely be no. Organizing, representing, and interacting with bookmarked data is lacking here, and it is from the standpoint of current non-pliability in interaction and a lack of visualization in its presentation to the user, that I wish to readdress bookmarking.

2.6 Victor - Magic Ink & Information Software

Victor’s Magic Ink (2006) aligns well with pliability in that similar types of software comparisons are made, though Victor’s approach breaks software down into three categories: Information Software, Manipulation Software, and Communication Software.
For the purposes here we will focus only on information software which is defined by Victor as, “[serving] the human urge to learn. A person uses information software to construct and manipulate a model that is internal to the mind - a mental representation of information. Good information software encourages the user to ask and answer questions, make comparisons, and draw conclusions.” Victor then goes on by taking current examples of information based software and interactions and reinvents them with a greater emphasis on exploration, comparison, and thus ultimately decision making on the part of the user.

Victor also uses movies for comparison, but the context is when a user wants to see a movie in the theater and is looking at a website for listings and times. The first image shows how movie listings are currently arranged, where by the movies are organized by theater. Because of this layout the user must look through the offerings of each theater to find the movie they want, and then their eye must jump from listing to listing to compare the times at which the movie is showing at the different theaters. Interestingly, Victor explains that when movie listings were printed in newspapers they were organized by theater because the theaters paid to be listed. Today however this financial arrangement, and thus the graphic layout, between a theater and webpage listing does not exist. So one would assume that the only reason for the information to be treated the same way in its digital form is if someone merely copied a solution from the previous era and only thought of implementation and not how to design the information for its given context.

Victor re-imagines this layout starting from a very simple observation. “The primary question is, ‘What movies are showing today, at which times?’ Given the two spatial dimensions available to us, this should suggest a graphic with movies along one axis and times along the other.” In his redesign Victor lists the movies vertically, color codes the theaters, puts time along the x-axis, and puts a light gray shade on the past so that the barrier between shaded and non-shaded time listings represents “now.” His information graphic skillfully includes brief movie descriptions and ratings, all of which serve to better inform the user about the choice they wish to make.
It is these transformative elements, from simply putting text on a page without consideration for its context of use, to understanding that data can be arranged as information graphics, that I wish to bring to bookmarking. Thinking back to the former example of the terminal, finder, and bookmark list. The idea that a solution from a previous era was copied into a new context and only implementation, and not design, was considered at least in theory would appear to have similarities to the movie listing example above. So perhaps a simple distilling of interaction and layout, similar to the narrowing down of just graphing movies vs time on a chart, can be done for bookmarks. Such an approach might help to alleviate the difficulties of folders, and the complexities of categorizing one's data into rigid hierarchies. The idea of bookmarks as a tool to create a “personal information space” (Abrams, Baecker, and Chignell, 1998) would seem to dovetail nicely with Victor’s definition of information software as something we use to “construct and manipulate a model that is internal to the mind.” Because, as Victor says of his own example, “this is not a list of search results - it is an information graphic. It’s for learning.”

2.7 Internet Scrapbook

Upon reflecting on the ideas of pliability and data as information graphic, one might wonder in which direction bookmarking can be taken. And it is perhaps in the prescient work of Sugiura and Koseki (1997) that some initial influences can be drawn. The Internet Scrapbook was conceived by its authors to be an “information personalization system,” which, as the name suggests, transforms our idea of information on the internet from a series of pages we must remember the location of and constantly navigate to, and reframes it as a single personal page on which we can arrange the snippets of information we find into a collage.
There is something really important going on here. The makers of the Internet Scrapbook identified that the act of remembering where information is online and searching or navigating back to it as being quite cumbersome. Their conclusion was to let the user snip valuable information from the web and arrange it visually in the hopes that this would solve the difficulties they had identified. Internet Scrapbook attempted to rethink how to represent found, valuable information online. However, if one considers that many users reported having somewhere between 100 to 300 or more bookmarks (Abrams, Raecker, and Chignell, 1998), then one might need to consider what scrolling through 300 or more scrap book entries might look like. Without the ability to search or sort by criteria, perhaps Internet Scrapbook in its current form might suffer from similar issues as regular bookmarks in regards to information organization and retrieval. That said, this approach of making found online information visual is very interesting to consider.

2.8 Integrated Back, Bookmarks, and History

The work of Kaasten and Greenberg (2001) takes a similar approach to Internet Scrapbook (Sagiura and Koseki, 1997) but they propose a slightly different approach. They suggest that a browser’s back and forward buttons, bookmarks, and history be integrated into a single tool. They suggest that the browser’s back and forward buttons should go through a user’s entire viewing history instead of being limited to a single web browsing session. Also, a user’s history would be ordered in terms of frequency of page view instead of a chronological list. In this proposed new tool, a green bar is added next to each bookmark which increases in height based on that bookmark’s frequency of use, and users can optionally dog-ear a bookmark to help it stand out. Their proposed system takes a snapshot of viewed webpages and displays a small icon view of this snapshot in a vertical list of the user’s web history. The back and forward buttons would then move up and down this displayed vertical list. By hovering the mouse over a small web icon a larger snapshot is displayed, allowing the user to make out some of the details from that webpage in order to better identify it. Finally, clicking on this web icon takes the browser to the actual webpage. With regards to
bookmark retrieval a search function has been included, though it should be noted that this only searches a bookmark's title for keywords.

Figure 8: Integrated Back, Bookmarks, and History

While the thread of visualization is also present here, a number of considerations could be made. First, one must weigh the difference in approach of frequency of use for listing bookmarks vs Abrams, Baecker, and Chignell's (1998) suggested chronology sorting. Additionally, tablets lack mouse hovering, so the idea of displaying nested website snapshots via mouse hover would need to be redesigned. Also, evaluating just how small these preview icons can be before they lose their value would require user feedback, especially for sites that are mainly text. That being said, the proposed solutions of Kaasten and Greenberg (2001) suggest a number of very interesting avenues worth pursuing in understanding how bookmarks might be visualized and retrieved. While their research is primarily aimed at web history instead of creating bookmark collections, there is quite some overlap in these two adjacent domains.

2.9 Visual History Mechanism on Mobile Internet Browsing

The Visual History Mechanism (Yoong-en, Su, and Seong, 2007) explored visualizing browser history on mobile phones. Here, fullscreen snapshots of recently viewed webpages are taken by the phone automatically, placed in a vertical list and sorted by frequency or date last viewed, but not alphabetically. The design concept attempted to reduce the user effort of re-finding previously visited websites through visualization, but because non-touchscreen cellphones were the target platform, with relatively small screens and weak cpu's, a number of design decisions followed as a result. Tree node graphs and other information visualizations were avoided, the website thumbnails were
kept very small, and because the solution targeted web history and not bookmark collection, the number of visualized bookmarks was kept to 20 in total. A simple system of marking (favorite-ing) and displaying the number of page views numerically was added. But despite the hardware imposed limitations, their user testing found that “19 out of 22 test subjects agreed that the proposed Visual History mechanism was easy to use” as compared with a text only view. But perhaps more interesting was a “total of 7 (31.82%) test subjects found the system unnecessarily complex yet easy to use. Hence, it was believed that the complexity of the Visual History mechanism did not affect the ease of use of the mechanism by chance.”

![Figure 9: Visual History Mechanism](image)

While it is unclear from the text what impact the introduction of touch screens would have, it is interesting to note the positive feedback from the users when comparing their visualized history to the equivalent text version, and that ease of use outweighed additional complexities introduced by the visualization. Though the authors were addressing browser history, limiting the number of visualized webpages to 20, and the size of the icons were very small due to screen size, based on their conclusions one could surmise that bookmarks may also benefit from a similar visual treatment.

2.10 Visual Snippets

The work of Teevan et al. (2009) attempted to see what role different forms of website representation played in finding and re-finding information online through search. The research they referenced examined the role of text-based website summaries and thumbnail icons to assist users when searching for content. However, what Teevan et al. introduced was a new method of representation called *visual snippets*, which were icon sized images composed from a mixture of webpage thumbnail, “salient image” or company logo derived from the same site, and the website title or url. These were originally hand-generated but later were computer-generated. They wanted to see what role a multi-faceted, visual representation of websites could play, as compared with text-summaries and thumbnails for search. 197 users were asked to find, by way of a modified search engine for testing purposes, different pieces of information about products, services, and medical knowledge in an attempt to successfully answer a number of questions posed by the researchers. Accompanying the users’ search
results were either text based descriptions of websites, thumbnails, or visual snippets. The following day these same users were asked to re-find the same information, again through the same search engine. The researchers concluded that when considering finding and re-finding tasks together visual snippets performed the best and text summaries performed the poorest, however when only considering re-finding tasks thumbnails were the best. They commented that, “the trend suggests visual representation of previously viewed pages may support faster revisitation.”

![Figure 10: Visual Snippets - Text (top), Visual Snippet (bottom-left), Thumbnail (bottom-right)](image)

It is interesting to consider this research in light of the Visual History Mechanism (Yoong-en, Su, and Seong, 2007) and the findings of Jones, Bruce, and Dumais (2001). If visualizing history was seen as helpful to users, while the text based nature of bookmarks became a stumbling block over time, then perhaps the visual representations that helped with re-find websites in the above study could be applied to bookmarks, given that the nature of bookmarks is indeed to help us re-find information. Also, because a user actually makes their own collections it is safe to assume that they will have seen their visualized content previously, thus aiding in retrieval.

2.11 A Comparison of Visual and Textual Page Previews

In a roughly similar vein, the work of Aula et al. (2010) compared different webpage preview strategies in an attempt to understand users’ perceptions of helpfulness when searching online. Specifically, they wanted to see how helpful users predicted a webpage would be in providing them with desired information, as compared with its actual helpfulness, based on the the type of preview presented to the user by a search engine. Users were given text-summary previews, small to large thumbnail previews with no url or title, and thumbnails with a url or title placed either at the top or bottom of the thumbnail. With regards to the url or title being at the top or bottom of an image, they used eye tracking and heat maps to determine where the user looked and for how long. They found that with text-summaries alone users over-estimated the usefulness of a website, while with a thumbnail only users tended to under-estimate a website’s usefulness. But, interestingly enough, “by adding the titles and URLs below the
thumbnails and making sure that the thumbnails are large enough (200x200 or larger), the underestimation bias could be largely alleviated.”

Figure 11: Different Page Preview Styles

A users’ ability to judge the helpfulness of a webpage in providing them with the information they want, based solely on a preview of that webpage, touches on their ability to predict. This is because a user is essentially making an assumption or prediction about the website they will be taken to and the kind of information it will contain. A user’s level of satisfaction will be determined by how closely the predicted result and the actual result match. Methods for correctly informing this type of prediction could have implications for bookmarking because, as mentioned by Jones, Bruce, and Dumais (2001), users often have a hard time remembering what information their bookmarks link to or a bookmark’s relevance based on the title alone. Therefore, assisting the users’ ability to predict what information they will be lead to when selecting a bookmark could potentially improve their relationship with their information, and the bookmarking toolset on which they rely to reach that information.

2.12 From Text to Imagery and the Implications on Memory

If an emphasis is to be placed on visualization over text based lists for bookmark organization, then it is perhaps worth considering whether imagery can assist in the recollection of information more so than text or language. The work of Hart and Graham (1975) sheds at least some light on the topic. They conducted three experiments where participants were asked to remember and recall the contents of several 4 x 4 matrices who’s cells contained a single letter each. In the first experiment participants were given the contents of the matrices verbally, but asked to construct a mental image of what the matrices and their contents looked like. In the second test the participants were shown images of the matrices and their contents. In the third test the participants were given the contents of the matrices verbally only, with no
instructions to imagine the matrix contents. The participants were later asked to recall the matrices’ contents and were graded based on time and accuracy. The assumption being tested was that if the results were the same, then perhaps a similar mental “abstract representation” was being used in memory, but if the results differed then the representations perhaps were also different. It was found that “recall was best when students saw the matrices, intermediate in the imagery situation, and poorest in the verbal situation.” However, equally interesting was the finding that “recall was best for the corner cells of seen and imagined matrices, indicating the spatial nature of these processes; no such effect was found for verbal processing.” While it is beyond the scope of this paper to delve the inner workings of human psychology and neurology, the above test at least suggests that it is worth evaluating the qualities of imagery and comparing those qualities to their text based bookmarking counterparts.

2.13 External Memory Aids

Regarding memory, the work of Intons-Peterson and Fournier (1986) focused on understanding memory aids and their use in different situations. They break down aids into two groups; internal aids such as "mental rehearsing, alphabetic searching, mental retracing, the method of loci, and other mnemonic systems," and external aids like "making lists, writing on a calendar, and putting an item in a special place." They suggest that external aids can be helpful when there are long periods of time between learning and recalling information, when memory alone might not be accurate enough, when there is not enough time for memory strategies like mnemonics, or when a person is focused on another activity. They further suggest that internal aids can be beneficial when external aids are not convenient like when acting on a stage, when one is without pen and paper, when physically carrying aids is inconvenient, and when recalling information happens soon after its learned.

Intons-Peterson and Fournier conducted three experiments testing various conditions, situations, internal and external aids, and imposed different limiting factors on roughly 200 participants. Their study used "(a) memory aids to sample internal and external types; and (b) situations that were past and future, verbal and spatial." They found that external aids were helpful in assisting spatial and future memory situations where users knew that information would need to be recalled later. These aids were perceived as more accurate and reliable by participants than internal aids, and that creating external aids like lists were helpful in recalling information later even when the list was not available.

From this perspective, bookmarks could be considered as an external aid for memory, where memory strategies are offloaded as digital artifacts for later recall. There can be a long time between bookmark making and later bookmark finding, a user’s attention is on browsing and not using mnemonic memory activities for url’s, and one’s browser bookmarks are always adjacent to their web viewing activities. Finally, when making bookmarks one can assume they might need to be recalled later. However, when comparing these insights with the research findings of the British Audio Visual Society (UK Center for Materials Education, N.D.) the disconnects with

Marcus Ghaly
bookmarking found by Jones, Bruce, and Dumais can be clearly seen - “We remember 10% of what we read, 20% of what we hear, 30% of what we see, 50% of what we see and hear, 80% of what we say and 90% of what we say and do at the same time.” If only 10% of read material is remembered, and bookmarks are a text-based external aid, then perhaps we can understand how easily users forget their bookmarks and folders based on title alone. If instead the research of Teevan et al. and Aula et al. can be shifted to bookmarks, then we might also shift this external aid into the 50% category of seen (visualization) and heard (read) information. Further, if the user can become engaged with their bookmarks spatially through a touch screen, then perhaps we might inch closer to the 90% category by including "doing" as the direct manipulation of bookmark making. This overlapping of visualization, bookmark interaction, and engagement could be interwoven into this external aid in an attempt to remove some of the difficulties users currently report with their bookmarks.

And so now, with a number of touch stones for orientation, and after examining several possible future tools, exploring just a few online bookmarking services is important to help understand the current trends and developments in this design space and how they influenced my design process.

2.14 Delicious

Delicious (2003) was one of the first services where users could keep their bookmarks online, but their real innovation was in tagging. Instead of organizing bookmarks in folders, users could instead tag their content with keywords that could be searched for again later. Users could even browse by tag keywords. Multiple tag words could be associated with a single bookmark, aiding in the categorizing and searching of one’s collection.

However while Delicious and tagging have become popular (several people I interviewed reported using Delicious) there are a number of problems with tagging in general. Firstly, spelling mistakes and slight variations on tag words cause organizational difficulties; a user can tag one bookmark with “gallery,” another with “galleries,” and another with “galeries.” But also there is the problem that one must remember under which tag cloud they categorized a given bookmark when looking for it again later, which is identical to the problem of remembering which folder a bookmark is in with browser bookmarks. Seen this way, the difficulty of identifying a bookmark based solely on text can be seen as quite similar with bookmark folders and tagging.

2.15 Trunkly

Trunkly (N.D.) is an online tag based bookmarking service which manages to overcome some of the problems with tagging. Instead of users tagging their content manually and having to remember those tags when searching for their content later, Trunkly treats the text in webpages themselves as tags. When a user bookmarks with Trunkly it saves a copy of the website’s entire text as meta-data that it attaches to the
bookmark. This removes the need to manually tag and makes search more flexible. By turning a website's entire text into tags, Trunkly leverages readily available data instead of placing the burden of manually managing tags and tag collections on the user. However, Trunkly still represents bookmarks as text only elements, but visualization is not the problem it attempts to solve.

Trunkly represents true folder-less, non-hierarchical, bookmarking. While users can add tags if they so choose, there is no requirement to categorize, sort, or organize one's bookmarks. This improves the creation and retrieval of bookmarks, and does so not by adding new interactions or structural paradigms but by removing the current hierarchical paradigms of files and folders. It essentially abstracts away the idea of a bookmark into an informational object, as opposed to a bookmark being an object who's information one must know about in order to interact with it.

2.16 Pinterest

Pinterest (2010) can be thought of as a service for content gathering in a social network context. Like other social networks, users have followers, can follow others, and users can pin (post) and re-pin the content they find online. Users also have a dashboard for curating their found content, and users can comment on each others pinned content, add “likes,” etc. But Pinterest is a noteworthy here because it's an application for collecting information found online and representing it visually. When a user saves a link (bookmark) in Pinterest, they are prompted with a list of all the images available from the associated webpage. The user selects an image to be their visual bookmark, selects a folder for storage, and optionally adds a description. In some ways Pinterest offers the best of all worlds because a user's content is visual, users can share and find content, and users can comment on or “like” content, essentially ranking it. Visualizing found content is the major distinguishing feature of Pinterest, but this service is not without its downsides.

To begin with, users have no options other than to be social as there is no private content. Furthermore users can look at and search through one another's content without the prerequisite of being “friends.” So all of one's content is available to the entire social network at all times. This has lead to a number of privacy concerns regarding online bookmarking services. An article from Fearless Web (2012) had this to say about Pinterest's lack of privacy, “Don't post any pictures that you wouldn't feel comfortable showing to anyone including your parents, kids or co-workers (that includes your boss) in person.” This is a remarkably strong stance, though perhaps warranted, and so one must ask does this really reflect how users should use their personal information spaces? Should a user second guess each bookmark they make for fear of social repercussions? The issue of privacy then further strengthens the argument to return to the browser as it is not a social service, but a solitary piece of software on a personal device.

But more importantly is that while this service does visually represent content, its organization is still folder based, links (bookmarks) are still displayed in static vertical
lists, and search-ability only comes by way of manually added descriptions. As such, the burden of organization, curation, and retrieval still rests on the user. However, the takeaway I drew from Pinterest was that visualizing information resonates with users. Given Pinterest's extreme popularity online, I would argue that this is no accident.

2.17 Archiving & Data Management

In light of the above research and examples, if we accept that bookmarks are how we create a personal information space, then one must ask what are the qualities of these types of spaces? What are the attributes of these personal archives of our found online information, and what are the implications if we do not reevaluate them? Abrams (1997) states that complex information spaces have five qualities: 1. they contain a large enough volume of information to cause information overload 2. they carry a large amount of low-value information making it hard to find high-value information 3. unless consistent effort is spent on organization they become extremely disordered 4. while they may have structured areas, there is too much complexity for the entire space to be evenly and equally structured 5. and they are so large that there is no way to view the space in its entirety. Abrams claims the web is one such system, but that bookmarks run counter to this because they are a personal information space. All of the literature reviewed here, and the many interviews conducted for this work suggest otherwise. With the possible exception of the second quality, the data suggests bookmarks are in fact a complex information space.

Collections do contain large amounts of information as users constantly add bookmarks. When looking for a specific bookmark, the other bookmarks in one’s collection can be considered “low-value” as the user must sift through them to find the desired bookmark. From the literature and interviews conducted here, users spend very little time organizing their bookmarks and so their collections move towards disorder. Tag clouds and folders do allow for localized regions of structure, but large collections sizes mean this structure is not evenly distributed. Finally it is not possible to see one’s entire collection and all the information it contains from a single vantage point. And so what follows is that we must consider what these five qualities suggest if we do not reevaluate our bookmark collections and the management of the data they hold.

A clear example of this comes form Abrams, “Humans have physiological tolerance levels to information. If the volume of information exceeds the capacity of our sense, then our comprehension declines.” Because collections grow in size, if we do not consider ways to curtail the amount of information presented to users, as in the FilmFinder, users will not be in a position to make informed decisions and draw conclusions based on their vast archive of information. If there are in fact high and low value elements in our collections, we do the user no favors by not considering approaches like visualization which allow them to estimate a bookmarks value and usefulness when sifting through their collections. Entropy is simply unavoidable, and so we must actively pursue alternate means of dealing with this issue, like automatically grabbing meta data to aid with search, or users will be forced to
constantly and meticulously organize their data by hand if they want to find their bookmarks again later and derive value from their collection. New methods of evenly structuring this data space, whether through alphabetical, chronological, or other means of classification, must be evaluated in this asymmetric space or users will not be able to easily sift through their extensive information collection. And finally, while users’ collections may be too large to map out in a traditional one-to-one scale, systems of arrangement that afford “serendipitous discovery” can offer at-a-glance insights that can currently only come from unrealistically exhaustive dives into, and critical analysis of, our data. These considerations suggest that instead of accepting the status quo, we should try to understand the implications that complex information spaces pose and attempt to address them with conscientious decisions through design.

2.18 Summary

Given the sheer vastness of the internet, bookmarking, or at least categorizing information in some fashion, is essential for users to organize their found information. However, many notable researchers have identified a number of problems with the currently available tools. Jones, Bruce, and Dumais (2001) found that users had a hard time identifying and determining the usefulness of bookmarks by their title, and had similar problems with folder titles. In light of this, as bookmark collections grew in size they became unmanageable because of the gap between the ease with which a user could make a bookmark and the difficulty they encountered later with identifying and managing their bookmarks. Yet, the work of Cockburn and McKenzie (2001) found that 81% of user’s browsing habits involved returning to previously seen websites. Putting these two studies side by side suggests that there is at least some room for improvement in assisting users in their daily web routines. Löwgren’s (2007) pliability and Victor’s (2006) thought to view information in terms of “graphics for learning” could perhaps be the framework used to consider in which direction bookmarking could be taken. The current lack of pliability and assistance with decision making in browser based tools constitutes a hole in current usability and design. In fact, the lack of evolution in these tools means that reasonably old research is still quite relevant for this discussion. That being said, there have indeed been a number of studies that attempt to address the problems of bookmarking.

Internet Scrapbook (Sugiura and Koseki, 1997), Visual Snippets (Teevan et al., 2009), Integrating Back, Bookmarks, and History (Kaasten and Greenberg, 2001), and indeed many others have attempted to apply visual imagery in one form or another in an attempt to improve already existing patterns of interaction. These proposed future tools assist with decision making in that they better inform users about the information they interact with and find valuable. And in fact we see some components of visualization in existing products and services, as well as the introduction of text based tools like tagging and search in an effort to assist with re-finding activities.

And so this is the landscape in which I have done my research. This is the conceptual environment in which I wish to reevaluate bookmarking and suggest that
maybe a better way to think about bookmarks is to stop thinking about them as bookmarks. Perhaps instead we should think of them as ideas, as being connected to information. Perhaps they are indicators of the types of information and experiences we have found and can re-experience online. Perhaps it is through this lens that we can offer some possibilities to answer the question of how we might better support users in the creation, organization, and retrieval of their found online information.

3 Methodology

3.1 Design principles

There were two main design principles that informed my process. To begin with, user centered design influenced my choice to involve users throughout my research. This began with initial interviews to understand the design space and user habits, then email surveys to find gaps in tools and habits and desires for future tools, critiques of the many mockups and medium-fi prototypes, and finally an evaluation of a hi-fi prototype.

The second influence was research through design, with its notion of a design artifact as outcome. Here, my desire was to build a designed thing which, to some users, would hopefully portray a preferred future state. Therefore, a number of mockups and medium-fi, video, and hi-fi prototypes were constructed, portraying a myriad of futures that were narrowed down to just one over the design process.

These two methodologies overlapped and influenced each other in each phase of the design process. On the one hand, user feedback at times sparked ideas for future designed states, while on the other hand explorations in the design space and elements of designed artifacts were kept, modified, or removed based on user feedback and opinion. In this way users are included in the process while the designer is still free to explore.

3.1.1 User Centered Design

Users were actively involved in every phase throughout the design process in keeping with the ideas of user centered design (Saffer, 2007, pp. 31-32). From concepts to mockups, users and professional designers were consulted and their comments and reactions helped guide the design process. Feedback on mockups led to reflection and the creation of new mockups, and those mockups to new rounds of feedback and reflection, and so on. Numerous in-person interviews were conducted, email surveys were sent out, and even users in other parts of the world took part in skype interviews. Later, user feedback was considered in regards to medium-fi and hi-fi prototypes in an attempt to determine whether user needs were adequately being addressed.
However, I did not engage users in workshops, develop personas, or attempt to identify gatekeepers. Bookmarking is not a specialized field where the user customs and traditions are unknown, but rather it is a reasonably universal practice for internet users. And so users who had tablets as well as those who did not were interviewed, users with large and small bookmark collections were engaged with, and users who used traditional browser bookmarking, those who tagged, and those who used alternative means for saving found information were also considered. I did not attempt to design for everyone, but the intention was to design for a wide audience. And so understanding user needs and wants across a large segment helped to keep me from thinking I was the intended audience, and helped to form designs around current user behaviors.

3.1.2 Research Through Design

However, the work presented here also employed the ideas of research through design because of the framing this approach offers to the produced design artifact. Zimmerman, Forlizzi, and Evenson (2007) argued that these artifacts, “describe a vision of a preferred state,” which when compared to the current state reveals a gap about which discussions can happen. Furthermore, they state that “use of this model results in a holistic research contribution that reveals the framing of the problem and the balance the researchers have made between the intersecting and conflicting perspectives.” Indeed, as will be discussed later, the chosen framing of visualization that came early in my work greatly affected the outcome as did the discovery and evaluation of conflicting users practices. User habits and tools, as it turned out, were at times poorly aligned with their ability to manage their bookmark collections.

That being said, this was an explorative process. Re-imaging something as broad as bookmarking required more than just a list of user needs. Exploration was done through divergent sketching using paper, pixels, coding, mockups, and medium to hi-fi prototypes. These sketches posed new forms of organization, different modes of representation, and new methods for interacting with information. These sketches explored the design space and materials without always needing the prerequisite of going to the users. While user centered design was employed to understand users, research through design enabled me to sketch out ideas first and then consult users.

3.2 Synthesis, Selection, Detailing of Chosen Concept

The intended goal of this research was to create a working hi-fi prototype that portrayed some of the themes and ideas touched upon during the many interviews conducted. This was done in an attempt to understand experientially at least a few directions we might point towards when trying to answer the question of how we could improve the creation, organization, and retrieval of our found information online through bookmarks? To reach this goal, not only did interviews need to be conducted, but prototypes ranging from low-fi, to medium-fi, to high-fi needed to be built, video prototypes had to be developed, code written, and validation (and invalidation) of design choices had to be weighed and considered. Undertaking this endeavor
required that the design process be broken up into manageable stages of inquiry. Each stage consisted of its own goals, had its own synthesis and selection of designs, and its own detailing of the chosen portion of the design concept. Specifically, this project was divided into the following seven stages:

Figure 12: Design Process

Phase 1 Understanding Users & Their Bookmarks

This was the first step because if there has been a move towards bookmarking via social and online services in addition to standard browser based tools, then one must understand users’ current relationships with their bookmarks and the tools they employ. Therefore, in-person, closed form questions were carried out to determine if users rely on just one tool or multiple tools, where the weak points and gaps in their practices and toolset(s) are, and what new framings could we consider that might offer new possibilities for organizing found information. Regarding reframing, three different mockups representing three different modes of visualization were presented to the interviewees and open form questions were asked so as to gage their general reactions and perceptions.

Phase 2 The Conflicts in Expectations & Habits

It was important to understand friction points as well because user habits and toolsets at times conflicted with a user’s ability to build, maintain, and use their bookmark collections. An attempt was made here to identify poorly or unsupported elements of information organization for which potential solutions were then incorporated into future mockups and tested in the next phase of research. An online email survey was employed, using closed form short answer questions and quantitative (rating from 0 - 10) based questions discussing current habits and asking users to comment on potential future toolsets in light of those habits.

Phase 3 Re-Imagining Collections - Prototypes 1, 2, & 3

Re-imagining collections came from pursuing the thread of visualization which had emerged from the first phase and attempted to address some of the inconsistencies identified in the second phase. Here, the bookmarks of a design professional were turned into three medium-fi prototypes and presented back to the designer in an
attempt to gain real user feedback for a potential future tool. Open form questioning was used and the designer commented on aesthetic choices, interface elements, and the different modes of interaction and organization presented by the three prototypes. Other design professionals were consulted as well, though they only saw mockups constructed from the first professional’s bookmarks and not their own.

**Phase 4 A New Method for Bookmark Creation**

Several design iterations followed in an attempt to re-imagine bookmark making in much the same way that re-imagining bookmark collections had done in the previous phase. Several design professionals were consulted because of their depth of knowledge in usability, interface design, and interaction with touch screens. A number of medium-fi prototypes were developed and open and close form questions were asked so as to consider broader topics of user interaction as well as specific elements like button placement, labeling, and GUI elements.

**Phase 5 Evaluating & Refining Design Choices**

Up until this point many designs and interactions had been considered and debated for both bookmark making and bookmark collections, and so video prototypes were used in this phase to demonstrate the summation of the design choices, interface elements, and modes of interaction developed in all previous phases. Both design professionals and non-professionals were interviewed and both open and closed form questions were used. The closed form questions were designed to consider graphical elements, order of operations, and methods of interaction, while more open form questions were used to help identify potential assumptions and biases I had formed during the process thus far.

**Phase 6 Hi-Fi Prototyping - Programming as Sketching**

Based on the interactions presented in, and feedback received from, the video prototypes and mockups from the preceding phases a final prototype was constructed. Here, the tools selected to build the prototype are briefly discussed as well as a discussion about how much of a final experience needed to be created.

**Phase 7 Final Interviews & Evaluation**

As stated previously, the final hi-fi working prototype was developed so that a number of potential themes could be reflected upon in action to try and better understand how we might consider improving our relationship with our found online information. Closed form questions were asked to see if specific design choices could have potentially positive outcomes regarding supporting user habits and expectations, while open formed questions were used to try and understand how users felt about the prototype as a whole and what potential new avenues could be explored for future work.
4 Design Process

4.1 Phase 1 - Understanding Users & Their Bookmarks

4.1.1 Introduction & Methods

I began by trying to understand how users think about their bookmarks; their mental model of linked information and its organization. I conducted in-person interviews with five people. The participants were asked to describe their bookmarking practices and tools as well as rate their tools and comment on strengths and weaknesses. They were asked whether their habits changed when working on a project where finding and organizing information plays a role. A small test was done to see if the participants could re-find a website they had previously bookmarked and explain their actions and thoughts aloud. Once the test was done and both I and the participant considered their workflow, they were asked what they thought could be changed or improved about their current systems of working. Finally, they were shown three mockups (listed below) of potential future tools and asked to consider these mockups in comparison to their current workflows and tools and give open ended feedback on the mockups. In light of the findings of Jones, Bruce, and Dumais (2001) that users found bookmark recognition difficult based on folder and bookmark titles, these mockups attempted to find ways of replacing titles as the main stepping stone or gateway to a users’ online information.

The first mockup represented information as more of a collage of related or similar elements. Because many people either use folder structures or tags as a way of grouping similar bookmarks, I was curious about how strongly bookmarks in these groups were interrelated. Users were presented with two example scenarios of both putting together a new outfit made of clothing from different websites and remodeling a kitchen. Those interviewed were asked to imagine they had a digital scissor tool that would allow them to clip things out of webpages, somewhat similar to Internet Scrapbook (Sugiura and Koseki, 1997), but be able to arrange their clippings like a collage. Czerwinski et al. (1999) used Implicit Queries as a way of computationally finding similar bookmarks and highlighting them for the user in an attempt to influence their grouping strategies. However, in the mockup below users were instead told that they could draw lines between different clippings so that they could decide how their information was interrelated. Finally each clipping had a title or URL from the originating website visualized as a speech bubble. In this format users could see a number of linked pieces of information, how they were related, and reevaluate the relevance of these items and relations. This could all be done at a glance and without needing to sift through folders, remember tags, or read lists of website titles.
The second mockup considered bookmarks as a tool for information gathering. Currently, if a user wanted to relate several different article sections or images together, they would either have to bookmark the different webpages and later visually scan those pages to find the relevant information again (MacKay, Keller, Watters, 2005), or copy and paste the URL and relevant information out of the webpage into a separate document (Abrams, Baecker, and Chignell, 1998 and Jones, Bruce, and Dumais, 2001) and thus loose the original context the information was in.

MacKay and Keller (2005) introduced the concept of *Landmarks* to assist in information retrieval. Here, bookmarks not only link to webpages but to highlighted, “landmarked,” sections within webpages. In the second mockup those interviewed were asked to consider a tool that allowed them to not only highlight different images and text on different pages, but then also be able to link the highlighted text and pages together visually to create a single idea, grouping, or narrative from disparate pieces of information. Here, the history of the cellphone was shown where an article about the Newton (left) was linked to an article about the Palm Treo (center) which was then linked to a review of the newest iPhone (right). In this way the three different texts from three different sources made up one total idea. Therefore they weren’t just bookmarked pages, but linked information that formed concepts and relationships.
The final mockup was not based on linking information in clusters or groupings, but instead touched on data-visualization and search using visual bookmarks and collections. The example given was searching for a set of previously bookmarked tutorials showing how to sculpt a female head in 3d, and the images below were snapshots taken from websites by the user as visual bookmarks. These images were themselves the hyperlinks back to the original site. The sites’ URLs were included at the top of each image. This treatment touches upon the work of Teevan et al. (2009) in that a website thumbnail previously seen by the user improved information re-finding.

The responses given to the above states questions and feedback on the three mockups have been grouped into the following six sections: 1. Bookmarking Overall, 2. Organization Habits, 3. Tagging, 4. The Retrieval Test, 5. What Could Be Improved, 6. Reactions to the Mockups.

4.1.2 Bookmarking Overall
Though user bookmarking habits and tool choices differed greatly, they all expressed a general dissatisfaction with bookmarking as a whole. The difference in the tools employed for bookmarking was quite striking. One person used browser based bookmarks with folders and subfolders, another emailed links to himself and searched his inbox later to retrieve his links, another stored her links in Google Docs (2006), and another temporarily stored bookmarks in his browser before migrating them to Delicious. Everyone reported previously trying different bookmarking services, and many reported switching bookmarking strategies (bookmarking everything at first, then later bookmarking as little as possible after collections became unmanageable). And yet, no one had found either a balance, a workflow, or a toolset they reported being truly satisfied with.

Quinn, who used browser bookmarks and folders on his desktop and tablet, said there was a disconnect between his bookmarks and the information they linked to; a common sentiment by those interviewed. “The problem with remembering what bookmarks link to is when the bookmark is just words. Here (he points to a few bookmarks on his screen) I have ‘City Repair’ and ‘Garden.’ I have no idea what garden is.” But when asked why he didn’t change his bookmark titles to better reflect their content he explained, “I have never in my life labeled a bookmark. I don’t know how to do it.” In fact not changing bookmark titles was common to nearly everyone interviewed throughout this project.

While one might jump to the conclusion that some innovation around changing bookmark titles might solve this issue, his next comment hinted that perhaps the solution would require further exploration. “When I go to links from last Christmas or whatever, I just have to start stumbling through, opening links at random to find what they are.” If Quinn wanted to remember what a given bookmark linked to he would first need to find it in his hierarchy, open it in a tab, and wait for the site to load. If he then wanted to edit or delete that bookmark he would also have the extra cognitive load of remembering where it was in his hierarchy, and then search for it a second time because his file-menu would have closed once he had initially selected his bookmark. This seems to stand in contrast to what Löwgren (2007) calls a “sense of tactile involvement with the information” and increases, rather than decreases, “the effort of perceptual reconciliation.” Quinn’s comments, and many just like his, suggest that if the representation of a bookmark is a text title which users seldom or never change, and that if over time one’s memory of their bookmarks fades and the titles become less helpful, then perhaps something can be done to change a bookmark’s representation.

4.1.3 Organization Habits

Four out of the five people interviewed reported spending very little time organizing their bookmarks, with one expressing spending some time organizing. Sveta expressed difficulty with keeping tagged bookmarks organized, “I used Delicious, I was just kind of collecting links. I added lots of tags instead of one or two and it ended up in a mess of tags. Like ‘internship’ and ‘internships.’ It was just a mess, its really
easy to make a mess.”

Vincent previously used a folder based tool before switching to archiving his bookmarks in Gmail (2007). “XMarks is like an old Windows 95 folder structure (similar to browser bookmarks), but I have to drill down through the folders to get what I want. It made sense (the folder names) at the particular moment I made it, but if I was looking for media art right now I would not look in the masters thesis folder.” His comments perfectly mirrored comments made by users in research of Jones, Bruce, and Dumais (2001). He went on to express that with folders one must remember which folder a bookmark is placed so it can be found again later. He concluded by saying, “When I think of the bookmark I think of the bookmark, not how to find the bookmark.”

While Scott was the one user who spent time organizing his bookmarks, he did express similar difficulty with organization. He said this while showing his bookmark collection, “let me see what’s in my masters thesis folder here... (he clicks a folder and a huge bookmark menu opens) This is why I can’t do this. This is basically unusable unless I really know what’s going on here.” The number of root level bookmarks in this folder and his expressed difficulty with the folder’s contents echo the decades old work of Cockburn and McKenzie (2001) almost exactly. He said that he preferred to organize after making bookmarks. “I have to go back later and organize it or its a real shit show.” Again his comments and habits mirror previous research perfectly (Abrams, Baecker, and Chignell, 1998). When asked if his personal system of organizing took too much time he responded, “I would say yes. I can probably find what I have in here. But it was an elaborate process to get to this point. Its probably the most organized its ever been, and I don’t remember everything I’ve put in here either.”

4.1.4 Tagging

As expressed by Sveta earlier, simple spelling differences (internship vs internships) created difficulties, and Scott elaborated on this further. “I get stressed out when I tag things. Do I use two word tags with a dash, or [several] individual tags?” But besides the problems of linguistics in tagging, there is also the issue of how tags are presented to the user graphically. Delicious organizes users’ tags in a descending list, ordered by the frequency a given tag has been used, not alphabetically, chronologically, etc. Scott - “Delicious tags are listed on the right, but there's lots, because what's weird here is they are organized by the number of tags, not alphabetical. The tag ‘portfolio,’ the problem I have is ‘portfolio’ has 25 [bookmarks], ‘portfolio example’ has 17, and ‘portfolio examples’ has 25. I'm always trying to remember what tag cloud is this part of.” Scott’s difficulties with his tag cloud is almost identical with Vince’s folder structure in that the cognitive burden is placed on the user to remember where a bookmark has been catalogued or categorized. So the user is left searching either through tag clouds or folders to find their content again.

Again though another easy conclusion to draw is that organizing and presenting tag words, and tools for removing redundant tags, should be improved to avoid these
issues. But it was Scott’s next comment that might make such conclusions seem too simplistic. Scott went on to explain how his mental model of his content does not match his tag cloud for that content. “I know this one girl has a french sounding name (he points to her portfolio website). So I go down the list, skim for a french name until I find it. It would be extremely weird for me to tag things in the real world how they appear in my brain - girl with french sounding name, makes furniture, has a boyfriend at Umea, etc.” This perhaps speaks to the fact that a user’s mental model of their data is not currently being fully supported with tag words, folders, and other forms of representation.

4.1.5 The Retrieval Test

The small test users performed was originally designed to see if they had an easy or difficult time retrieving bookmarks using their current habits and tools. I asked them to think of a website they had previously bookmarked, and then simply to find that bookmark again. The problem here was that since I had no prior knowledge of their bookmark collection I was not able to select a specific bookmark and see if they could find it. In the end everyone was able to find their bookmark relatively quickly. This left me wondering if they simply picked a bookmark they knew how to find or a bookmark that was fresh enough in their memory to recall easily, and thus they were able to find it. This test, it turned out, was somewhat ill fated and inconclusive.

4.1.6 What Could Be Improved

Perhaps the one quote that best summed up what could be improved, and was reflected in other user feedback, came from Scott. “What could be improved? If I didn’t have to think about it. If I could get a tool in the browser, click it, and add it (a bookmark) with all the meta data around it.” Indeed most people in this interview, and interviews in other design phases, on this specific topic reported wanting a tool to just do it all for them. Oddly enough, I would agree with that.

4.1.7 Reactions to the Mockups

The first design mockup which linked information in collage was considered to be both messy and hard to read. My original assumption was that users would be able to arrange and connect their content to somewhat match their mental model, but this mockup and the notions of information organization it hinted at was not embraced by those I interviewed. In light of Scott’s comments and others along the same lines, ease of use was perhaps more important than accuracy of information representation. The second mockup had a similar fate. It was perceived of as being too analytical and only considered websites as things to be linked together and not necessarily as collections, reminders for later, or considering the sometimes random nature of the things we bookmark. It was deemed too narrow in focus.

Those interviewed however strongly favored the last mockup. Quinn said, “If this were available I would totally use it.” And while praise is always nice, Vince’s
comments pointed to something deeper. “I think its super user friendly. You are getting so close to the essence of what I’m looking for.” Now it may be the case that developing a system that can accommodate everyone’s mental models is impractical or even impossible, and it may further be the case that requiring users to search for their data is inescapable, but based on comments like this it *might* be the case that visualizing bookmarks could be enough to bridge the gap between the user and the information they are searching for. And so this mockup and the possibilities it suggested became the foundation for future iterations.

4.1.8 Conclusions & Looking Forward

While visualizing bookmarks might be a step in a new direction, a number of issues with current systems of organization arose and should be considered regardless of the direction taken for new bookmarking tools. Music players like iTunes (2001) allow users to sort their data by name, date, ranking, genre, etc. to help users find what they’re looking for. Bookmarking tools however don’t offer these sorting features. Bookmarks are static lists, organized chronologically, and yet do not display the time stamp information associated with this type of categorization. Users only know the “age” of a bookmark relative to neighboring bookmarks, but there are no opportunities afforded to the user to look for other bookmarks made on, near, or around specific dates (weddings, birthdays, vacations, etc). Therefore the exploration of data visualization for bookmarks was the decided direction to move towards. Organization, not just by list view, but by chronology, frequency of use, and even content is worth consideration so that bookmarking might help create new knowledge artifacts by presenting users with new views of their data.

Moving forward, consideration was given to the implications for interaction a particular design posed and the user group it satisfied. In Tap Worthy (Clark, 2010), an example of three different location based services illustrated this point. Loopt (2005), Foursquare (2009), and Gowalla (Web Trends, N.D.) are all mobile apps designed to do the same thing - allow users to check-in at their location. However, more than simply offer different graphic treatments for the same activity, they approach interaction from different perspectives. Loopt focussed on making the process of checking-in and seeing friends *efficient*. Foursquare instead offers points and status elements for repeatedly checking into the same location, introducing *competition* between users. Gowalla offered unique badges at different locations prompting users to explore their surroundings to find new badges creating a feeling of *discovery*. Therefore, the implications for interactions shape the tool, the user experience, and both identify and exclude users.

Finally, given the number of different services and tools people reported using, and that regardless of service they reported an overall dissatisfaction with bookmarking in general, it was concluded that the available tools are perhaps not in sync with users’ expectations. Assuming this was the case, the next round of interviews was intended to better understand those expectations, and try to understand how they might change if bookmarks became visualized data.
4.2 Phase 2 - The Conflicts In Expectations & Habits

4.2.1 Introduction & Methods

An email survey was conducted to better understand user expectations and habits. 20 people were emailed with 8 responding. They were asked questions like how often they organized their bookmarks, what was the difference between a bookmark and a note, and whether they deleted bookmarks. They were also asked how easy it was to look through their collections, and to choose whether they would want tools to help make bookmarks or tools to search for bookmarks afterwards. Finally, they were asked to rate their habits on a scale from 1 - 10. They rated things ranging from when they wanted to organize their bookmarks, to how much effort they would like to exert when organizing and searching for bookmarks, and if their bookmarks were actually visualized whether this would lead to more or less effort for the user to manage their collections.

Their answers have been grouped into the following five sections: 1. Ease of Use and Expectations  2. Not Changing Titles 3. Organizing and Deleting Bookmarks 4. Curating, Forgetting, and Too Many Bookmarks 5. How Specific Should Tools Be.

4.2.2 Ease of Use & Expectations

There was an inherent conflict between people wanting making bookmarks to be easy and require little input, while at the same time wanting finding a bookmark later to be equally effortless. I use the term conflict here because if one thinks of their bookmark collection as a mini database of information, then one must either put effort into categorizing their information (like a personal Dewey Decimal system) or one must put effort into searching for their content (like the advanced search from a desktop Finder / Explorer with file extension, location, date modified, date created, etc). But the expectations the users expressed are that they would prefer to put effort into neither activity, and yet they still wanted to use their bookmark collections effectively to find their information again.

On the one hand this may be because browser tools have a low threshold for creating bookmarks. On the other hand Google (1998) makes searching for content online relatively low friction as well. So if bookmarking tools already make the first part simple, then focus instead could be put on the second part with a few cues taken from search engine conventions. Sveta - “I would like tools which help me find stuff, because its not a big deal to make a bookmark, but once I have a bunch of them it is hard to make use of bookmarking at all. It is like having an offline Google, but less responsive and without updates.” This idea was echoed by others as well. Camilla - “I would like the bookmark tool to sense what kind of website it is through the meta tags and try to categorize it, or at least show a suggestion for where they want to categorize it.” To this exact point, Trunkly saves the text from webpages people bookmark for the same reasons Google caches websites - to improve search results.
users aren’t required to put any effort into categorize their information, because as they add bookmarks to their collections all the meta-data gets extracted from those webpages and is added into Trunkly’s database. This removes the need for tagging and makes search easier because if users can remember one or two keywords related to a given website, it is likely that the associated bookmark will appear in the search results. So perhaps the users can have their cake and eat it to.

4.2.3 Not Changing the Title

Related to users not wanting to put in effort to make or find their bookmarks is that the interviewees also didn’t want to put in effort into changing bookmark titles, even though this might save them time and headache when sifting through their collections. However titles are different than making, categorizing, or searching for bookmarks because user expectations are different. Out of everyone interviewed in this questionnaire, and this project as a whole, only a small number of people reported changing bookmark titles. Of the few who did change titles it was only done sporadically, but on the whole the practice wasn’t a habit for users despite how easy titles can be changed (both when a bookmark is made and when reorganizing later). That said, Camilla gave an interesting response to the question of what the difference between a bookmark and a note was. Camilla - “A bookmark is more static in its function. It is format based and therefore not as descriptive as a note, though its purpose is to be informative in a peripheral way.” So while few people reported changing bookmark titles they still are informative, though perhaps as Camilla says, peripherally. Therefore challenging the idea of bookmark titles or supporting alternate user habits did not become a focus in this project. Instead, maintaining titles became part of future mockups in the following design phases.

4.2.4 Organizing & Deleting Bookmarks

In most cases users reported rarely or never organizing their bookmarks. Devon - “Rarely, maybe once or twice a year when I get annoyed by how many have piled up.” Paul - “In my browser bookmark bar, rarely” The most extreme case being Tobias - “[I organize] when I get a new laptop.” Those that used tagging sites like Delicious also reported difficulty organizing tags. Sveta - “Almost never. Once I cleaned my tags, but I was bored.” However roughly one in ten (both in this interview and throughout my research) did report exerting some effort towards organizing their collections. Interestingly this was done usually at the moment of bookmark creation.

That said, people in both camps reported rarely if ever deleting bookmarks. Camilla, one of the few people who organized their bookmarks said “I [delete bookmarks] once a month, maybe. But they are placed in the recycle bin and they can be there forever.” More common were the habits expressed by Devon, “Once or twice a year,” and Paul, “almost never from my browser bar.” The most extreme case was again Tobias - “When I get a new laptop.”

This could mean bookmark deletion should not be considered, at least within the
scope of this project. However, deleting bookmarks should not be dismissed so easily. As stated in the first experiment, the actual user interaction required to delete bookmarks is rather complex: the user selects a bookmark and after the associated website loads the user deems the bookmark as worth deleting, then they must go back through their collection and re-find the same bookmark, and only then can they finally delete it. According to Abrams, Baecker, and Chignell (1998), “pruning a personal archive... takes too much time and cognitive effort.” This rather complex task could be a contributing factor in user habits. Comparing the ease of making bookmarks with the difficulty of deleting them and we might see one potential influence on user behavior. If we consider that most users expressed that their bookmark collections are large and difficult to manage or navigate, then perhaps making bookmark deletion as easy as bookmark creation might allow users to better prune their collections.

4.2.5 Curating, Forgetting, & Too Many Bookmarks

Continuing in the theme of bookmark deletion, most interviewees reported only remembering frequently used bookmarks, and that they quickly forget most of the other bookmarks they’ve made. When this behavior and those surrounding bookmark deletion are put together it leads to a lot of unused and forgotten bookmarks, which in turn makes sifting through a collection more difficult. Sveta - “[bookmarks] are very useful in theory, but when I bookmark stuff I very often forget about it very soon.” Camilla - “I have a large amount of bookmarks since I started to use my Opera link account since 2007.”

As mentioned previously, it is not currently possible to sort bookmarks by different criteria, i.e. date made, date modified, alphabetical, etc. But if some bookmarks are used often and remembered by the user, and some bookmarks are rarely or never used again and become forgotten, then perhaps this could be a sorting criteria to consider. Sorting bookmarks by “most viewed” could save the user time when looking for their favorite sites. But alternatively, and perhaps more interesting regarding user-behavior, if a user could sort by “least viewed,” could this promote bookmark deletion? If there was an easy method to help users identify potentially obsolete data, then would they be more likely to delete it?

4.2.6 How Specific Should it Be?

If a search tool was developed to help users find their bookmarks, then how specific or accurate would it need to be to meet users’ requirements and expectations? When asked whether such a tool would need to return the exact bookmark a user was looking for or bookmarks “close” to what a user was looking for, literally everyone responded by saying it would have to return the exact bookmark they wanted. However building a tool to meet this rather extreme requirement is realistically unfeasible, but creating a user “perception” of accuracy is another thing all together. The FilmFinder essentially strip out non-relevant data, based on search and other criteria, and left the user with only a tiny subset of results from the full database. Users could easily sifted through this by sight to find the information they wanted. The FilmFinder didn’t attempt to find
“exactly” what the user was looking for, but got them close enough that users could realistically finish their search manually and find what they were looking for. This type of solution is both achievable and avoids attempting to build “perfect” automated systems. Applying ideas from The FilmFinder to bookmarks may in fact get close enough to meet user’s expectations, given the degree of accuracy they claimed to requirement.

4.2.7 Conclusions & Moving Forward

If Trunkly’s method of saving website text makes searching through bookmark collections easier, then this method of reducing user effort should be considered as an option for improving bookmarking. Maintaining support for bookmark titles is still important, though perhaps users wont frequently interact with them. Simplifying bookmark deletion in the hopes of making collection sizes more manageable might make sifting through collections much easier for users. Given the amount of reported difficulties with finding and using bookmarks, adding some very simple data-sorting (date created, most viewed, alphabetical, etc) could be an improvement in usability. Finally, if data filtering can help narrow down search results, then perhaps the act of finding a specific bookmark could be a less painless interaction; potentially even a positive one at that.

4.3 Phase 3 - Re-Imagining Collections - Prototypes 1, 2, & 3

4.3.1 Introduction & Methods

Considering the user responses, requirements, contradictions, and thought experiments thus far, the original mockup that received positive responses was re-envisioned into three new medium-fi prototypes. I appropriated the word medium-fi here to mean something between Coyette, Kieffer, and Vanderdonckt’s (2007) medium and hi-fi prototypes. Given that I was attempting to visualize website information, the content taken from these pages for my prototypes can be thought of as already medium to hi in their fidelity. The prototypes here explored interactions at the medium-fi level. The word “prototype” should also be considered loosely here because for this exercise the prototypes were simply jpegs. Because the user interactions considered in these prototypes were scrolling, pinch-zoom, and panning, a regular tablet photo gallery app was the perfect test environment to mimic these interactions. Because of this, responses to open form questions were informed by users actually trying out these basic touch interactions. They also commented on visuals, information layout, and the touch-ability of UI elements.

In an attempt to gain deeper insights into specific user wants, opinions, and expectations, one design professional currently working in the field was interviewed for this phase (and other phases) of my research and was a main source of feedback, along with shorter interviews with other users and design professionals. This design professional gave comments and critiques throughout this project, and his guidance

Marcus Ghaly
was extremely valuable. The main user, Dan, suggested I use part of his bookmarks in my prototypes and mockups so that he could get a better sense of how such an application would work in real life. Therefore, the visual bookmarks in the following examples belonged to his collection. Due to time restrictions the other users and professionals interviewed only interacted with the prototypes displaying Dan’s bookmarks and not their own. Finally, across the three different stages of making a bookmark, finding a bookmark, and using a bookmark to link to a webpage, this design phase and these initial three prototypes only covered the last two steps. Making bookmarks was addressed in the next phase.

4.3.2 Prototype 1 - Scrolling Bookmarks

Figure 16: Prototype 1

Prototype 1 was more visually developed over the original mockups in the first phase. It had two rows of bookmarks arranged horizontally and incorporated a search field to help winnow down the number of displayed bookmarks. A time slider was added, but instead of just sorting things chronologically, it also incorporated adjustable GUI range-sliders that could be manipulated to further refine search results. The area between the two range-sliders represented the time segment for which bookmarks were displayed. Finally, titles were included at the bottom of the visual bookmarks for further visual clarification. Aula et al.’s (2010) work suggesting titles should be at the bottom served as confirmation rather than inspiration for this choice. The image above illustrates that the jpeg image of Prototype 1 extended past the bounds of the tablet’s display. Because of this Dan was able to “scroll” left and right to get a sense of what this type of bookmark arrangement would feel like in real life. Finally, simply because of implementation the visual bookmarks were 250 pixels tall. Aula et al. (2010) suggested that preview thumbnails should be at least 200x200 pixels for easy recognition. Again though, this research served to confirm design choices.

Prototype 1 involved thinking about filtering bookmarks based on time. Given that the tablet used for prototyping was only 7”, screen real-estate was at a premium. Traditional desktop advanced searches include robust filters like date-created, size, file type, location, date modified, etc. The results of these searches can consume a lot of screen space and are vertical, text-only, lists.
To do the same in a tablet context would be to only consider implementation and not design (Victor, 2006). The image below shows the solution considered for this prototype. A full timeline showing all of the user's bookmarks chronologically is presented along with titles like Today, This Week, This Month, etc which is graphed logarithmically. This logarithmic representation of time was chosen over a linear representation because it requires less space. If a user was searching for bookmarks older than a few months in a linear arrangement scroll bars would be needed because the timeline would be far longer than the size of the screen. Users would then have to scroll left and right to simply move their "view" to the correct point in time, and possible other UI elements might be needed. A cue was taken from Victor's (2006) example of online movie listings, where redesigning the presentation of information reduced the amount of time required to look over the movie listings tables and make a choice.

But people also move between times of heavy and light bookmarking. As such, in order to find a bookmark in a linear system, users might scroll through large areas devoid of bookmarks. Such a system was employed in “Trails” for the Playbook (mobilemag, 2011), but here it was an advantage. Trails is an email concept which shows the user a visual representation of their email. Here time is linear, but it serves a purpose. Showing the dead space that comes with heavy and light periods of email activity is itself useful information because one can derive both personal, company, and family communication habits. I would argue that the requirements here are not the same as when bookmarking, and thus Trails served as a point of reference, but not a design pattern to follow.
Finally, bookmarks are themselves displayed in the timeline as dark blue bars that highlight to light blue when they are within the viewable time range. This allows the user to know which bookmarks are currently being displayed, and where additional bookmarks may be to fulfill their search. Lastly, the bookmarks in the timeline are arranged into vertical bars indicating the amount of bookmarks at a given point in time. This may help the user remember when their bookmarks were made based on the trends or circumstances at certain times, i.e. bookmarks made in December might be more likely to link to gift ideas while those made more recently may be due to work, etc. Here the cue was taken from Löwgren’s idea of “serendipitous discoveries” in dynamic queries (2007) in that hopefully the presentation of information can lead either to new discoveries in, or realizations made about, the data itself.

4.3.3 Prototype 2 - Scrolling Bookmarks & Relevance

Prototype 2 was a variant of Prototype 1 as the bookmarks were still arranged horizontally, and scrolling happened along the horizontal axis. Here the idea of search “relevancy” was introduced as a way to help narrow down search results via visual
cues instead of omitting bookmarks that closely, but not perfectly, matched keyword searches. Bookmarks deemed as “less relevant” by a search algorithm were scaled down visually, while bookmarks deemed “more relevant” were left at full size. This was done because perhaps including search results that were “close” might reduce the number of times a user has to refine keyword searches to find their data. Due to screen size this shrinking of bookmarks made their titles slightly difficult to read, so the user interactions of pinch-zoom as well as panning were proposed.

4.3.4 Prototype 3 - The X & Y Axes

Figure 21: Prototype 3

Prototype 3 attempted to graph bookmarks along the x and y axes. The idea suggested here was that if two axes were used, one for time and one for frequency of use as an example, a more meaningful graphic might arise. This might give the user a greater ability to compare the contents of their collection, or lead to further insights about their collection. Additionally the user may have to pan less to find what they are looking for because this layout has greater information density. To test this interaction users could pan in all directions and pinch-zoom.
Cues here were taken from Microsoft Pivot (MicrosoftLiveLabs, 2009) and Gapminder (2005). These two applications dynamically display information with powerful filtering tools designed to allow connections to be made, and conclusions to be drawn about the displayed data. Their use of both axes makes this possible. Again, the ideas of Löwgren (2007) and Victor (2006) can be seen here, and thus I attempted to capitalize on their layout and approach.

4.3.5 Timeline & Other Views

In addition to the three prototypes, two smaller mockups were made as alternates to the time slider; namely alphabetical and frequency of use arrangements. While my own research and that of Abrams, Baecker, and Chignell (1998) and Jones, Bruce, and Dumais (2001) suggested chronological arrangements were perhaps preferred by users, I wanted to know whether seeing bookmarks outside this view might affect user perceptions.

These alternate designs attempted to address different interactions. The alphabetical version was a variant on the time slider. This was because the time slider assumes that a user might remember when they made a bookmark, so there is no reason to not also assume a user might remember the first letter of a website title. Alternatively, displaying bookmarks from most viewed to least viewed addressed discoverability. Making the bookmarks viewed most frequently easily accessible might make for better usability, but rediscovering forgotten bookmarks or facilitating their deletion might help with collection management.

4.3.6 Assessment
Prototype 3 and 2 however were quickly eliminated by Dan and others as being both somewhat awkward and slightly confusing. Prototype 3, he explained, was difficult to navigate and easy to get lost in. In under 30 seconds one user said this prototype just didn’t work. Sadly, using both axes did not create a greater sense of meaning or comparison of information. This may be due to both lack of navigational points of reference and screen size. In Pivot, the vertical bar heights serve as reference points for where different information is located. Also, because it can be viewed on a 27” display, the entire graphic can be seen at once and makes the visual icons large and recognizable. By contrast a 7” tablet provides only a small window into this space, and thus the user does not know where they are in relation to the information around them.

Prototype 2 had similar problems because the “less relevant” bookmarks that were scaled down also had their titles scaled down so these title would still fit on the bookmark. This had the unfortunate side effect of rendering the titles too small to read. The use of pinch-zoom attempted to correct for this, but consequently became a source of confusion. The idea of only panning horizontally when mixed with pinch-zoom was considered somewhat cumbersome and lacking fluidity.

Prototype 1 in contrast was the more successful design by far. Dan explained that because some of the bookmarks got clipped by the left side of the screen it implied that there was something more he could pan over to see. The time slider at the top also implied that panning to see more was the mode of interaction. He also found that bookmarks being different widths was visually interesting and created some diversity. Other users echoed his comments, but what was perhaps most telling was the amount of time users lingered on Prototype 1 critiquing it and making suggestions in comparison to the relatively short time spent considering the other two prototypes.

In regards to Dan’s personal visualized bookmarks, he explained that to some degree the bookmark images gave a hint of what he was looking at. Some of the bookmarks looked like they were just screenshots of a whole webpage, while other were large images, maybe meaning they would link to videos or were part of image galleries, etc. He said they were a bit of a predictor of the type of experience he would have if he selected a bookmark and navigated to the associated website.

Finally, the alphabetical and frequency of use based organization styles had a mixed reception overall, and the original chronological display was kept. In an alphabetical system the interaction would have to be redone because if a user wanted to only see results starting with an “a” and an “s,” the current sliders wouldn’t work. Instead, some type of radio buttons would be required, leading one to question whether this would offer a superior interaction over just text-searching for “a, s.” Frequency of use faired better as the interaction method still made sense. However, people commented that frequency would be nice as an alternate view in addition to chronology, but that chronology should be the default option.

4.3.7 Conclusions & Moving Forward
Dan’s comments regarding Prototype 1 lead to the belief that this approach to bookmarking, meaning making, and ultimately user decision making, still had merit. His comments that panning left and right would reveal more content, that different bookmark widths were visually interesting, and that the visual bookmarks could be a predictor of the information they linked to all spoke positively about this graphical layout and the discoverability of the information it contained.

Further exploration into the use of gestures was not pursued based on the reactions to Prototype 2. Mixing two gestures (pinch zoom and horizontal panning) lead to confusion for the users, and it was deemed that a successful use of gestures would require significant research time. The work of Wobbrock, Morris, and Wilson (2009) attempted to find commonality among users in defining what hand gestures would invoke which actions on a surface computer. Perhaps then a similar study would be required to evaluate gesture recognition and discoverability for users in the context of bookmarking, and to understand when gestures performed by users were in sync with actions made by a prototype. In light of this, interactions in all future work here were limited to single finger input.

In regards to Prototype 1 there were however areas for improvement. Firstly, Dan commented that the time slider controls were over complicated. Like in the FilmFinder, both keyword search and limiting the time range removed irrelevant content from view. However the implementation here raised two problems. Firstly there was the UI in that, given the screen size, the text label size, and finger size, there was a lot of interaction in a tiny space. Secondly there was the connection between the time slider and the user’s view of their bookmarks. The time slider denoted the left and right maximums of the displayed bookmarks, assisting users in excluding bookmarks. However Dan pointed out that if a user was panning left and they reached the left-most time slider, they would not be able to pan further. To see more bookmarks they would have to stop panning, move the time slider to reveal more bookmarks, and then return to panning to look through their bookmarks. This created a clunky way to move through one’s content. In an attempt to increase pliability, this mixture of features instead reduced it.

![Figure 24: Timeline](image)

In future iterations the left and right sliders were replaced with a single scrollbar which could change size, similar to a scrollbar in a document changing size based on the document’s length. Because of this one can see if they are scrolling through a long or short document, and know how much of the overall document is currently in view. Similarly, if a user performed a search, they could look at the scrollbar length and know if they were looking through a large or small amount of returned bookmarks.

Furthermore, representing text-based websites (blogs, news feeds, etc) was brought up by Dan and many others. This was one of the most commented upon down-sides...
to a purely visual system, though no clear solutions presented themselves. To better understand this concern I made several visual bookmarks from text only sites to see how, or if, they translated into a visual system. The only successful technique found was to include an article's title or logo in the visual representation. While this may be less aesthetically pleasing than a bookmark from a photographer's gallery or product catalogue, it also doesn’t necessarily offer less of an experience than current text-only bookmark systems. In text-only systems we only have the title to work with, but in the visual bookmarks below there is the title of the website, they also include part of the article itself at a readable size, the website's color scheme, and in one instance a company logo. And so while I do agree that text based websites offer a challenge, I was unable to find any further solution and can only conclude that much more research would need to be done to reach further resolutions.

Figure 25: Visual Bookmarks of Text-Based Sites

Finally, alternate organizational views like alphabetical or frequency of use were set aside in favor of chronology. Chronology had a strength both as an idea users liked and in UI interactions, and so due to time restrictions research into alternatives was left behind.

And so with a number of insights gained about how one might treat the graphical layout of a user's bookmark collection, the next step was to actually take one step back and consider how users could make bookmarks and how these bookmarks would get added to a user's visually based collection.

4.4 Phase 4 - A New Method for Bookmark Creation

4.4.1 Introduction & Methods

There are four major factors at play when users make bookmarks that were important in this phase. Firstly, a whole new system had to be developed to facilitate users actually making visual bookmarks from within their current browser experience. Second, the qualities of a touch screen UI mean they have no mouse-overs, no right-clicks, and no hotkeys. Third, it's standard across major browsers that making bookmarks is a simple process and, based on my previous research, any new system should be at least as simple to be acceptable by users. Fourth, while simplicity was important, any new tools should have depth enough to support the small but committed user group who put effort into organizing their collections. In considering these factors I made a number of mockups to compare and contrast different design
This phase differed from the previous two as it was mostly focused on professional opinion on interaction and iteration rather than user interviews and general concept evolution. Because I had access to several design professionals for critique, including Dan, it was only natural to lean on their experience to help move the design forward. This lead to a rapid iterative process where ideation, mockup, and critique was churned through quickly and repeatedly. This phase continued to use still image mockups on a tablet as a system for medium-fi prototyping. Mockups were built and tested, professional opinions and insights lead to reflection and the next round of mockups and testing, and so on. That being said, the amount of graphic design was kept to a minimum so the design process could remain nimble and, as Coyette, Kieffer, and Vanderdonckt (2007) put it, “giving more importance to the contents than the style with which these contents are presented.”

4.4.2 How to Make a Visual Bookmark

Some obvious observations are stated here because, while straightforward, they informed the interaction style that was finally arrived upon. To begin with, webpages vary drastically in the types of content they display - images, movies, interactive content, etc. Graphic styles and layout are almost as numerous as there are webpages themselves, and the types of content webpages display can be thought of as essentially infinite. Therefore there is no way to predetermine what type of information a user would see on a webpage or what they might find meaningful and want to use as a graphical link back to that website. So the idea of taking a screenshot with crop marks became the focus for allowing users to make visual bookmarks. This meant screenshots could be taken independent of web content, allowing the user to determine what webpage elements had meaning to them personally. Cues here were taken from Apple’s screenshot program (MacRumors, 2011) because a user can either capture a small region or their whole screen as an image. Additionally, taking a screenshot with crop marks didn’t require new concepts or interaction paradigms that a user would be unfamiliar with and need to learn. Also, literally all the academic literature on visualization only considered full-screen thumbnails, and so crop marks attempted to go down a different path. Because visual bookmarking could be considered a new approach to content organization for users, the first mockup attempted to incorporate existing browser interactions. It was intended that the process for making bookmarks and adjusting options would be familiar to users, but just in a new arrangement.
The problem with this approach was that it looked too much like a desktop experience. Dan pointed out that Mockup 1 did not consider the touchscreen as a medium unto itself, with its own requirements and design patterns. The critique of the two buttons “Fullscreen Image” and “Manually Crop” was that they felt too much like PC dialogue boxes. These buttons attempted to address different levels of effort exerted by users when making bookmark. If a user wanted to exert the least effort they could select “Fullscreen Image” and a screenshot of the whole webpage would be taken and added to their collection. “Manually Crop” was for users who might spend more effort adjusting their crop marks to select a region of a website. However, after reflecting on Dan’s comments the UI was redesigned to involve more direct manipulation as this would play to the strengths of touch screens.

4.4.3 Touch Screens & Direct Manipulation

In Mockup 2, a smaller version of the current webpage was displayed with the crop marks already at the webpage’s full extents. By default, users who exert the least effort might be satisfied to just press “OK” and make their bookmark. Those who wanted more control could drag the crop marks to frame a specific region. Lastly the title and tag fields were displayed for those who spend the most effort managing their collections.
Christian, another design professional, commented that this interface felt like a window that came between him and the website he was bookmarking. Displaying the crop marks by default was an improvement, but it was removed from the browsing experience. Furthermore, if only a small number of users add tags or change titles, the options for them could be kept in the background. These and other similar comments made by different design professionals lead to thinking about users as regular users and “power” users. Seen this way, showing regular users extra options upfront might be overkill or frustrating.

It was also suggested that crop marks could “snap” to content like images and videos, but given the initial assumptions of not know what types of content users view, this idea was left behind. This type of snapping could cause the crop marks to snap around advertising or UI elements just as easily as photographs. However, an idea was proposed to show a list of every image from a website and let the user choose one as their visual bookmark, not unlike Pinterest’s method for bookmarking, which inspired one of the next prototypes.

4.4.4 Ease of Use

In light of Christian’s and other’s comments, Mockups 3 and 4 were created. Mockup 3 let users either manually adjust crop marks, or swipe through a list of all the images from a given website. It was hoped that this might help people quickly find a suitable image.
Mockup 4 put the crop marks closer to the webpage. Here, Christian, Dan, and others were asked to assume there was a browser button which started the bookmark-making-process. From here the website would shrink and “ok” and “cancel” buttons were added at the bottom of the screen. Users could move the crop marks and scroll the website to find a region of the website to use as a visual bookmark. It was hoped that if the crop marks took up more of the screen it would remove the feeling of separation between bookmarking and browsing, and make cropping easier because the user would have more room to work with. In Mockups 3 and 4, options for editing the title and tags were removed in the hopes that this would make bookmarking easier.

Upon critique there were a number of problems with Mockup 3. Firstly, there was no guarantee that users would have seen every image on a website. Therefore, when
bookmarking, the list of images could contain images users had never seen. Additionally, on media rich pages users might have to scroll through large numbers of images before finding a suitable one. This was made all the worse by only have a 7” screen for image viewing. Finally, this list of images might include UI elements from websites, background images, and advertisements. A bookmarking tool wouldn’t be able to distinguish between an advertising image and a photograph, piece of art, or a product. Therefore the more simplistic approach of adjusting crop marks manually had fewer potential pain points.

Consequently Mockup 4 was seen as an improvement. However, it was suggested to move the accept and cancel buttons into the browser UI, avoiding the need to shrink the website to accommodate these buttons. Cropping could then become full screen, giving the user more room to maneuver their fingers and the website in making visual bookmarks. Finally, it was commented that removing the options to edit tags and titles might frustrate those who expected to have these tools available.

4.4.5 Supporting Additional Options

Finally, two images representing the different stages of Mockup 5 were developed that met the above mentioned criteria for how to make a visual bookmark, considering the touch screen as a medium, maintaining ease of use, and having additional options accessible for users who wanted them.

In Mockup 5, users would select the “add bookmark” button from their browser UI and crop marks would appear at almost full screen. Regarding ease of use, users could select “OK” and the bookmark would be added to their collection without further effort. If however users exerted more effort they could manipulate the crop marks, position the website, and frame a more visually representative bookmark. Finally, users wanting more control could press the “More” button and would be presented with additional options. As such, these additional tools remained in the background for regular users.

Figure 30: Crop Marks in Mockup 5
In the More menu users could adjust the crop marks, edit bookmark titles, and add tags. Pressing “OK” would add the bookmark to their collection and return users to browsing.

Figure 31: More Menu for Mockup 5

4.4.6 Assessment

This final design took several iterations to arrive at, and built upon the lessons learned along the way. The final prototype met with a positive critique. The closeness of the crop marks to the webpage and the tools for more options remaining in the background were considered strong improvements over previous designs. The low threshold for making bookmarks was an improvement as this process was considered no more difficult than bookmarking found in other tablet browsers, yet it offered more functionality. Finally, supporting three different levels of bookmarking effort was considered a good solution for supporting different user habits, ranging from regular to power users.
4.4.7 Conclusions & Moving Forward

For the remainder of this project the elements of Mockup 5 changed very little despite continued user interviews and professional feedback. In future interviews the design choices made in this phase either received additional validation, or were not questioned to the point of needing to be reevaluated. Future changes were graphical, not structural, as all the text-labeled buttons were changed to pictograms. This considered the finger as a user input device, and moved further away from desktop paradigms of text buttons.

At this point there was enough information gathered that I felt comfortable in entering a design phase of video prototypes. These prototypes would illustrate user interactions with the interface above, include animated transitions, and demonstrate the order of operations users would go through to make bookmarks.

4.5 Phase 5 - Evaluating & Refining Design Choices

4.5.1 Introduction & Methodologies

Given that the visual bookmark collection layout had been refined based on user and professional feedback, and the bookmark making prototypes went through several revisions with professional critique, it was time to bring everything together through video prototyping to see if they worked together in concert. Would the still image mockups that represented moments in interaction translate into a coherent process? The main areas of focus here were transitions and animations, icons and layout, and overall functionality.

This phase returned to user interviews to see if design choices from previous phases resonated with users once they saw the designs in motion. Because the professional input in previous phases helped evolve the design, and the project had narrowed in
focus, this phase employed closed form questions to test specific transitions and nitpick icon and layout details. However, open form questions were used regarding overall functionality to catch anything missed, and tried to combat my own design blindness and assumptions given my closeness to the project. The video prototypes were loaded onto a 7" tablet to represent a real working prototype as closely as possible.

### 4.5.2 Transitions and Animations

An idea had come out during the previous two phases that visual bookmarks could be thought of as digital notecards. The metaphor was interesting because, like notecards, visual bookmarks held text and imagery, were added to a stack or collection, could be rearranged, searched for, and retrieved. Therefore, once a visual bookmark was made, adding it to one’s collection could be thought of as similar to filing away a notecard. This metaphor played on an idea raised by Dan of over cuing visual elements and animations. Over cuing confirmed to users that the action they intended had in fact been done by the software. This metaphor became the basis for an animated transition where a user added a bookmark to their collection. It visually connected what was happening in software to an already familiar interaction of filing away analog notecards.

In the following animation, when a user selected “OK” to add a visual bookmark to their collection, the screen rotates forward like opening a filing cabinet. The visual bookmark then moves upward and is filed away with other bookmarks from the user’s collection. Some portion of the user’s bookmarks are visible to reinforce the digital filing cabinet idea. Finally the screen rotates back into place, like closing a filing cabinet, and the bookmarking UI fades away and the user returns to browsing.

![Figure 33: Video Prototype 1](image)

This animation met with mixed results. A number of users made comments similar to this remark by Steve - “Oh, it gets filed away. It’s funny because that’s a simple animation that lets somebody see their bookmark, that they’re visually bookmarking, getting filed away into their [computer] system.” However, others commented that the animation was too long or too visually involved. Vince - “I think it’s nice, it makes sense but its too long. I’m a power bookmarker so I need it to be quick, it should be like a one second animation.” Some said this animation might be nice the first few times, but would get frustrating by the 100th time. Put together, the comments for and against
this animation implied that people understood the metaphor, but a literal and lengthy animation for explaining it was over done. The metaphor’s visual interpretation was redesigned so the transitions that leaned on the metaphor didn’t become imposing on the user experience.

A new animation was created, removing the literal interpretation of an animated filing cabinet. The visuals were stripped down to just the visual bookmark as a digital notecard. The animation showed a user adding a bookmark to their collection by pressing the “add-bookmark-button.” Leaving the crop marks in their default position the user presses the “accept” button. The visual bookmark animates by sliding under the browser GUI at the top of the screen, showing the bookmark has been “filed away.” The filing cabinet became implied but not shown, the user sees their bookmark went somewhere for safe keeping, and the animation length was halved.

![Figure 34: Video Prototype 2 - http://vimeo.com/42524140](image)

This animation was received much more positively as it was quick and to the point. However, it was not until the final iteration that this issue of metaphor was concluded. The main criticism here shifted from the transition to the icons and interface. The UI unfortunately had several problems.

### 4.5.3 Icons and Layout

Because there is limited space on a 7” screen for UI elements, when a user selected the add-bookmark-button a UI transition happened (image below). The button for adding bookmarks was replaced with buttons to accept or decline the visual bookmark and bookmarking options. The buttons switched because if a user pressed the add bookmark button they entered a new mode where they could add visual bookmarks, so they wouldn’t need the add bookmark button to be displayed. But replacing GUI buttons to save space caused one large problem: changing buttons under users’ fingers leads to confusion and dissatisfaction.
First, if a user’s finger blocked their view of the icon itself, they wouldn’t see it change. Vince - “If there is a change to the icon, my finger is over it, so i will be less likely to see it.” This was echoed by everyone interviewed and confirmed by professional opinion. Next was the problem of accidental double-taps. Here users tap once to start the bookmarking process, but accidentally tap the screen a second time which stops the bookmarking process because now the cancel button is under their finger (image above). Dan commented that accidental double-taps are something to watch out for when designing for touch screen.

A solution was found when Martina suggested it made sense if the accept and cancel buttons were subordinate to the add bookmark button. This way they could slide out from underneath the add bookmark button. Done this way, a user could double tap without accidentally causing the application to cancel their bookmark (image below). This design was strong enough to became part of all future prototypes.

The final video prototype showed the full range of interactions designed thus far. In the video a user choses to add a bookmark. The user then adjusts the crop marks to frame an embedded video. The user scrolls down the webpage to look for a better image, but changes their mind and returns to the embedded video. They press accept, the visual bookmark animates by sliding away to be “filed,” and the user returns to browsing.
The feedback lead to some interesting changes in the design. Button hierarchy was raised again regarding the newly designed GUI, though it was about subtle cues in graphic design and not overall interaction. Sveta - “when you click here (add bookmark button) it becomes blue, so my attention is still on this one. So maybe you can make these two (accept and cancel button) bigger and bring them forward, because now I need to interact with these two (accept and cancel) and not this one (add bookmark button).” This led to a drop shadow being added around the accept, decline, and options buttons making them visually connected with, but subordinate to, the add bookmark button (image below). The visual cues were taken from the desktop file menu because when a user clicks on “file,” it highlights and a subordinate menu pops open revealing new options.

Regarding the crop mark handles, Vince explained - “In some software mid-points are used for rotation, so its not clear what they are supposed to do in the video. Maybe you should make these handles (he points to the corners) more clear, like in the Android UI when you change volume or go to Youtube, there is this big chubby button.” After doing some research these two points were indeed quite valid. Firstly, several graphic programs use mid-point crop marks to rotate, scale, or stretch an image. In applications that instead use mid-point crop marks to adjust a crop vertically or horizontally the functionality is redundant because adjusting corner crop marks gives the user control over the vertical and horizontal alignment at the same time. Furthermore, the size of the crop handles in the video prototype were in line with desktop software and not tablet software where buttons are “chubbier.” Because of these two insights, the crop mark handles were revised (image below) from their original style (left) to being touch friendly (right).
Responding to the section of animation demonstrating how crop marks worked, Sveta commented - “I kind of feel like I want to move this one around (she points to the crop area), because then you can move it with just one movement instead of using all four of them (the handles in the corners).” Until this comment I only considered manipulating the crop marks from the handles. Dragging one’s finger inside the highlighted crop area to move the entire crop region sounded obvious once said, but had been completely overlooked during the design process. This interaction did not require a new video to demonstrate its functionality, but instead was added to the final working prototype.

Lastly, bringing things full circle to the animated transitions and metaphor, one user made a comment that resolved the issue of what happened to the visual bookmark after it was made. Daniel - “You’re sort of throwing it (the visual bookmark) away. Maybe having the visual bookmark go to the bookmark button is closer to the idea of filing them away.” This was quite clever because the last two animations had the visual bookmark fly off the screen, but it didn’t go anywhere. Having the visual bookmark go to the bookmark button explained where the bookmark went - into the bookmark collection, and didn’t create lengthy or distracting animations. Taking this into account the final design prototype added a button to switch between browsing and one’s bookmark collection, and the visual bookmarks flew up to this button.

4.5.5 Conclusions & Moving Forward

Transitions visually communicating to users what has or is currently happening within software, they visually confirm actions the user has taken, and can play on familiar metaphors. Yet they are difficult to get right and require user feedback to ensure they resonate with users. Furthermore icons and GUI layout change when designing for touch screens and fingers, and require the designer to unlearn some ideas found in desktops. Finally video prototyping has a lot of value in user testing, especially when designing for new types of experiences. Here, users were able to hold the experience in their hands on a tablet and react to animations demonstrating entire processes.

With a picture of what a bookmark collection might look like based on previous research and an idea of what the process for making bookmarks could be, the next phase was to implement a working, hi-fi prototype and begin to collect user feedback.
It was time to develop these ideas into a real experience and see if in fact the prototypes developed so far held true in practice.

4.6 Phase 6 - Hi-Fi Prototyping - Programming as Sketching

4.6.1 Introduction & Methods

The decision to make a hi-fi prototype was motivated by wanting to see if user behaviors, perceptions, and opinions changed when faced with real interactions and real design patterns. Would the types of interactions, the order of operations, and assumed usability proposed in mockups hold up? Could users interact with a prototype and imagine themselves in a future scenario where, as part of their bookmarking habits, the prototype could support bookmark creation, organization, and retrieval?

This design phase marked the transition from medium-fi to hi-fi prototyping to create a prototype that had enough functionality, and was critique-able-in-action. The three issues addressed here were how to get a user's current bookmark collection into a prototype so they could have a connection with the information they saw, what tools would be used to create this prototype, and deciding how much of the experience to create.

4.6.2 A User's Real Bookmarks

An original assumption for the prototype was to make several “default,” pre-loaded visual bookmarks (news sites, video sites, social media, etc) so users would have something to interact with, but not to make a prototype with so much functionality as to create “real” bookmarks. Professional opinion suggested using part of a user’s “already existing” bookmark collection in a prototype would allow for much more accurate and informative feedback. If users could see their own personal data in a new context through a prototype they could better evaluate that context and critique its qualities. This also side-stepped trying to make a prototype with real functionality.

It was shown to me that one could export their browser bookmarks into an html file complete with bookmark title, url, add date, and last-viewed-date. If participants shared their bookmark collections by this method, they would only need to make screenshots of the websites in their collections (using their PC) and all the elements for making a prototype with real visual bookmarks and real data would be in place.

To merge these pieces of information into usable data, an html to xml conversion program and an image resizing program were written. Browsers can export html files containing a user’s bookmarks, but the formatting was hard to read with the human eye and hard to parse through code. The html to xml converter fixed the formatting, making a human readable document. Therefore, a test subject would only need to send me a copy of their bookmark file and this program would reformat it. The image...
resizing program let test subjects make visual bookmark screenshots as big or small as they desired on their PC. No matter what the shape or size, the resizing program reformatted the visual bookmarks so they fit the layout decided upon in previous design phases and fit on a 7” screen. In this way there were no restrictions placed on the test subject when taking screenshots of bookmarked webpages, mimicking the proposed crop mark functionality from the previous design phase.

4.6.3 Tools for Creating Prototypes

A working prototype running on a tablet required a development environment, and selecting an appropriate environment was important based on the degree to which the materials could talk back (Schön, D. A., 1987). It was decided that Unity (Unity Technologies, N.D) would be the best environment for just this reason. Unity can essentially be thought of as equivalent to Flash (Adobe Systems Incorporated, 1996.), but in 3D. There is both a section for writing code as well as a section devoted to the direct manipulation of objects, animations, sound, etc. The image below illustrates this by showing Unity’s programmer-facing c# development environment (left) and the artist and design-facing GUI (right). Much like with Flash, the combination of these two modes of development in a single tool allows the designer to “apprehend the consequences of his moves as back talk that calls for a new round of frame experimentation.” (Schön, D. A., 1987)

Figure 40: C# Development Environment (left) & Design-Facing GUI (right)

One such example of the tools talking back are the transition animations that came out of the prototype building process. When a user transitions between internet browsing and viewing their bookmark collection a transition was needed to suggest to the user that they were switching into a different mode but still staying within the same application. A simple animation was made where the screen essentially flipped 180 degrees over when switching between modes, not unlike turning a piece of paper over. This animation came from a playful engagement with the tools in Unity, and met with extremely positive reactions by users. It was so successful that this same animation was adopted for when users want to edit their visual bookmarks. Here a user long-pressed on a visual bookmark and it flipped over to reveal more options, like looking at the back of a postcard. These transitions, and many other small details, were
sketched, refined, and implemented through engagement with the available toolset.

4.6.4 How Much of the Experience to Prototype

Originally, and quite naively, attempts were made to create a prototype that could be placed in the hands of users without prior instruction, and that the users could simply be asked to try out the prototype and comment on their perceptions and interactions. After a few failed attempts to achieve this it was quickly discovered that one cannot give users a work-in-progress prototype and expect them to use it flawlessly; discovering only its strengths and avoiding its weaknesses. Instead, users navigated down rabbit holes or into corners of the prototypes that simply do not work. After some professional advice, the more realistic approach of building a golden path was determined to be the best solution. In light of this, only features along the golden path would be created, and users would be shown the golden path before the prototype was placed in their hands. Additionally, this reduced the amount of programming required to make the prototype, while allowing users to give constructive feedback without getting stuck in a part of the prototype they perceived of as having functionality, but that in reality had none.

4.6.5 Conclusions & Moving Forward

In light of leveraging users’ already existing bookmark, the flexibility of the toolset, and the focus put on developing just the main elements of the design into a prototype, this design phase ended quite successfully in having something which was both usable and critique-able. The final step then was to put it in the hands of users.

5 Final Concept

In consideration of the above research, sketching, and design development, the final concept (http://vimeo.com/42542416) is presented here. The three steps in creating a personal information space (Abrams, Baecker, and Chignell, 1998), which are making a visual bookmark, organizing one’s collection, and finally retrieval of the desired information are described as follows:

Once Thoughtmarks has loaded the user is presented with a web browsing experience as they would find on any other tablet. However, when the user selects the “add bookmark” button they are presented with a set of crop marks, superimposed over their view, which have been positioned to fit almost the entire viewable webpage. At this point if the user does not wish to exert any further effort they can simply select “accept” and return to browsing. In this instance a full-screen snapshot will be taken of the page they are currently viewing which will be added to their bookmark collection. The title or URL of the website will be integrated at the bottom of the visual bookmark, and the webpage’s text will be saved as meta-data to aid with later searches. Upon pressing “accept,” a small animation plays where the currently framed region, here the
full screen, of the website “shrinks” and moves towards the “bookmark collection” button in the browser GUI until it disappears entirely. This serves as confirmation that the visual bookmark has been saved, and implies that it can be found by pressing the “bookmark collection” button. However, if the user wishes to exert a little more effort and frame a more visually representative region of the website to assist with later re-finding, they can adjust the crop marks. They can either drag-select the corners of the crop marks to change the crop size, they can drag-select the entire crop region and reposition it elsewhere, and they can scroll the webpage independently to make further adjustments. To confirm this cropped bookmark they can then select “accept,” and the same shrinking animation plays. Finally however, if the user wishes to exert yet more effort categorizing and organizing their bookmark they can select “more options” and the options window will appear allowing the user to change the bookmark title, add tags, or share a link via social network or email. It is worth noting that the user does not necessarily need to tag their content, as the text, title, and URL of the webpage being viewed are saved as meta-data attached to each bookmark, making it easier to search for later. However, the option of tagging is still available to the user. The user can then accept or cancel any edits they’ve made, causing the “more options” window to close, returning them to the webpage with the crop marks still active. Finally, the user again simply needs to press “accept” and their bookmark, with edited title or added tags, is saved into their collection and again the shrinking animation plays.

To view their bookmark collection users can press the “bookmark collection” button. Once pressed, an animated transition plays in which the screen flips over 180 degrees to show users their collection. This animation is intended to imply that users are still within the same application, but that they have navigated into a separate mode within the application. Here, a users’ visual bookmarks are arranged in a two-tiered, horizontal row, similar to a tablet photo gallery app layout. This layout represents a folder-less, non-hierarchical method for displaying a bookmark collection to the user. While this visualized bookmark representation alone may assist with re-finding, visual bookmarks in Thoughtmarks also have the webpage title or url embedded at the bottom of each visual bookmark. It is hoped that these two elements together can offer greater assistance in re-finding information than either one on their own.

Users can swipe left or right to scroll through their collection horizontally. Additionally, when looking for a specific bookmark users can perform a keyword search which searches through bookmark titles, tags, and website meta-data. In this case only the bookmarks matching the search parameters are displayed, reducing the overall number of bookmarks visible to the user. Next to the search field is the timeline which shows the age of the bookmarks currently being displayed with the labels This Week, This Month, 3 Months, 6 Months, This Year, and the Dawn of Time. The user can additionally swipe along the timeline to move their collection horizontally, much like moving a scroll bar on the desktop. In addition to the timeline showing when bookmarks were made, there is a horizontal bar graph integrated into this graphic showing how many bookmarks there are at discreet time intervals along the timeline. This additional information is intended to show the user trends or patterns with their bookmarking habits to better inform them about their collection and assist with re-
finding the desired information within their collection. It is further hoped that the combination of key-word search and chronological sorting will help filter away bookmarks which do not match what the user is looking for, and thus only display a relevant, smaller subset of bookmarks which the user can search through by sight.

Lastly, if a user wishes to edit or delete a visual bookmark they can long-press on that bookmark and it will animate by flipping over. On the back of the bookmark the user can edit text fields for the title and tags or select buttons to delete the bookmark, and accept or cancel any edits they’ve made. By selecting “delete” the bookmark disappears, while “accept” or “cancel” causes the bookmark to flip over again, returning to its default position. It is hoped that by providing the user with a quick method for editing and deleting bookmarks that they might be able to better manage their collection’s size.

Finally, once the user finds the bookmark they are looking for, a quick tap on this bookmark will take the user to the associated page. Here an animated transition is played where the screen flips 180 degrees over, returning the user to the original state of browsing with their selected webpage loaded and ready for viewing.

6 Discussion

6.1 Phase 7 - Final Interviews & Evaluation

6.1.1 Introduction & Methodologies

I concluded with two separate user interviews using the final working prototype with Quinn (chef / project manager) and Matt (interaction designer). For each interview the participant emailed me their bookmark collection and on my laptop they opened roughly 20 bookmarks in a browser and took snapshots of these websites to use as visual bookmarks. Using my automated xml and image tools these bookmarks were added to the prototype, and the prototype was given to the participants so they could see a small portion of their bookmark collection within Thoughmarks. After the participants had been shown the golden path of the prototype’s functionality and given some time to interact with their visualized bookmarks, they were asked a number of questions.

The questions covered a number of topics ranging from how Thoughtmarks compared to their regular tools for bookmarking, whether recognizing bookmarks was different in the prototype, their opinions of the user experience, the helpfulness of different bookmarking tools compared to Thoughtmarks, and how their habits might change if they were to use a visual system. Their responses can be loosely categorized into the following five sections: Visualized Bookmarks, Timeline, Text & Images, User Habits, and Folders and Hierarchy

6.1.2 Visualized Bookmarks
Both Quinn and Matt were very positive in regards to seeing their bookmarks visualized. Quinn - “It has the same information as my regular bookmarks (the titles) but this one has pictures so I’m going to recognize it better, faster, plus it just looks really nice.” This would suggest that in fact visualization does have at least some supportive qualities over just text for representing information. From a usability perspective it would also appear that visuals can help overcome at least some of the difficulty of recognizing information, as found in my research and that of others (Jones, Bruce, and Dumais, 2001). Quinn - “This is much more enjoyable, because with my regular bookmarks its just a wall of text I have to stumble through hoping that I’ll find what I’m looking for.” The idea of creating an experience that is enjoyable, as well as informative, was also something it was hoped this prototype could make. But more than just ease of use or speed of use, Matt made a comment that touched upon something quite interesting. Matt - “I think there is a better experience, just by default if I have made all these screenshots, then there is something that I found to be special or particular about it (a bookmark) and so I would have a relational value by default. It has a user defined value.” This notion of value could perhaps have parallels to Victor’s (2006) movie listings in that the base information was the same in both of his visualizations (*which* movies are playing at *what* time and *where*), but the layout of this information was different and thus the information had a significantly different value for the user. Perhaps then Matt’s comments suggest a similar notion with bookmarks (*which* bookmarks link to *what* information and *where* are they located), when comparing their layout visually as opposed to text.

### 6.1.3 Timeline

Additionally, both Matt and Quinn commented favorably with regards to the timeline. Matt - “Currently I bookmark things I think would be relevant later, but I almost never go back and visit them. But if I had a history. I think this timeline is probably one of the most relevant things just because when I look at them (bookmarks) as a directory list without any kind of visual relationship or time relationship, I almost never use them (bookmarks).” This would suggest that a chronological component could be just as important as visualization when users attempt to re-find information. The fact that nearly everyone interviewed preferred a chronological layout compared to frequency of use and alphabetical organization, leads one to consider just how deeply rooted is chronology embedded within our cognitive skills? Because while I argue visualization could be brought to bookmarks, it may be equally valid to question into what other domains could chronology be brought?

### 6.1.4 Text & Images

While the idea of using visuals instead text-based systems of organization is argued for strongly in this work, and many of the comments by users would seem to suggest a superiority of visuals, the value of text in concert with visuals would appear to have the greatest strength as far as supporting users. Quinn - “They eye travels so that you’re looking at the photo first, and if you question what the photo is representing, then you
look at the text. Its nice because its that further assist that you’d need if you are confused.” This play between visuals and text is really then something quite valuable because it would appear that there is no one direct link back to what we remember or how we recognize and recall things. Based on this comment we might instead consider that it has more to do with relationships and the overlapping of several forms of representation that lead to recognition and comprehension.

6.1.5 User Habits

Here the interviewees began to take very different paths. Matt’s comments would appear to be in line with those made thus far, “The reason I never use my bookmarks is because the system of a list without any relational value to time or an image I might be able to recall for why I was even on that page and bookmarked it. I think this definitely does change the way I feel about bookmarking. A lot about my practices would change.” This speaks in some ways to a mixture of both prediction and recollection in identifying a bookmark, knowing where it leads, and knowing why it was originally made. This process begins at the point of making a bookmark and is carried through the experience of organizing one’s information until it reaches its conclusion at the point of re-finding. The hope was that supporting prediction and recollection would create a better link between users and their found information, and this comment suggests this may be the case. But there was also a downside. Quinn - “to be honest I very rarely delete bookmarks. I can’t even think of a single instance when I did. Cause why, the storage is there so why wouldn’t you. Especially with something like this, it would make me even less likely to delete bookmarks because its pretty.” It would appear that the ever growing size of collections over time, commented on over 15 years of research as a point of difficulty, could yet become even worse with the introduction of visualization. This would require prolonged user testing to be verified, but from the outset there seems to be much more work needed if collection sizes are to get even larger as a result of tools like Thoughtmarks.

6.1.6 Folders & Hierarchy

However, with folders and hierarchy future work is also needed. Quinn began by pointing to a visual bookmark showing a chef cooking, then looking at the the title, yet he claimed to still want some distinguishing element informing him which part of his collection this bookmark came from. Quinn - “Ideally for me it would have an indicator on each bookmark what folder it belonged to... I have so many different bookmarks in so many different categories that I would... need something that would be able to distinguish what I’m looking for.” Quinn pointed out he is a heavy folder user, and that any new tool he would consider would require folders. Ideally, as he said, the name of the folder a bookmark is in would be integrated into the title area of the visual bookmark. He even suggested swiping gestures that would move him in and out of folder viewing modes. It would appear that folder-less, non-hierarchical bookmarking may not be the final iteration for this work. Matt - “I would want more like a structure system, like if you had a hierarchy page so that way you could start organizing things like you would do on a hard drive or a file system or anything else where you start
developing value into it.” Perhaps then we are just familiar with computers having a hierarchical structure, or we may prefer systems for organization in this type of context. Regardless, both Matt and Quinn commented, without prompting, on their desire for at least some form of organization, whether with tags, folders, or hierarchy. But this leads to a new considerations which is that this prototype could instead be seen as the minimum of structure from which to build up. Instead of taking folder structures as a given, degrees of organization could be slowly introduced until a threshold was reached at which the users’ habits were satisfied. And this leads us to the future of this project.

6.2 Future Work

From this vantage point there are in fact many directions to move in. Much like reevaluating bookmarks has lead to the paradigm of visualization which has been very positively received, perhaps then organizational structures could undergo a similar reinterpretation. An example of this was Quinn’s comment to have the folder name a bookmark was in actually displayed on the bookmark itself. This is opposite to how folders and their content are currently structured, so this would be very interesting to user test. Furthermore, with tablet in hand both Quinn and Matt began imagining gestures that would facilitate the user moving through the levels of a organizational structure, making user movement correspond to movements within the software. Quinn even suggested the idea of zooming out to get a broader view of one’s collection. This could be viewed as similar to zooming in and out of Google Maps (2005) in that their are different levels of information displayed at different levels of zoom. These levels of information inform the user in their moves through the data space; a concept not present in current folder structures.

While Quinn commented that he would be less likely to delete bookmarks, given that once visualized they were “pretty,” the work of Cockburn and McKenzie (2001) may offer at least some help in this instance. They found that roughly 25% of users’ bookmarks were in fact invalid and linked to pages which no longer existed. Users also often times had duplicate bookmarks, adding to the problem of collection size. Perhaps then adding the functionality to periodically scan a user’s collection and flag “dead” or duplicate bookmarks would help users identify bookmarks worth deleting, and thus reduce their collection size. Given the amount of difficulty users report having with managing their ever-growing collections, this goal is still very much worth pursuing.

It is interesting to note that when users saw mockups from photoshop that lacked their personal bookmarks, the ideas of folder-less bookmarking was not seen as an issue. However when Quinn and Matt saw their own bookmarks in the prototype they both specifically spoke of folders, tags, and organizational structures. But both commented on several occasions that they would need prolonged exposure with this prototype to understand how it would impact their habits in the long run. The next logical step then would be to give users a prototype for an extended period to see how user habits and expectations would change over time. How would visualizing all of one’s data change
re-finding habits over the span of a year? Would users see other domains in which visualization could be adopted? And what forms of structure could work in tandem with visual bookmarks? These are just some of the important next steps.

6.3 Reflection On My Process & State of My Result

To begin with, it would appear that in surveying this design space there are already several examples, both in academia and products, where visualization has been integrated with tools for organizing, searching for, comparing, and retrieving information. It is however specifically within bookmarking that this approach has been absent. Given that bookmarking tools have changed little in the past 15 years, and that the user comments of today echo those made over a decade ago, bookmarking is a topic ripe for interaction design. By bringing the discoveries and research of others and my own to bookmarking it is hoped that perhaps this region of design could benefit from visualizing information, and that this might better assist users in their daily lives.

With regards to interaction design it is very interesting to note that both Matt and Quinn claimed to want additional organization tools, and that these comments were relatively absent in previous interviews when the mockups contained mockup-bookmarks. I would argue that this is partly because Matt and Quinn had a real, functioning prototype in their hands that they could interact with and reflect upon. They could consider its implications for their habits and understand themselves in the new context it suggested. This was evident as they both independently began to invent gestures and new interactions they could have with the prototype and suggested additional functionality they wanted. But this was perhaps also because their own bookmarks were part of the prototype and so their experience with the prototype was personal. This has implications for design outcomes because as we designers interview users and show them mockups, we also need to consider the degree to which users are personally involved with our questions, mockups, and prototypes.

For my methodologies I would argue that the combination of user centered design and research through design were an excellent mixture for this type of project. There were an amazing number of insights gained by user interviews that were in fact truly impossible to gain through any other means. Understanding user needs, desires, and requirements puts the designer in an excellent position to begin forming directions to point at and move towards. These directions can then be validated or invalidated through user testing, which in the iterative process above evolved the design beyond what I could have created in isolation and through self-reference. Thus, identifying that the designer is not always representative of the user is a valuable concept to follow. However, reevaluating a process or toolset considers more than a list of user requirements. For a designer to leverage their abilities and construct possible futures, sketching through paper, pixels, video, and code are equally important. Divergent sketches that explore use cases, methods for working, and consider different contexts are something that cant necessarily come from fieldwork alone. Furthermore, designing for a preferred state creates a reflective opportunity for the user in that they
can evaluate their own habits and preferences against this new state and start to understand and comment on potentials and possibilities. I think that the multi-phase process used here allowed for these methodologies to be integrated at different points, and revealed outcomes that would not have been seen with either method alone.

While technically it would have been possible to develop this project without professional input, the overall design would have suffered quite significantly. From the theoretical to the practical, an experienced practitioner leverages years of know-how that a student is simply not able to. But through coaching the student learns by example.

The main goal of this research was to re-imagine what bookmarks and bookmark collections could be and to assist users with making, organizing, and retrieving their online information. The creation of a working prototype was my answer in that it allowed users to experience a potential future tool by which they could imagine themselves and their habits in a new context. I think the produced design artifact considered these topics and allowed for user feedback that pointed to the strengths and weaknesses of the proposed ideas, and in new directions yet to be explored. Furthermore, it was hoped that the use of visualization could move the user that much closer to the information they wish to interact with, and the overall feedback seems to suggest this may in fact be the case. The prototype has interesting implications both for design researchers and professionals. As mentioned previously, turning text based information into visual information met with extremely positive feedback from users. This suggests that it is at least worth considering bringing this idea to other domains, as bringing it to bookmarks seems to have made some improvement in user engagement with their information collections. Also, while chronological views of data are common in some areas of computing, with bookmarks this was not case. Bringing this method of organization to other data-sets then might also yield similar results as were found here. In conclusion I would say that the outcomes here point to very interesting possibilities for future work.
7 References


Gmail, 2007. *Gmail: Email from Google.* [online] Available at: <https://accounts.google.com/ServiceLogin?service=mail&passive=true&rm=false&continue=http://mail.google.com/mail/&ssc=1&ltmpl=default&ltmplcache=2> [Accessed 19 May 2012].


Appendix A
Original In-Person Questionnaire

1. How do you organize interesting links, photos, videos, etc that you find on the internet?
2. What kind of information is important for you to organize online?
3. When working on a project, where finding information online plays a role, how do your habits of organization change?
4. What tools do you currently use in this process?
5. If you use more than one tool, rate them from your most favorite to least favorite (or most used to least used).
6. If you only use one tool, explain what you find to be its strengths and weaknesses (possibly consider things like efficiency, organization, ease of use, etc).
7. If you use multiple tools, explain what you find to be the strengths and weaknesses of the different tools, and compare them with one another as you write your explanation.
8. Now, as an experiment, think back to a previous project you worked on where researching information, tools, resources, hardware, or software online played a large role, and where you used one of the tools mentioned in the previous questions to organize and compare the things you found. Go back to the tool you used and see how easy it is to retrieve the information you previously organized.
9. Describe how you re-found your previously organized information.
10. Consider what you think could be added to make an improvement on that system or those systems of organizing information?
Appendix B
Online Questionnaire

How is making a bookmark different than taking a note?

Is searching and browsing for bookmarks the same as searching and browsing for information on Google?

How useful do you find bookmarking websites to be?

How often do you organize your bookmarks?

How often do you delete bookmarks?

How easy is it for you to look through your bookmark collection to find the specific bookmark you’re looking for?

There are two steps when bookmarking - the first is to make the actual bookmark, and the second is to find the bookmark later. If you had to pick between tools that helped organize and categorize bookmarks when you are at the moment of making a bookmark, or tools that help you search and find your bookmarks later on, which would you choose and why?


After bookmarking a website, do you want to organize your bookmarks?

| 10 -- 9 -- 8 -- 7 -- 6 -- 5 -- 4 -- 3 -- 2 -- 1 -- 0 |

Yes, I want to keep my bookmarks organized

No, I’m fine with them not being organized

When organizing your bookmarks, do you want any tools to help with organization?

| 10 -- 9 -- 8 -- 7 -- 6 -- 5 -- 4 -- 3 -- 2 -- 1 -- 0 |
Yes, I would prefer extra tools for organization  
No, I prefer to organize my bookmarks manually

If there were tools to help you find your bookmarks again later, how accurate would they have to be?

<table>
<thead>
<tr>
<th>10   --   9   --   8   --   7   --   6   --   5   --   4   --   3   --   2   --   1   --   0</th>
</tr>
</thead>
<tbody>
<tr>
<td>They should always return the exact bookmark I'm looking for</td>
</tr>
</tbody>
</table>

Would you prefer if the computer helped to organize your bookmarks?

<table>
<thead>
<tr>
<th>10   --   9   --   8   --   7   --   6   --   5   --   4   --   3   --   2   --   1   --   0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes, the computer should do it for me</td>
</tr>
</tbody>
</table>

How much effort would you like to exert when organizing and searching for bookmarks?

<table>
<thead>
<tr>
<th>10   --   9   --   8   --   7   --   6   --   5   --   4   --   3   --   2   --   1   --   0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organizing and searching for bookmarks is easy the way it is now</td>
</tr>
</tbody>
</table>

Could seeing your bookmarks visually (see attached image) alleviate the need to keep them organized?

<table>
<thead>
<tr>
<th>10   --   9   --   8   --   7   --   6   --   5   --   4   --   3   --   2   --   1   --   0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes, now that I can see my bookmarks I don’t need to organize them</td>
</tr>
</tbody>
</table>

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Appendix C
Final Interview In-Person Questions

1. Now that you've made a visual bookmark with thoughts marks, how does it compare with how you usually make bookmarks in your browser?

2. When trying to find a bookmark in thought marks vs. your regular bookmarking tools, how do they compare to one another?

3. When trying to recognize bookmarks and predicting what websites or information they link to, how does thought marks compare with your traditional tools?

4. What are your opinions on the user experience of the thought marks vs your traditional toolsets for bookmarking?

5. Is there a difference in helpfulness between the two methods of bookmarking?

6. Is there a difference in supporting your daily routines or activities?

7. Do you think thought marks will change your habits?

8. What do you think about having the titles mixed with the pictures?