

# Mail2Tag: Augmenting Email for Sharing with Implicit Tag-based Categorization

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## ABSTRACT

*New technology can disrupt existing social processes, especially those formed within the workplace email habitat. Recent abundance of sharing tool choices and disruption of practices makes for a lack of agreement and coherence in the use of information sharing tools. At work, email remains the primary way for sharing information, despite years of knowledge management research. We examine the design of a system for lightweight organizational sharing called Mail2Tag, which augments email by utilizing existing email sharing practices to help gather content, implicitly organize that content, and evolve both the shared content and the groups of people interested in that content. The vision is to get the right information to the right people at the right time, without increasing overall information noise.*

**KEYWORDS:** Platforms for collaboration, email, social tagging, collaborative knowledge management.

## 1. INTRODUCTION

Installations of social media and Enterprise2.0 software have proliferated within many companies, driven both by employees' experiences of consumer sites such as Facebook and Twitter, and by companies' desires to derive new efficiencies from their knowledge workers. In our research as well as others' [18], researchers found that, as a consequence of the increasing number of choices of information sharing tools, users find it more difficult to determine what tools might be appropriate for a given context. Any new tool consequently has difficulty taking hold, an effect that only compounds with the fatigue of past adoption failures. Evidence suggests that new Web2.0-style tools are gaining wide introduction into organizations, but are not being widely and routinely used by individuals and groups in those organizations[7][14]. A question for the new breed of Enterprise2.0 tools as well as CSCW systems in general is: Do we supplant

existing tools and practices with new ones, or build on what is already there?

Challenges for developing tools for organizational information sharing have been described from many perspectives, including groupware tools [16], organizational memory [2], and expertise location / social matching [28] to name a few. One common theme across various perspectives is the disruption of existing social processes that can happen when introducing new technologies into an organization.

We also know from past research that email is currently an essential communication channel and it is deeply embedded in the workplace [13]. It is part of the social fabric and processes of a workplace. Despite the many forms of sharing now available, we continue to see email as a tool that all organizations adopt for a wide spectrum of collaboration needs [18]. It is pervasive and used daily, including extended usage scenarios such as file sharing or task management. Email continues to be used to distribute documents, hold discussions, and schedule meetings, although it causes problems for information sharing [30]. From a knowledge management and information sharing perspective, email has a number of problems. First, email requires explicit addressing, both to individuals and/or to mailing lists. Focused sharing via person-to-person allows little or no visibility of the content at the level of the organization. The explicit addressing can lock information away among a few inboxes.

Second, mailing lists provide broadcast delivery to a group or whole organization that increases the overall load in reading and coordination [17]. We see noise in 'true spam' and 'not always wanted' repetitive messages, such as project-wide status updates and humor. The sender-controlled nature of email limits the receiver's ability to consume information. Receiver preferences and actions are not used to reduce noise. We need a design that gets the right information to the right people at the right time, without increasing overall information noise.

Refining our research question, do we supplant email with other collaboration means (e.g., will “Social Networks Spur the Demise of Email in the Workplace” [31]) or is it feasible and less disruptive to facilitate organizational sharing by working within the constraints of email?

Here we take the latter perspective, and experiment with a possible solution by proposing the “Mail2Tag” design. We allow people to send a message addressed to any topic of interest in the organization. For example, when interesting information arrives in an individual’s inbox through an incoming message, this can be forwarded to specific others as usual in email, and/or be shared organizationally by sending the content to an email address associated with a keyword (e.g., a Call for Papers for the CTS conference may be forwarded to ‘CTS@share.X.com, where X is the company domain name). This simple process tags an email, associating people (senders, receivers), content (in messages), and topic areas (indicated by tags) together as a shared resource. These tags now serve as a organizational resource, forming an evolving folksonomy of content [26].

In this paper we consider how design is informed by prior work in organizational sharing. We describe a field study of a particular information sharing behavior that we aim to encourage, namely news diffusion in organizations. We describe the Mail2Tag design and findings from its long-term deployment in a company. We conclude with lessons learned and design implications.

## 2. RELATED WORK

We begin by examining prior work on email and other methods used in organizational sharing, focusing on the organizational resource demands and precision of sharing. From this consideration we propose design requirements.

### 2.1. Building on Email

Workers often encounter challenges in sharing information due to the many steps required and the many interfaces available. Researchers [3][18] have observed that workers and groups have many tools available for sharing content such as files, bookmarks, tags, text, photos. This makes it difficult for them to agree on which tool to use. As a result, rather than using multiple dedicated sharing tools, they typically fall back on using email, as the ‘minimum common denominator’ [13][30]. This leads to adoption problem for Web2.0 tools in organizations [7][14]. Our own prior fieldwork with knowledge workers in a large IT services organization, also pointed to similar challenges: too many steps required and too many ‘siloes’ channels for sharing [11].

There are tools, such as Decisiv Email by Reconnind ([www.reconnind.com](http://www.reconnind.com)), which augment work email with automatic data processing capabilities. For example, Decisiv automatically files emails, helps to tag and organize them, and shares them automatically when new team members join. However, this and other tools that add automatic functions to email tend to centralize control on the content and make interaction more cumbersome.

Given the ubiquity of email, several commercial web-based platforms now support the function of sending content via email to a shared repository (see SharePoint, Jive SBS, SocialText, KnowledgePlaza). Some repositories, such as Threadbox ([www.threadbox.com](http://www.threadbox.com)), are even explicitly modeled after email. Threadbox provides a shared web-based inbox. The workers use it to publish and organize in threads their shared email messages, files, and tasks. They can start a new thread by emailing content ([start@threadbox.com](mailto:start@threadbox.com)). The drawback for many of these tools is that the users must remember the specific address or tool for distributing their content. Moreover, the information posted remains generally unorganized unless someone takes the time to structure it. The same limitations applies to similar consumer tools such as Posterous (<http://posterous.com>) and Yahoo Groups (<http://groups.yahoo.com>).

Past academic research has examined augmenting or extending email to promote lightweight forms of organizational sharing. TeamInfo [4], Knowledge Depot [27], Answer Garden 2[1], and MCS [6] all aimed to augment email to build better knowledge repositories. In an example of collocated sharing [10], the wall of a physical workplace is given an email address. Interactive, large screen displays receive content via email and in this context an established practice of person to person mailing was channeled to another outlet.

This research suggests a clear need for reducing the too many steps and channels for sharing. The tools reviewed above suggest that having a close connection with email is a useful starting point to reduce the cost. However, an open challenges for these systems are allowing easy access, enabling low-cost organization of the content, and preserving flexibility and distributed control (as in email) while useful automatic functions are introduced. In the Mail2Tag design we thus propose that tags (describing what is shared), senders and receivers of email (who is involved), and timestamps (when) be used as the key natural organizers of contributed content.

### 2.2. Considering the Weight of Sharing

Researchers have argued that the changes in the infrastructure, including networking, support, and behavior, can affect adoption (e.g., [22]). In a study of

calendar applications, Palen and Grudin [23] observed that key facilitators of adoption “included the presence of an organization-wide infrastructure, integration with email, and substantial peer pressure”, together with the support from upper management, versatile functionality and ease of use of the tools. A success case for a sharing system that was built around existing processes and practices is the Eureka project. Using Eureka, Xerox technicians in the field are allowed to share tips on how to address technical problems. The system extends the prior practice of sharing solutions through informal stories [5].

Software-as-a-Service (SaaS) vendors are proposing heavy-weight web-based platforms such as IBM Lotus Connections [12] and Microsoft Sharepoint [9] as comprehensive solutions for organizational sharing. These platforms include multiple dedicated tools for sharing files, bookmarks, photos, blogs, wikis, and social networking. These platforms appear appropriate for IT-centric, business process management situations, but require a large investment of resources for the organization to install, customize, learn, and maintain. There are certification courses for installing Sharepoint servers, administering their use, and designing and deploying a Sharepoint application. Deploying these platforms requires training for workers and managers to learn (and be motivated) to adopt new sharing tools [22]. A few solutions have been proposed to enable lightweight sharing in organizations, while requiring only minimal infrastructure costs and minimal disruption of existing processes. For example, Raza et al. [24] argue that web mashups can improve collaboration in enterprises, but with a cost in ad hoc programming and maintenance.

In summary, several contributions have pointed to the benefits of minimizing infrastructure costs for changes to technology and people’s practices. A key challenge remains developing tools that are not only lightweight and flexible but also widely visible and support powerful interactions. In Mail2Tag, we propose a lightweight solution by adapting email and social tagging. Email requires neither user registration nor large platform installations. A folksonomy of social tagging is designed to help with maintenance of information over time.

### 2.3. Considering Noise in Sharing

Imprecision in directing the right information to the right people at the right time leads to noise such as unwanted items in the inbox. This results in cognitive overload (i.e., too much information to be processed). The increasing quantity of information that individuals must manage limits their ability to discriminate relevant information and share it. Email is not itself a low noise system. Whittaker and Sidner [29] observed that email overload leads to loss of information and reduced responsiveness.

The broadcasting model of sharing introduces a large amount of noise, as in the case of multiple people subscribing to group, project, departmental, and organizational mailing lists. Users have little or no support for condensing, re-finding, and reusing information from mailing lists [6].

Beyond the obvious implications for the workers’ overload, the exposure to too much noisy content from too many sources leads to loss of specificity and therefore less actionable information. One research focus is in improving targeted and less disruptive sharing through collaborative filtering and recommendations [15][25][27]. Dugan et al. [14] built Blog Muse, a web-based tool that increased the rate of sharing via blogs in an organization. Blog Muse helps to inspire potential blog writers by connecting them with their audience through a topic-suggestion system.

Other tools have focused on reducing the noise in the shared traces left by prior sharing. The Arkose system helps to distill knowledge so that users can efficiently re-find it [20]. Zhang et al. examined how to create and use profiles of experts based on what was shared [32].

In summary, a large amount of noise in sharing leads to loss of relevant information and less effective collaboration. Open challenges related to the noise reduction are how to make the information sharing flow more targeted but still inclusive, and how to facilitate effective refinement and distillation of the traces of knowledge activities for reuse. Mail2Tag should adjust over time to the user’s interests and relationships from his/her history of communications and proactively provide notification about relevant content that is shared on topics of interest for the user. Users should be in control of the frequency of the notifications.

## 3. FIELD INTERVIEWS ON SHARING

To further our understanding and examine a local specific context for organizational sharing, we studied news sharing and diffusion in one company. News is one, specific case of established sharing practice that occurs throughout many organizations. We selected an organization that allowed complete access to staff and support services, namely our own company. This is also the site of initial deployment of the Mail2Tag system described later. The company is an established research organization, having approximately 200 staff members in one location. Most employees belong to an approximately 5- to 10-person group, organized into four larger multi-team organizations. The company uses wikis for project and group knowledge repositories. The project wikis typically receive brief but intense activity (e.g, collecting

web links on a topic), and then lapse into occasional use. Group wikis are updated infrequently, usually when there is organizational change (e.g., new projects and people). External blogs on topic areas promoted by the company are encouraged. Internal blogs receive infrequent use for general sharing on topics of wide interest. Microblogging (e.g., Yammer.com) was tried early, but did not persist.

Note that the specific circumstances of this organization are a constraint of this study. Long term deployment in one organization is very useful for understanding a technology, but is not definitive and extending to other contexts needs to be done with care.

Sixteen interviews were conducted in people's offices and across job types. Two basic questions were asked: How do people send you news? How do you send news to others? We found email is indeed the channel of choice for news (16 of 16 responses). Although we find that news arrives and is diffused by many channels, with different levels of timeliness and audience, the primary means of communication is email (either directly or via company mailing lists) and face-to-face conversations in offices, hallways, and at lunch (14 of 16 responses). There is some penetration of social media use (e.g., Twitter, blogs, given in 7 of 16 responses).

News follows people's social/work networks, and there is a strong effort to pass along only news seen as relevant to others. We see people filtering of news streams for their peers as a part of their ongoing conversations at work: e.g., *"I have to read it [news related email] to find out if it is unique enough. I do try to filter if it is worth forwarding. There is a huge quality assessment thing, because I would hate clogging peoples' streams. I would probably send it to people who are actually engaged in a conversation of this type"*. Further, not only did people filter for others as a matter of practice, they expected others to do so for them: *"All is biased by what I would expect. If you send me something I would expect that you probably would have thought [about] why you sent [it to] me"*.

People also arrange news delivery to be readily accessible or 'in the path' of themselves or others.: e.g., on how others position news for them: *"I have found ... people are reluctant to give news. So I have a prompt on my calendar every Wednesday, I'll send email every week say "would you mind mentioning this at our lab meeting"*.

Through these various processes aimed at people's own news consumption and delivery to others, we can see that the distribution network built up over time is a parsimonious one, meant to convey value quickly and in line with how work gets done. News not travels along social networks in the organization [8], but also there is a strong effort in passing along news that is known to be

relevant. People are conservative in their choices. We propose that Mail2Tag bring the access to sharing closer to the point of need [16], and for news this is email. The interface is well understood and there is a practice of sharing to build on. The infrastructure is already established for groups and organizations. Overloading is a concern and hence noise reduction is a priority in design.

## 4. THE MAIL2TAG SYSTEM

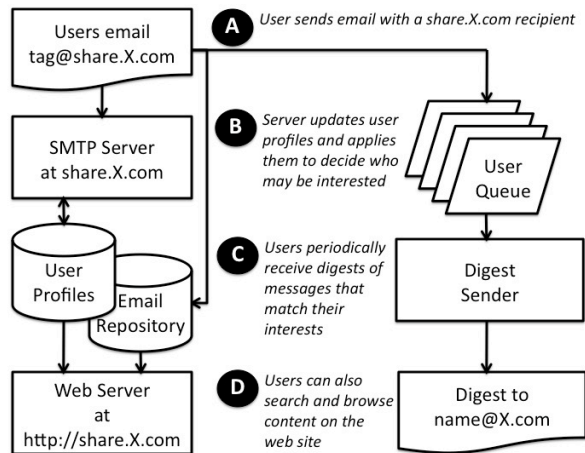
We have built and deployed a persistent information sharing system called Mail2Tag, leveraging email-addressable topic tags. In this section we detail the design, concentrating on the points raised above, including:

- Bring access to sharing functions close to email;
- Offer a socio-technically lightweight solution;
- Evolve the system over time to user interests and relationships, derived from the history of communication; and
- Reduce noise by proactively and adaptively providing notification about relevant content.

**We enable interaction through email.** Users mainly interact with Mail2Tag through email, both to share information through the system and to stay informed with what others share. In Mail2Tag we enable users to target the email for sharing, thus making sharing easily accessible in the flow of routine email triage. Triage is a common behavior for coping with messages arriving in one's inbox [21]. Users triage emails by scanning through Subject, Sender, body text, etc. Users react to email in various ways, and one reaction is to share the messages with someone else. When sharing the message, the user can target it at another person or a mailing list, or a topic tag. For example, if an arriving email message is about the topic 'marketing' then one can hit 'Forward' in the mail client, type in the address desired and CC to "marketing@share.X.com", where X is an organizational domain name. This is illustrated in Figure 2, Step A. When a message is sent it goes to the directly-addressed persons and is also posted into the Mail2Tag system. Mail2Tag then decides who else might be interested in the content (Figure 2 Step B & C).

**Email acts as a bridge to getting user-generated content, tagging it, and allowing 'Web2.0'-style uses.** We provide an alternative web interface for browsing and searching contributed content in pull-oriented fashion if desired (Figure 2 Step D and Figure 3). The messages to share.X.com are organized in ways that are similar to social tagging sites. Each person gets a page of all messages that have been targeted at her. Similarly, each tag, user, and posting gets its own page. Users can then navigate the shared information by people and tags.

An overview page (e.g., <http://share.X.com>) is divided into sections for top tags, top contributors, and recent posts (i.e., incoming messages to the system). Each post is marked with who posted it and the associated tags. There is a dynamically generated Web page for each posting, as we have set up templates to make a posting appear like blog entries. This lists the content of the posting and its metadata (who posted, when, and what other tags are associated with the posting). Tags are used like blog categories with related postings having the same tags being listed on the side of the page. The posted entries may be edited in a manner similar to wiki software.



**Figure 2. The Mail2Tag architecture incorporates services for organizational sharing into email without modification to existing email clients.**



**Figure 3. Content mailed to Mail2Tag is presented as Web pages in forms familiar to users of social websites. Private information has been blacked out in the figure.**

Dynamically generated user profile pages show emails that have been created by, comment on, or directed at the indicated person. A tag cloud of the associated tags gives viewers some indication of the user's interests according to the collective consciousness of the organization. Similarly, topic tag pages present a view of one topic of organizational interest. A tag page shows the latest posts to a tag and the tags most related that tag (based on co-occurrence with other tags in postings). Other social features include showing reply messages as comments in the Web view. A 'thank you' button similar to 'like' in Facebook or voting in other systems is provided. Recall and discovery are supported by searching and pivot browsing interfaces on the website (Figure 2, Step D). When searching and navigating the information space presented in the Mail2Tag Web interface, opportunities are also provided to users who can contribute further on each topic. This repository, accessible by anyone behind the firewall, also becomes a destination indexed by the company's official intranet search tool.

**Mail2Tag provides a lightweight infrastructure for sharing.** The email interaction is implemented as an SMTP server and can be hosted anywhere in the organization's network (e.g., a host named share.X.com). The system makes associations between people (sender and recipient) linked in the Mail2Tag database to content and tag words. A user profile is built up over time, building a network of people associated with tags and content through the normal practices of sending and receiving email. As an interesting side effect of capturing the tagged email traffic, our system also constitutes an emergent folksonomy [26] of organizational expertise and interest. The mail server, repositories, and web server with dynamic page generation are typical open-source-based web implementation: Python ([www.python.org](http://www.python.org)) using the Django framework ([www.djangoproject.com](http://www.djangoproject.com)) and the PostgreSQL database ([www.postgresql.org](http://www.postgresql.org)).

**We have designed an adaptive digesting capability to support noise reduction.** People periodically receive a digest email (Figure 2, Step C) at an interval of their choosing. A user-configurable setting limits the rate of notification of new posts, with a default of no more than one notification in any six-hour period (most users keep to the default). If multiple notifications are queued for a user they are condensed into a single digest email containing links back to the web site. If only a single post is queued it is forwarded in its entirety.

A "topic profile" for each user is automatically built by the system over time (Figure 2, Step B) by examining the emails that are targeted at a user. The intuition is that if a person has been targeted by many emails that use the tag 'Python' then they are likely to be interested in future

emails about 'Python'. Since the topic profiles naturally evolve over time, the system provides a self-updating, customizable filter for shared information. The user topic profile tunes the delivery of posts through digests, feedback messages from the system about recent activity, and periodic summaries of system activity. For digesting, new posts are distributed only to people whose tag profile overlaps with at least one of the posted tags. Other events such as page and tag edits and comments are only relayed to people already explicitly associated with a post.

When users address a new post to the system they receive a feedback email thanking them for their contribution and detailing the effect of their action: who may see it in their digest; what similar posts already exist; suggested tags that are relevant to the content. Replying to an existing thread does not trigger a feedback email. Each week people who have been active in the system recently receive a short summary of the week's activity (how many times each of their posts was viewed, who posted the most content and their top tags, and most popular tags overall). The timing of these messages has also been designed to reduce noise by capitalizing on other signals of interest in the system.

In these ways, even if a person has not been explicitly included in an email message that also includes a Mail2Tag address, they can still be exposed to relevant content. Furthermore, anyone has the opportunity to see the message by browsing and searching the Web interface.

## 5. DEPLOYMENT

Mail2Tag has been deployed in a working organization now for 21 months and is still in use. The system first became available for limited use in December 2008 by a small team of users. Invitations for general use were announced in June 2009 (as tags.X.com) and a second release of the system with interface changes and rebranding of the server to its permanent name, share.X.com occurred in August 2009.

To date, deployment shows usage in which 25% of the employees have contributed content (mean 13.8 posts, min 1, max 279, SD 42.2, median 2) and 75% have received emails associated with the Mail2Tag system (through CC activity and digests). 70% of employees have visited the Mail2Tag Web pages in 10541 visits (mean 68.4 visits, min 1, max 2755, SD 276.7, median 5.5). In all these numbers we observe a typical 'power law' distribution of social media usage [19] with a few contributors being very active and a longer tail of others interacting with the system less actively. These results are favorable compared to other enterprise deployments of social sharing.

An example deployed usage illustrates the tag topic profile and noise-reduction features of the design. Mail2Tag supports the accumulation of both people and topics over time, and lets the topic-interest affiliations of people accrete as a course of their normal email traffic. One case in point is the Ruby-on-Rails (ROR) group that has formed around a web software platform of interest in the company. As shown in the table below, the process was started by an initial email query from one interested person to another along their social network at work. When the message addressing starts to include Mail2Tag addresses, then the group starts to form as shown in Row 2 of Table 1. Over several steps, we see how the conversation evolves to include more people that might be interested in Ruby-on-Rails. The CC practice in email accumulates people of interest as the emails travel along social network links.

| Addressing in X.com                        | ROR group members | Message content  |
|--|-------------------|--|
| From: L<br>To: R                           | {empty}           | "I wanted to use Ruby on Rails. Have you used it?"   |
| From: R<br>To: N,<br>CC: L,<br>ROR@share   | {L,R,N}           | "I've never used Rails, sorry. I have a feeling there are some Rails people [here] though. N, have you?" |
| From: N<br>To: R<br>CC: P, L,<br>ROR@share | {L,R,N,P}         | "Nope, that wasn't me. I dabbled in Django (the python equivalent). Maybe P knows?"                      |
| From: P<br>To: N<br>CC: R, L,<br>ROR@share | {L,R,N,P}         | "I haven't used RoR myself, but I am interested in learning about it"                                    |

**Table 1. Mail2Tag groups accumulate in the course of normal email traffic to become a permanent resource.**

Mail2Tag also creates a 'topic space' that functions as a group memory device and expertise and shared interest location that reduces noise in sharing. One source of email traffic that is commonly accompanied by an apology for redundancy is the 'Call for Papers' (CFP), in which conferences and funding organizations broadcast their interests in topics. One use that has emerged in Mail2Tag is the redirection of this email traffic into the less intrusive communication channel provided by the system (e.g. using the address cfp@share.X.com, or for the Intelligent User Interface conference this might be cfp+ui@share.X.com). In this case, not only are people incorporated into the 'cfp' interest group through CC activity, but as the tags become known, emails are sent directly to the tag address, and not adding to inbox noise. Further, CFP emails consist of various domain topics that are picked up as added tags such as 'cleantech', 'IUI' (Intelligent User Interfaces), 'robotics'. By browsing through the 'CFP' tag, one can get a sense of the research interests around the organization. Librarians of the

organization can then compile a master calendar of deadlines. People with specific interests can look under just the relevant topics, with the search function.

## 6. DISCUSSION

We conclude with design experiences gathered through the deployment and refinement of the Mail2Tag system.

**Mail2Tag supports implicit organizing.** In work there is often little time for organizing, but time is usually made for communicating. The system we have presented here is self-organizing and self-evolving, both in presentation of the content and the formation of people into interest groups. Content is implicitly organized for later use by tag and time. People are implicitly associated by the traces of their main work communication practices --- picking receivers for messages. Within the daily mundane communications we see that Mail2Tag leverages a unique source of implicit knowledge in an organization -- a person becomes associated with a topic of interest not by maintaining a self-profile, but by the knowledge of others concerning the expertise in an organization. This connection is made as a by-product of a simple CC in a history of email messaging. Because of this simplicity, the chance for noise created by the easy opportunity to share must also be managed, as we have discussed above.

**The system is designed to go beyond mailing lists.** Email can be seen as a sender-controlled system (you do not have control over what's directed to your inbox). We seek to put information receivers more in control. Tags create a shared interest spaces that are easily added to by anyone with email access. In a single email, users can both target information to particular persons (when they are confident that person would be interested), and to the tag topic space. We find the Mail2Tag process differs significantly from the use of 'mailing list', namely, an explicit collection of addresses. Mail2Tag sends only digests and has an adaptive algorithm that sends with a frequency appropriate to users' level of engagement with the system. For a sender, this ensures that contributions will not annoy receivers, and hence increases the likelihood of sharing. Finally, it is the association of people to topics of interest over time through normal email activity that builds the Mail2Tag interest lists.

**In deploying new technologies, compromises in design are a reality.** We chose not to modify email clients in support of the principle of lowering social and technical infrastructure costs. There are some interaction costs to this choice. First, new tag generation is not supported by auto-completion or contact lists. In future work, we intend to look at modifications to email clients for tag recommendations. Second, by adopting the email interface, we inherit its issues, one of which is the care one must have in using Reply-to-All. Just as people learn

the social conventions of taking care in authoring a reply that goes to all, people must think about the way messages will persist in Mail2Tag. This change requires attention and adaptation time from the users [22]. To enable users in correcting mistakes, we added the 'Edit this Post' feature in the web interface.

**Lightweight design is both social and technical.** By focusing design on optimizing the main organizational communication channel, we get effects on group memory and social matching; e.g., one interview participant noted the role of email in group and organizational memory. In Mail2Tag we put the point of memory capture close to the flow of the work process -- where that work intersects email [2]. Indeed, one kind of mailing to Mail2Tag is hints and tips [5] on topics such as 'Python' and 'XML'. Researchers have addressed a broad range of techniques for matching people, including social recommenders, implicit social matching, and opportunistic matching [28]. In Mail2Tag, the model for matching people to topics of interest is built up opportunistically and implicitly as people communicate normally in email.

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