

Design Talk in a Community of Innovators

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ABSTRACT

This technical report describes an exploratory analysis of a community of innovators who indirectly contributed to the design of del.icio.us, a system for social tagging. Participants in this community, which is mediated primarily by an e-mail listserv and guided by a de-facto moderator, envision and reflect upon systems for social tagging. The analysis of a sample of messages shows that participants evoke patterns of conversation that promote reflection and creativity. This finding, in turn, leads to opportunities for enhancing social creativity and the management of design knowledge in computer mediated spaces.

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Author Keywords

Design Knowledge Management, Social Tagging, Social Creativity, Reflective Practice, Open Source Development

ACM Classification Keywords

K.6.1 [Management of Computing and Information Systems]: Project and People Management—*Systems analysis and design*.

INTRODUCTION

The Age of Participation [30] and the Architecture of Participation [24] are two labels that point to a seemingly inevitable trend: More people will participate, with varying degrees of directness, enthusiasm and influence, in the development of information systems. von Hippel labels the trend *democratizing innovation* and provides evidence from a variety of domains that users are often the first to identify new needs and invent significant improvements [34]. He argues that for commercial advantage, if not for social or ethical reasons, firms will need to structure product development to take full advantage of people's creativity and their situated adaptations of systems.

Two familiar and fundamental developments lie behind this trend. First, system developers have more options, enabled

by computer mediated communication, for exchanging information between design teams and communities of users. Second, users are being offered tools that afford greater degrees of autonomy for shaping, by extension or by appropriation, their information systems. Both developments invite developers to reconsider how best to draw upon the knowledge of users, especially *innovators* [27], venturesome users with strong inclinations to explore, envision, discuss, and adapt or create systems.

The possibility of a long-term trend toward the democratization of innovation highlights the importance of the information systems used in design. These *design information systems*, as we shall call them, serve, in the most general sense, two functions. First, they are containers that enlist, record, collect, and organize particular kinds of information. In turn, they become information resources that mediate design activities through the provision of specific kinds of information. Design teams shape these systems to serve specific needs.

Examples of needs addressed include: to coordinate amongst project stakeholders (e.g., TODO lists [36]); to capture and manage the design rationale for a system (e.g., IBIS [20]); to formalize reoccurring discourse patterns (e.g., bug tracking [9]); to elicit feedback or to mark progress (e.g., sketches and public displays [23]); and to promote analogical reasoning or creative exploration (e.g., IDEO's Tech Box [22]). Of course, the characteristics of any design information system, whether physical or electronic, will promote particular kinds of communication and analytic work. A system for tracking software errors, for example, might not be amenable to tracking usability problems or for discussing value-oriented issues of use [32].

Studies of design information systems are relatively few. The view seems to have been: Why study such systems since design processes, organizational factors, and technology *determine* their functionality and shape? With the advent of the open source software movement and its evident strength in enabling collective action, this view may be changing. In this distributed, knowledge-intensive setting, the importance of design information systems (e.g., source control, bug trackers, mailing lists, etc.) is striking. This observation, in turn, calls for empirical studies of open source software practices [28, 35, 36].

In this paper, we report on an exploratory study of a design information system of the most mundane sort: An ordinary

mailing list (listserv) for discussing del.icio.us, a social tagging and bookmarking system [17]. The mailing list, we shall see, mediates a community of innovative thinkers. Unlike other studies of mailing lists in open source software development, which have focused on the coordinative roles of mailing lists [16, 36], in this study we focus on how a mailing list can enhance reflective and creative work.

BACKGROUND

Design and Information Systems

As early as 1965, Archer [3] observed the importance of information collection in dynamic, design-oriented settings when he sought to develop systematic methods for design. The model he proposed focused particularly on information collection and use in various stages of design and illustrates two major points. First, design is an information-intensive process, where information collection, organization and retrieval, take place throughout the process. Design activities and information behavior interpenetrate.

This view implies that design information systems can be deliberately shaped to support the specific information needs of designers. An outstanding example of this is the sustained work on integrated design environments by Fischer and colleagues [4, 12]. This work, which draws on Schön's philosophy of practice [29], explicitly separates spaces for *action* and *reflection* and stresses the importance of deictic references between those two spaces. In this study of del.icio.us, we shall see that innovators create their own spaces for action by constructing input and presentation applications that build upon the del.icio.us API, while using the mailing list as a space for reflection.

The second point from Archer's model was left unsaid; namely, the instruments for collecting and finding information—technology, organization structure, policies—significantly impact the design process. In the intervening 40 years, however, it is now clear that there are vexed trade-offs associated with deciding what information to collect, how to represent it, and how to organize it, and how much time to invest in “re-finding” it. The trade-offs associated with the interplay between desired activities and the constraints that are created by a design information system remain poorly understood [15, 25].

This interplay can be readily observed in various design orientations. An apt example is Rittle's influential approach to design rationale, Issue-Based Information Systems (IBIS) [20]. Rittle's approach appeals to the idea that systematic argumentation will enable teams to manage the complexity of an (unstructured) design problem: “IBIS ought to stimulate a more scrutinized style of reasoning which more explicitly reveals the arguments” [24, p. 3]. When performing under the rules of IBIS, a design team generates a network of linked information units, each labeled according to its rhetorical purpose. The network's function is to be a “documentation and reporting system which permits fast and reliable information on the *state of*

discourse [emphasis added] at any time.” [24, p. 4]. Experience with building systems that reify this conceptual model, however, shows that the resource costs of accessing and updating this network is *very* significant [20]. Generalizing, we see that the *cost of knowledge* [6] and the *cost of update* [14] with a design information system must be commensurate with the benefits obtained by the team.

A second example of design information systems comes from scenario-based design [7, 8], which endeavors to create representations of activities, couched in stories of actors, goals, artifacts, settings and sequences of events. Like the IBIS method of argumentation, scenarios make elements of the design situation explicit in order to promote deliberate consideration and reflection of design options. Unlike IBIS, scenarios appear to have a low cost of knowledge and update: Narrative materials lend themselves to easy and repeated revision and the number of scenarios to organize for sharing and retrieval is typically modest.

Scenarios, nevertheless, do present interesting costs of knowledge and update expenditure because in use they spawn derivative representations, such as unit tasks for usability studies, claims analysis of options, or functional requirements. Such derivative representations—and the work associated with their creation—will uncover new knowledge. A critical question is how new information is then fed back into the scenario.

One response is to ignore newly discovered information, which, if done frequently, will lead to the fossilization of the scenario. On the other hand, continually updating the scenario—perhaps maintaining a citation structure that links the elements of the scenario to its derivative representations—presents an update cost, which may be significant. As the citation network of artifacts grows, finding related information becomes more likely, albeit with increasing search costs. One empirical study of software development, for example, reports that developers did not update scenarios to accommodate new functional requirements identified during implementation [19]. As a consequence, the requirements list assumed greater importance than foreseen and desired by some stakeholders.

The above examples concern the formalization of the coupling between a design information system and design processes; yet in general, we know that formalization can lead to significant inefficiencies in design settings [31]. In contrast to these examples, in this study we inquire into a case where the couplings between design information system (mailing list) and both the design process and evolving information system (del.icio.us) are weak.

Social Tagging

The central concept in tagging is that individual resources, such as web pages, websites, photos, or files, are assigned one or more tags. A tag is usually a single term that somehow represents one element of the content of a resource, with a combination of tags being used to

triangulate a more complete meaning. Thus, a person might assign three terms to www.ideo.com: *international*, *industrial.design*, and *consultants*. Later, a user can search for this resource using one or more of these terms.

When the tags are made publicly accessible, a community of actors can benefit from others' tags by searching for resources about specific topics using the tags that other people have assigned to these resources. Thus, systems for social tagging provide an alternative to traditional approaches for assigning tags—automatic tagging by computational means and centralized human tagging—and to free text searching. A number of systems for social tagging, some popular and some academically oriented, have emerged in the past years [17].

The underlying data model for social tagging is straightforward, consisting of such entities as USER, TAG, and RESOURCE. However, to support such activities as information management, resource discovery, and dynamic knowledge representation, a very large space for interaction design unfolds. The conversations in the del.icio.us mailing list, as we shall see, is largely concerned with exploring the usability and sociability issues of this space.

Participatory Development at del.icio.us

del.icio.us was one of the first widely used systems for social tagging. It began Sep 2003 as a personal project run by Joshua Schachter, hereafter called “Chief Architect”, with these goals: “... provide a good way for people to remember things for themselves (bookmarks); provide a good way to find other people's interesting things (discovery); and finally, see if the whole system can come together (social)” [11, 3 Jan 04].

Only the Chief Architect can change the del.icio.us code base, and users are neither able to read the code nor run their own versions of the code. Nevertheless, users can indirectly participate in its development in two major ways. First, users can discuss its design in “an all-purpose mailing list for chatting with other users” [10]. The Chief Architect, as we shall see, uses the mailing list to raise and discuss questions about del.icio.us. Indeed, it functions as a source of innovation. One participant put it this way: “the lion's share of the work put into [delicious](http://del.icio.us) is already available for free - it consists of the design and user interface decisions, including the vast number of features that have been considered and rejected over the life of the project. This represents an enormous amount of collective effort, including all of the members of this list” [11].

Second, many people have developed applications, browser extensions, sharable scripts, statistical analyses, and so on that build off of the openness of the del.icio.us data and Application Programming Interface (API). This decentralized, design activity has resulted in a wide variety of tools for accessing and updating data held by del.icio.us.

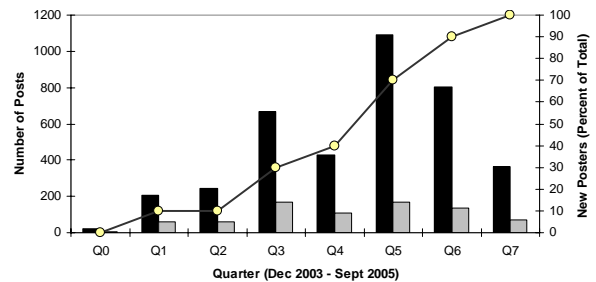


Figure 1. Posting activity by quarter.

Sometimes, these applications “scrape” pages and reproduce the content in different form. Alternatively, del.icio.us' API allows other systems to access and update the tag data. Many applications have been developed to explore how the data can be visualized and updated [1]. The openness of the API appears to contribute to a relatively active development community.

A second-order effect of this activity is that weblogs, unassociated with del.icio.us, take part in describing and critiquing these innovations. One weblog entry, for example, contains a tutorial on using del.icio.us [5]; while another contains a current and exhaustive list of over a 100 links to third-party development projects [1]. Links to weblogs sometimes appear on the mailing list. The broad picture that emerges is an intricate social network of joint reflection and the diffusion of ideas and tangible innovations (e.g., code fragments, user interfaces, etc.)

The del.icio.us Mailing List

The mailing list [11] began on 18 Dec 2003. By 30 Sep 2005, 597 different people (determined by unique e-mail addresses) had posted at least once. With 30K users of del.icio.us reported in Dec 2004 [2] and 300K in Dec 2005, we see that only a small fraction of users participate. The number of lurkers is unknown. The four top-level domains, com, net, org, and edu, represent about 86% of the posters, suggesting that participants were mainly from the USA. In this 22 month period, the mailing list contains 3,918 posts.

Figure 1 shows the quarterly posting activity (the first quarter contains only 14 days of activity), with posts from all participants shown by the black bars and posts made by the Chief Architect shown in grey. As can be seen, he is an active poster; indeed, he is responsible for about 20% of all messages written ($n=779$). The cumulative growth in new users, shown as a percentage, is plotted by the line, with increased growth starting in the Q4. From this data, we see a fairly active, growing community with the Chief Architect showing a regular, high-level of activity.

Figure 2 shows the overall posting activity. The Y-axis represents the number of posts and the X-axis is ordered by the number of posters who have posted a given amount, ranging from 779 posts ($n=1$, Chief Architect) to 1 ($n=235$).

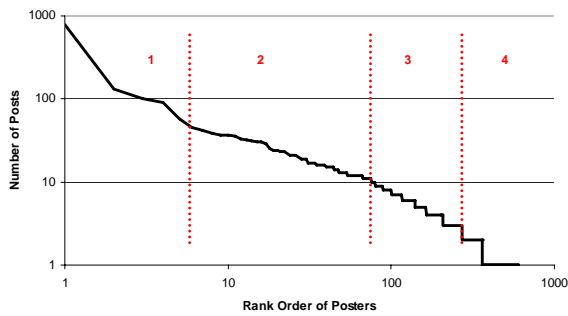


Figure 2. Ranked frequency distribution of posters.

To show the dispersion, the data is plotted on log scales. The curve approximates a Zipf distribution.

The “centrality” of participants can be roughly estimated by placing people into bins based on posting frequency. The cut-offs for the four bins, labeled 1-4, were selected based on our judgment. This breakdown shows that the 4 people in bin-1 and the 75 people in bin-2 are collectively responsible for about 66% of the posts (1100 and 1488 posts respectively) and that the 193 people in bin-3 and the 325 people in bin-4 were responsible for the remaining 34% of posts (917 and 413 posts respectively). Below, to convey involvement, we indicate all cited participants’ bins.

EXPLORATORY STUDY: TALKING ABOUT DESIGN

The aim of this exploratory study was to answer one major question: How do people use the mailing list to talk about the design and use of del.icio.us? We addressed this question by identifying salient episodes of conversation, by seeking to understand the underlying conversational intent, and by reflecting on how features of this situation might influence the conversations. As described below, an exploratory approach was followed.

del.icio.us is a noteworthy “site” for several reasons. First, the social tagging of bookmarks is poised to significantly impact information collection and use, with scores of projects exploring the concept in different ways [17]. del.icio.us is influential in this area. Second, early explorations of the mailing list suggested that a vibrant community had formed in support of the design of del.icio.us, with the Chief Architect as de-facto moderator. We wanted to examine this conversation and the practices used to shape it. Third, the technological simplicity of the mailing list and its public availability led us to believe that studying participation would be tractable and the findings would be applicable to critiquing and envisioning current and future design information systems. The combination of an interesting system (del.icio.us) and evidently successful design community suggested that we could learn lessons about design information systems, especially those used to further ideation, creativity, and deliberation.

Method and Sample

To analyze the content of the mailing list, we followed a three-phase process. In phase I, we constructed a timeline

of major events, including reports on growth, major releases, significant decisions on features, and so on. This work revealed the major topics discussed.

In phase II, we analyzed the content of the first 8 weeks of the mailing list using a provisional coding scheme, which consisted of concepts in three categories, *design talk* (conversations that appeal to analogical reasoning, conceptual metaphors, scenarios, etc.), *design issues* (handling abusive behavior, operation of the home page, etc.) and *miscellaneous* (conversations on open source, priorities, etc.). This work revealed a mass of largely disjoint details, and unsurprisingly, it was difficult to gain an overview of the conversational approaches; nevertheless, it was invaluable to developing a sense of the community.

In phase III, we identified conversations that were concerned with feature requests. We concentrated especially on the messages that triggered these conversations. Of these conversations, we further focused on those that seemed to be 1) significant to the community, and 2) noteworthy for the kind information drawn upon by participants. This orientation allowed us to identify salient conversational threads and to propose categories that seemed relatively general. A sample of these conversations, generally from the first 3 quarters only, is discussed below.

In this analysis we treat the mailing list as a public text and decline to make contact with participants. This decision limits our ability to answer important questions about how participants view the list, how conversations lead to design work, and so on. This study helps to set the stage for research that addresses such questions. We note, finally, that we are not active participants in this community.

RESULTS

Many of the conversations are oriented towards features; that is, functionality that is proposed to improve the usability or sociability [26] of del.icio.us. We identified four different kinds of triggers to conversations about features. In the following analysis we select and discuss exemplars, using anonymized names. Superscripts indicate frequency of postings, bin 1-4 (see figure 2) and all excerpts come from the mailing list [11].

Feature Requests Made Without Appeals to a Ground

In this kind of trigger, a participant makes a request for a feature without providing justification. Consider this post, which consists of five feature requests of this style:

...Space separated tags should include the possibility of quoted strings, so I can tag something e.g. "semantic web" rather than semweb... Oh, and thanks. This is terrific....

— [Andrea¹, 29 Dec 03]

Here, five feature requests are presented in the 1st person without justification. They are simply statements for how the interface should be changed. As many posts do, this one contains an expression of thanks. While these requests are

straightforward, the ensuing discussion, contained in a dozen or so posts, is not. Several hours later, the Chief Architect posts a message, responding to each of the five feature requests. Concerning the second one, he says:

... Hmm. The database can handle this, but I have to think about how to properly do a parser for this. Also, it'll make the url for that tag look like /cshirky/semantic%20web which is a bit uglier.

I've been thinking of adding code to let people give descriptions to the tags. So you could do "semweb" and then there would be a title in the page of "the semantic web" or something ... Would that do as well? ...

— [Chief Architect¹, 29 Dec 03]

In this response, we see a brief analysis of system-oriented trade-offs; then, he proposes a new feature which addresses the underlying issue while avoiding the downsides of the feature request, ending with a call for more discussion. In subsequent posts, others weigh in with additional features and comments on those proposed. No one, however, frames the discussion in a more general way with, for example, the question: What is a tag? These common definitional understandings are implicit. This feature request, simple as it seems, was a trigger for an involved conversation.

Often, however, someone will summarize a series of posts by imposing a structure for thinking about the topic of discussion. Here, the Chief Architect identifies and labels two requirements from a previous conversation and succinctly defines them with vivid, concrete examples:

Sounds like two separate issues, ... Private links:
"I don't want other people to steal my porn stash if I bookmark it"
Ignore list:
"That cshirky guy sure posts boring stuff, I never want to see it again"
These are both on my todo list. ...

— [Chief Architect¹, 20 Jan 04]

In contrast to the ending of the previous post ("Would that do..."), this post ends with a signal that the conversation is over. As is often the case, the Chief Architect refers to a non-public coordination device ("my todo list").

The pattern illustrated here is that one person's imperative can lead to an extended multi-participant discussion which is finished with a summary made by someone else. Feature requests made without specific justification can prompt exploratory conversations that lead to grounded, or specifically justified, requests. One does not have to begin with a fully worked out feature request to make progress.

Feature Requests with Appeals to Personal Experiences

In this trigger, a participant makes a feature request, appealing to personal experience to justify the request. In the next post, for example, we see a participant asking for a feature in order to obtain a personal goal:

I think del.icio.us has potential to be a very, *very* simple replacement for friend-finding networks like Tribe or Friendster (and IMO more effective, at least for the kind of socializing I want to do). ... I would really appreciate a way to simply specify a string to be rendered at the top of one's /username page. I would just put my web site address there, maybe others would put their email address, whatever. But I think it would be a great way to find people who have similar interests.

— [Barry², 15 Jan 04]

The Chief Architect follows up shortly with "This one is definitely on my list; I am working on this as well as a way to describe your tags, in the manner that you describe" [11, Chief Architect¹, 15 Jan 04]. Thus, as people use del.icio.us for themselves they encounter personal needs that may be applicable to others.

In contrast to drawing on personal experiences to justify a feature, the mailing list also contains many examples of people reflecting upon their uses in a less directed, more intuitive fashion. Consider this example:

Over the past few days I've noticed an interesting phenomenon, of course I may just be deluding myself but a few minutes after I post a link to Del.icio.us a related link is posted by someone else. It seems as if the other person is responding to my bookmark. I know I have done similar things. I see something and think "Oh that reminds me of....." and then I post a book mark for what I was reminded of.... I wonder what the effect of supporting threading of bookmarks just like a mailing list would be? ...

— [Chantal², 8 Jan 04]

Within hours, the Chief Architect [11, 8 Jan 04] replies "that's an interesting idea. what would the ui look like?" Building quickly, a participant posts in part: "I often do this. One of the great pleasures of del.icio.us" [11, Andrea¹, 8 Jan 04] and a thread of messages follows on how to specifically design the UI to track this subtle, though potentially valuable, information.

Here we see the mailing list serving as a place for playful exploration. An observation, its use uncertain, is made by one person, it is affirmed by two other people and attention is directed towards exploring its implications. Personal commentary and intuitive discussion, unveiled by any sense of objectivity, often promotes discussion about features.

Feature Requests with Appeals to Observed Use

Observations about others' behaviors were seen to motivate a discussion about features. In this post, we see that an initial observation is followed up with a future scenario for how del.icio.us might operate:

I noticed that a lot of people are saving links to aid in choosing colors for design. So I thought that maybe this idea would be interesting to others: ... How about a site like del.icio.us for sharing color choices? I already keep

a hand-coded table of colors I use with a page-wide sample, hex #, ... I would love to have a simple form I could fill out to create this list - and to be able to share the colors, that would be too fun. Just seeing what people name their colors would be very amusing, I think.
— [Dean⁴, 9 Jan 04]

This is the only message that Dean⁴ writes; yet, later, this scenario is cited in order to justify a relatively unrelated feature request. Observations of other users' activities provoke and support the furtherance of the discussion.

Another example concerns the problem of how to define and prevent abusive behaviors in del.icio.us, a recurrent topic. In one typical case, the discussion begins with an observation of a person's tagging behavior and his or her underlying motives: "What's up with this guy? ... Seems to be someone 'spamming' del.icio.us, for lack of a better term. Not that it is especially annoying. ... Or, maybe it's just someone that likes really lame websites. :)" [11, Erin², 14 Jan 04]. These posts follow:

So here's the weird thing -- careful, hierarchical tags of the sort that will never show up in anyone's tag set, and several lists, concatenated alphabetically. ... If its for advertising, it's using del as a base of ops, not advertising to us, I think
— [Andrea¹, 14 Jan 04]

I thought he was spamming as well, but then I realized I recognize a lot of those companies as legitimate. So I'm waiting to see what he does with it
— [Chief Architect¹, 14 Jan 04]

My Guess is that Amethyst is a IT consultant doing an vendor analysis for a client... I think this is a great example of someone else doing a nice job of classification of classification on our behalf. I will never compile such a list my self but I might use Amethysts.
— [Chantal², 14 Jan 04]

About a month later, the Chief Architect [11, 18 Feb 04] writes: "So, what behaviors ARE beyond the pale? ... Someone was making a number of accounts and then posted the same single URL to those accounts. This is obviously abusive". The next day he clarifies his question by stating: "I want to narrow in on what actually is unacceptable behavior and what is merely irritating or whatever; classification will allow me to decide what needs to be implemented in order to deal with it" [11, Chief Architect¹, 18 Feb 04].

The major observation about the responses to these posts is that they generally appeal to specific phenomena that, at the time, could be publicly confirmed. Months later, however, after many changes to del.icio.us, it is often not possible to inspect the original, cited evidence. Interestingly, we know of no examples where users of del.icio.us, who were not participating in the mailing list, were contacted and asked about their behaviors and motives.

Participants also use the board to discuss their tagging practices and to compare with and negotiate community practices. This message proposes a social mechanism for responding to bookmarks that link to illegal materials:

... If I see anything I think might cause you legal problems I will tag it as "del.icio.usAbuse". You can decide what, if anything you want to do with it ... Maybe others could do the same ? ...
— [Chantal², 3 Jan 04]

Shortly later, this idea is challenged: "so we should propagate legally questionable links as much as possible, thus exponentially increasing the headache if they must be deleted" [11, Erin⁴, 4 Jan 04]. The original writer response quickly:

Good point! But equally Joshua cannot police every link and some links will be much more legally questionable than this one. I suppose Joshua could make a "magic-link" for reporting potential abuse that does not get propagated. Or we could use email, but that seems rather outside the spirit of the game! ... Although I not sure why it would grow exponentially. That would only happen if everyone tagged a link as abusive. It should only take one such tag... I just feel those who find del.icio.us useful should cover Joshuas back....
— [Chantal², 4 Jan 04]

Here we see the discussion list as a place for reporting on questionable behaviors and discussing motives. In turn, the implications of behaviors are explored, with these examples showing proposals for new features (e.g., a "magic link") and changes in community norms (e.g., the use of e-mail).

Feature Requests with Appeals to a Scenario

Finally, a trigger can consist of a scenario, which then prompts a discussion of features. The next example concerns the del.icio.us home page, which at the time was running a continuously updated list of all posted links. Consider this post, which elaborates one conceptual metaphor, concerning Google, with another:

- > As more people start using del.icio.us, the more
- > del.icio.us will look like someone typed a random
- > word into google and hit 'I'm feeling lucky'.

The problem, of course, is that 'value of the front page per contributing user' is one of those $100x-x^{**2}$ equations; 50 users creates more value than 5, 75 users creates less value than 50, and when the crowd tips a hundred, there is negative value....
— [Andrea¹, 24 Jan 04]

Then, this message is followed up with a scenario which then leads to a discussion of functional requirements:

I completely agree with you. ... Regarding this problem I thought about creating "clouds" of users. We could have different types of clouds:

- inside a company or a department
- per interest (web desing, social networks, gardening...)
- ... [ellipses in original]

This way one could keep track of the cloud he's interested in, but at the same time the clouds could be merged together, and at different dimensions. Alas, each cloud could be using its own instalation, not depending on a central server, which could adress a future bandwidth problem for Joshua...

— [Gabrielle², 25 Jan 04]

This exchange, and the earlier one concerning the abuse tag, typifies much of the design talk found on the mailing list. Participants often build upon each others ideas through synthesis and argumentation.

Influence of Third-Party Innovations

The mailing list is often used to discuss third-party innovations, including software tools, scripts, applications, plugin extensions to browsers or webserver applications, and so on. These computational artifacts, in one way or another, update or draw upon the data held by del.icio.us. This design activity is enabled by using an open API and by using web technologies to “hack” different presentations and experiences. Metaphorically, these efforts can be considered seeds that may be cultivated by their developers and others [13]. Eventually, the ideas might be harvested by the Chief Architect and incorporated into the code base, which he alone controls. These efforts spawn reflective conversations, both on the mailing list and among a loose network of weblogs. We briefly present two examples of this development activity.

Example #1. Early in the development of del.icio.us “ideology spammers” would use del.icio.us' bookmarks to make politically and socially inflammatory statements. (All submitted bookmarks appear on the home page and the fewer the submissions the longer they appeared.) Spurred by a series of inflammatory statements, one participant requested an “ignore function”, to which the Chief Architect assigned a low priority. In response, the participant created a site that scraped del.icio.us and removed all text from a description field. He posted the 10 lines of Perl code on the mailing list and this prompted a discussion about priorities and appropriate practices for reusing and extending del.icio.us. Later, when the ignore function is implemented the participant takes down his site.

Example #2. The posting dialog is used to submit bookmarks to del.icio.us. The original interface consisted of four fields: URL, tags, description, and extended description. A user of del.icio.us invented an alternative interface, which suggested a list of tags. This list was computed by taking the intersection of two sets: 1) The set of tags already assigned to the URL (by users who have already bookmarked the URL), and 2) The set of all tags used by the user who is submitting the URL. This intersection, therefore, is a suggestion of plausible tags

based on community and personal evidence in the context of the URL. When the Chief Architect is informed of this project on the mailing list, he expresses approval and asks if he can incorporate this code in the user interface for posting. Upon receiving permission, this is done.

These examples show that innovators can contribute to the design of del.icio.us through loosely coupled ad hoc implementation efforts.

DISCUSSION

Conversation Patterns

Here we propose a three stage model of the design talk found in the above material. The function of this model is to systematize the conversations by assigning categories to salient CONCEPTS, that is, concepts judged to be important.

1. *Assertion about usage:* A statement is made about the practices of users' A) CURRENT-PRACTICES or B) DESIRED PRACTICES. The statement often includes assumptions about the user's motives and a prediction about how those practices will affect del.icio.us over time. Participants often advance differing views.

2. *Grounding:* The assertion about usage is often backed with A) OBSERVATIONS of users' behaviors, B) PERSONAL REFLECTIONS or needs, or C) a FUTURE SCENARIO. Often, when observations are discussed, enough information is given so that others can verify the evidence.

3. *Solution:* A solution is proposed. It might address an assertion about usage or grounding. The solution may suggest A) CHANGES IN PRACTICE, B) NEW FEATURE, C) FEATURE MODIFICATION, or D) NEW ASSERTION/QUESTION about usage. Or, the solution may be a WORKING ARTIFACT. The Chief Architect often gives resolution to this stage of a conversation by assigning a status to the feature (e.g., declined, high-priority, needs-examination, etc.)

Participants, as we have seen above, may begin at any one of these stages and move among them in different orders. In using mailing lists in open source software development, the dominant pattern is to begin a conversation with a report on an action taken (e.g., code hand-in) and to then discuss the action; it is much rarer to begin a conversational thread by making a proposal for action [36]. In this mailing list, in contrast, we believe that no one stage is a dominant trigger—all stages can be beginnings and endings to productive conversations. Testing this conjecture and, indeed, assessing the validity of this model will require detailed content analysis and further empirical study.

Reflective Practices

Drawing on Schön's epistemology of practice [29], we believe that a cycle of reflection in/on action is the fundamental organizing force *but* the mailing list imposes some interesting constraints. Below we take up this claim by discussing the results with Schön's vocabulary. Words set in italic are his.

To begin, we make a general observation. Unlike the work of Fischer and colleagues [4, 12, 13], which deliberately constructs environments to enable the interaction between spaces of action and reflection, in this case we see the emergence of structures that support a kind of social, time-delayed reflective inquiry. Sometimes participants draw *appreciations* out from artifacts that are deployed or from observed usage (reflection *on* action); other times, participants reflect on possibilities expressed on the mailing list (reflection *in* action). The context of the mailing list, in both cases, causes the yoking to be time delayed and loose. As well, while the mailing list is one focus, a patchwork of ideas and tangible artifacts located at weblogs and project websites seems to play a crucial role as well.

Social structure

Unlike Schön's protocol of master and student interacting in an architectural studio, in this case we see a single authority, the Chief Architect, and a relatively large, undifferentiated community of innovators. This relationship between the Chief Architect and community, allows many people to propose *exploratory experiments*, to draw out *implications*, and to propose new *moves*. Even infrequent participation can be important. Dean's scenario and Erin's challenge, for example, are two examples of influential, singleton contributions. Further in the background are the tens of thousands of people who use del.icio.us. Their activities provide information that is drawn upon by the innovators. In this case their involvement in the design is generally indirect; it is noteworthy that innovators' frequent conjectures about users' underlying motives might be clarified by contacting particular users. (Incidentally, the distribution of messages shown in Figure 2 and anecdotal inspection of participants' weblogs suggests greater differentiation of social structure, an area for future work.)

Language of designing

Like the studio master's use of language, the Chief Architect's sustained artful communication style is crucially important. We noted three common tactics for shaping the conversation. First, sometimes he dismisses an idea outright, often without explaining why, with such expressions as "Unlikely at this time. Sorry" [11, Chief Architect, 30 March 04]. These dismissals generally seem to be intended to maintain a working *frame* or *discipline*.

Second, he clearly supports one side of a discussion over another, while leaving open the possibility that future information might cause him to change his mind. For example, he wrote "In what way would it [a proposed feature] make the site better for the users?" before listing four downsides to the feature [11, Chief Architect, 6 Mar 04]. In this we see him exercising a *rigorous experiment*, where he "strives to make the situation confirm to his view of it while remaining open to evidence" [28, p. 74].

Third, he encourages conversations to unfold in directions that are useful to him. Here, the underlying intention often

seems to be to elicit new *exploratory* or *move testing experiments*. For example, from time to time he posts solicitations of this style "I wonder if [doing X] was a mistake?" In another example, he repeatedly encourages people to explain their reasons for wanting "hierarchical tags" despite his strong resistance to them. In this we see considered questioning.

In sum, the Chief Architect appears to be highly skilled at asserting particular stances, while leaving openings for others to contribute. With an appreciative, albeit brisk, style of conversation, he artfully guides participants to talk about topics that lead to evidently productive outcomes.

Virtual world

Like the shared sketchpad from Schön's protocol, the mailing list is a *virtual world* because the *experimenting*, so clearly seen in the above conversation fragments, is unconstrained by the *built world*. The mailing list, especially for this group of participants, is perhaps the most ordinary broadcast-oriented form of computer mediated communication imaginable [18]. While we don't know with certainty, it is reasonable to assume that most participants read and write messages to the mailing list through their everyday e-mail applications. Thus, like a sketchpad, usability is not likely to be at issue; of course, issues of competence, sociability and usefulness *are* crucial! Nevertheless, the expressive differences between a sketchpad and ASCII e-mail messages are striking. Schön's analysis makes much of the connection between talking and the spatial-action language associated with architectural work; yet, here we see reflective inquiry in a lean medium without the equivalent of a *spatial-action language*. What should be made of this?

Participants are seen to appeal to many *descriptive design domains* and evoke experiences with words. No graphic notation is available. Indeed, only a few posts contain graphic attachments (e.g., screen shots) or ASCII art. Sketching takes place largely through words alone. It is remarkable that so much evidently creative and productive work can take place in this lean medium. We believe this simplicity is crucial, a lesson that has not been easily learned [30]. Further, in studies of open source software development, mailing lists have been seen largely as spaces for coordination [16, 21, 36] and they been over looked as spaces for reflection and creativity [21].

Formalization

The mailing list, and the del.icio.us page that promotes the list, does not contain links to structured, supporting artifacts such as TODO lists, FAQs, and scenarios. The mailing list as technology and the social norms governing its use do not lead toward formalization. When structuring does take place it is informal, taking such forms as lists of priorities, feature descriptions, topics discussed, and brief cost-benefit analyses. Scenarios, claims analysis, and argumentative

rhetorical structures are present but are not easily isolated in single messages or even in threads of messages.

The work of harvesting, structuring, and organizing takes place off-line if at all. The Chief Architect, for example, often refers to his TODO list; yet, it is not made publicly visible, perhaps because he does not want to publicly announce his priorities. Further, we know nothing about its form or the form of other derivative representations that lead to changes in design. Ethnographically-oriented approaches would be required to address these issues.

Possible Determinants of Sociability for Reflection

Successful communities tend to have constraints and resources that are appropriate to their purpose. Preece organizes the determinants for success of a community into frameworks for sociability and usability [26]. The analysis of the del.icio.us mailing list suggests possible criteria and requirements for judging and informing the design of social spaces for reflection. We briefly discuss these next.

Simplicity of capture

The mailing list shows, in striking fashion, the benefits of a very simple read-and-post interaction style. Presumably, the community is embedded within participants' work through e-mail; thus, the incremental costs associated with belonging to this community are low. No enabling tasks are required to write to the list (e.g., classifying a contribution or filling in a template) and the awareness capabilities of listservs [16] allow even peripheral members of the community to chime in with productive contributions that are engaged in a sustained fashion by others.

Moderating practices

The Chief Architect shows great skill in guiding the dialog and enlisting the participation of many people. He seems, in short, to use the tactics of a reflective practitioner in this social context. In turn, participants are able to make a range of intuitive and analytical contributions, some sustained and some singletons. Thus, careful description and coaching of these tactics will likely benefit other, similar communities.

Reports of usage

Personal and observed reports of usage are important resources for this community. Thus, the ability to capture vivid or detailed information on usage (e.g., screen shots, activity logs, etc.), to annotate it, and to post it to the mailing list would likely enhance reflective conversations, as would an ethos or incentive system that allowed innovators to engage users with questions about their use.

Incremental formalization

The mailing list and its archive provide no social or technological enablers for structuring and organizing material that is generated on the list. Thus, the community's ability to address participants' needs for learning about major topics discussed, for retrieving previously discussed issues, for recording summaries of material, and so on is

limited. In turn, the community's ability to evolve to support different roles and purposes appears limited. If the community decided to produce scenarios, claims analyses, and design rationale where would they go? Without such structured representations, the prospects for long-term, indirect collaboration[12] are uncertain.

Participant identify

Many of the participants, especially active participants, have weblogs and projects related to social tagging. The mailing list, however, does not provide an overview of these other resources. For new users in particular, it would be helpful to see a list of participants' weblogs and projects, which can be found but with high search costs. This distal information for shaping users' identities could complement descriptive information about their activities [31].

CONCLUSION

As a design information system, the functions of a mailing list are limited and its use ordinary. Nevertheless, this work has shown how it can mediate rich, intricate conversations about design. It has provided a medium for experimenting, for reflecting, and for deliberating. At times it provides group awareness[16] about the status of del.icio.us; rarely, if ever, is it used to coordinate [36] since the social structure of this community entails no dependences on action. As with a virtual world for design [29], it evokes critical competencies in reflection and action, especially for the Chief Architect; yet, it lacks graphical externalizations.

Most significantly, the mailing enables *social creativity* [12], at least at a very early stage of system development. Its capacity for social creativity over the long-term and in cases with more complex social structures, with multiple social roles, is questionable. This community, indeed, seems to face significant limits in how it can adapt to accommodate hypothetical needs for greater structuring.

Three key directions for further study are 1) To formalize the patterns of conversation and to seek to empirically validate them; 2) To explore interventions that lead to greater structure for learning and coordination while preserving the simplicity of the read-and-post mailing list; and 3) To pursue the broader issues of how design information systems influence reflective practices.

We conclude that a mailing list can enable wide participation in reflective discussions of design. A key imperative, therefore, is to discover how unstructured read-and-post systems can be situated and adapted to serve other needs for information management in design, especially in the context of evolving, socially constructed systems.

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