Multimedia Fliers: Information Sharing With Digital Community Bulletin Boards

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Abstract. Community poster boards serve an important community building function. Posted fliers advertise services, events and people's interests, and invite community members to communicate, participate, interact and transact. In this paper we describe the design, development and deployment of several large screen, *digital* community poster boards, the Plasma Posters, within our organization. We present our motivation, two fieldwork studies of online and offline information sharing, and design guidelines derived from our observations. After introducing the Plasma Posters and the underlying information storage and distribution infrastructure, we illustrate their use and value within our organization, summarizing findings from qualitative and quantitative evaluations. We conclude by elaborating socio-technical challenges we have faced in our design and deployment process.

Introduction

Technological advances in networking and display technologies, combined with cost reductions, have resulted in the placement of many large-screen, digital displays in public places for advertising and information distribution. A recent example is the AdSpace Network's CoolSign, which "utilizes multimedia displays to offer advertisers a vehicle with the impact of print, the pull of television, and the immediacy of the web." Most of these systems present information on minimally interactive displays and are intended for distributing carefully crafted, broadcast content. Within the workplace, and more informally, large screen, publicly visible displays are being used as memory aids (e.g. Fass *et al*., 2002), and to offer awareness of colleagues' activities within small working groups (e.g. Greenberg and Rounding,

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2001; Huang and Mynatt, 2003). Capitalizing on touch-screen interaction capabilities, public displays are also being used for focused, task-centered, collaborative work (e.g. Guimbretiere *et al*., 2001; Klemmer *et al*., 2001; Pederson *et al*., 1993; Russell *et al*., 2002; Streitz *et al*., 1999).

In this paper we describe our work on the design and deployment of the Plasma Posters, large screen, digital poster boards that display community-generated interactive, multi-media content in the physical environment. Inspired by the use of physical poster boards in social spaces (see Figure 1), such public community technologies are designed for people who, at least on occasion, occupy or move through the same geographical location. They blur the notional "boundary" between virtual and physical locales of communication, and take advantage of the fact that relationships usually take place offline as well as online (Wellman, 1999).

The intent behind the Plasma Posters is to stimulate unplanned social interactions around digital content and thus provide opportunities for discovery of shared interests. Such conversations are central in establishing and strengthening social ties (Granovetter, 1983). This work sits within the same design space as research carried by Houde *et al*. (1998) who projected a digital newsletter created by members of a research group into a common gathering space, and Snowdon and Grasso (2001) who describe the "Community Wall" (CWall), a community bulletin board that displays community rated research papers and news in public spaces.

Figure 1: Community boards: in the launderette; on the street; in the workplace

In the sections that follow, we present results from our fieldwork on the use of informal poster boards, and describe the design, deployment and use of the Plasma Posters within our organization. We conclude with reflections on socio-technical challenges encountered in this deployment, and offer some future directions for our work.

Fieldwork: Information Sharing with Public Displays

Posted paper fliers are a mode of asynchronous communication that utilize the physical environment as their canvas or stage. They take advantage of the movement of people through social spaces, and are thus part of "the interplay of human activity with the physical place" (Jacobs, 1999, p6). Such poster boards are part of the fabric but not the infrastructure of a social space; in Brand's terms the poster boards are part of the malleable "space plan" of a space, with the posted fliers part of the "stuff" that "twitches around daily to monthly" (Brand, 1994, p13). However, while there has been much written about designing the physical environment to encourage interaction, social engagement and community identification (e.g. *streets*: Jacobs, 1961; Jacobs, 1999; Whyte, 1971; *public spaces, bus stands, waiting rooms, interior gathering places*: Alexander *et al*., 1977; *work places*: Albrecht and Broikos, 2000), there has been little written about the placement and use of community poster boards within these social spaces, or on the effect of such community poster boards in promoting social ties and encouraging community identification[1]. Therefore, our design process began with consideration of information sharing within communities, and in particular the use of physical poster boards in such communication practices. Observations from two field studies are presented below.

Our first study was intended to elaborate a design space for the design of digital poster boards, based on consideration of the placement and use of physical, poster boards in public settings. For the purposes of this study we defined "public" to be on a continuum from "unrestricted" (e.g. streets) to "restricted" (e.g. small group, closed workplaces). The second study focused on our own workplace, the site of our first technology deployment. Observations from this study were aimed at generating specific design instances as appropriate for our use community, but also to establish whether there was a 'natural' role for digital, public, poster boards as a content sharing technology within our lab; that is, if there was a potentially good "match" between the technology and communication styles within our lab (Bly and Churchill, 1999; see also Harper and Carter (1994) for an instance of a bad "match" between a social milieu and technology features).

Study 1: Community bulletin boards in public spaces

We investigated the use of poster boards in unrestricted, "open", public spaces (e.g. cafes, sports clubs and streets) in three local areas (Palo Alto, and two districts of San Francisco), talked to local inhabitants, and interviewed six local community members in depth about their use of and views regarding public poster boards. In

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[1] However, much has been said about the vital role of community print media in the form of local newspapers (that include classified ads, which in many instances are the print version of community bulletin board content) in this regard (e.g. Stamm and Fortini-Campbell, 1983; Tripp, 1994).

addition, we observed the use of public poster boards within three workplaces as instances of content sharing in more restricted public settings (a research center, a technology sales office and a technology start-up). Our observations focused on: (1) board location and form/degree of access; (2) content analysis of posted material; (3) usage (observing people reading from and posting to the boards); and (4) people's perceptions of poster boards.

Observations of "open" area boards

Poster boards are typically placed (1) where people are likely to have time on their hands while they wait for some other event (e.g. doctor's waiting rooms, train and bus stations, bus stops, barber shops, launderettes); (2) where people intentionally go to relax, pass the time and socialize (e.g. cafes, see Oldenburg, 1989); (3) where people go to intentionally seek information (e.g. local libraries, community center information rooms); (4) where people routinely go to pursue leisure activities (e.g. tennis clubs, gyms, community event centers, Oldenburg, 1989); and (5) where people routinely walk (e.g. corridors). Poster boards vary in size; this has consequences for how content is displayed. Unsurprisingly, materials for poster boards and posted content vary depending on location (more cork indoors; more plastic fliers outdoors). Some boards are more physically accessible than others.

Interviews with local residents indicated that poster boards serve an important communication function within communities. They provide a means for people to seek and advertise viewpoints (e.g. support for political candidates; rejection of current economic policies), activities (e.g. join our band), events (e.g. come to the local Arts and Wine Fair; invitations to political rallies) and services (e.g. babysitter wanted, carpool partners sought). Community members felt these boards provided an important function in demonstrating the vitality of their neighborhoods.

Loosely speaking, the boards provide a sense of the community "personality", reflecting the preferred activities and the needs of the local inhabitants. Content analysis revealed that poster boards in the Mission District of San Francisco advertised dance and cooking classes, English lessons, yoga classes, religious gatherings and political meetings, while nearby Noe Valley poster boards sought and advertised babysitters, dog walkers, hiking partners, lost pets, Pilates classes and, again, yoga classes. Content variations can also be seen at a finer grain, by local context within neighbourhoods (e.g. dance class posters near to dance studios), and in terms of *temporal scope of relevance* (i.e. some things are only relevant for a short period of time while others offer content that has ongoing relevance). Posting genres were visible: 'accommodation wanted' ads tended to be on small cards; announcements for events tended to be larger and on colored paper; items for sale were often accompanied by tear-off tags with phone numbers and email addresses; lost pet fliers were usually accompanied by a photograph. Posted content varies in terms of its *intended outcome* with regard to others' actions; some fliers solicit action (come to the dance class), some solicit transactions (buy my car), some seek

information (anyone seen my cat?), and some inform (stray cat found). The physical properties of fliers often relate to these intended outcomes (e.g. multiple postings and tear-off strips indicate content is to be taken away from the board). Posting types therefore have different affordances for action (Norman, 1988) and thus engender different (re)actions from readers (e.g. reading, writing down information such phone numbers or event times, referring content to others).

Although content is usually designed to be eye-catching and noticeable, postings vary visually; some boards impose *branding* (some poster boards require fliers to be in specific formats) while others do not (fliers show a great deal of creativity and are highly *individual* or personal in terms of size, colours used, images used, fonts, use of tear-offs strips, etc). Related to the last point, forms of moderation for poster boards map to those for online electronic bulletin board systems: from *formal and moderated* (items can only be posted by asking a "gatekeeper's" permission; someone regularly "garbage collects"; items tend to be in prescribed formats), to *reviewed and informally monitored* (checked over regularly; sometimes cleared by various people), to *open* (anyone can post anything, in any format, anytime; old posters seldom cleared off). Posted items in the latter two cases tended to demonstrate the greatest variety.

Observations of "closed" area, organizational poster boards

Informal poster boards within three local organizations (two research laboratories (~200 people and ~40 people) and one ~40-person technology start-up) also varied between moderated and open. Content was often related to competitors' activities, conferences, upcoming events, and recent news articles. Even in the two smaller organizations, people seldom had any idea of who had posted informal content. People were positive but less overwhelmingly enthusiastic about the presence of poster boards than the "external" community members we interviewed. Items were posted when persistent visibility was deemed to be more effective (unlike emails), or when materials already existed in paper form (e.g. photographs of holiday home rentals or cars for sale). The degree of enthusiasm appeared to correlate to the size of the organization. People in the smaller organizations were more likely to send email or talk face-to-face, so felt poster boards were simply an addition, and that other means of contact were likely to be used. People in the large organization felt inhibited sending emails to people they didn't know, being uncertain of others' standing in the social hierarchy or their tolerance for unsolicited emails. Hence, they felt that posting content to poster boards was more socially appropriate and did not risk being an unwanted intrusion.

Summary

Our observations of community boards in public areas and in organizations suggest a number of important dimensions along which boards vary. Dimensions relate to (1) board location, (2) social and material characteristics of boards, (3) social, material (particularly affordances for (re)action), and textual properties of content, and (4)

people's actions with regard to content (considering readers and administrators, and including placement, administration, moderation and consumption).

Study 2: Information sharing within FXPAL

FX Palo Alto Laboratory (FXPAL) is a software research company based in California, and is a subsidiary of Fuji Xerox, Japan. At the time of our study, there were 34 full-time employees at FXPAL. Twenty-five are full-time researchers drawn from diverse disciplines (e.g. computer science, psychology, engineering, linguistics), 6 are administrative staff and 3 are technical support staff. In addition, there are 14 contractors/consultants, in full and part-time capacities. Student interns and visiting scientists are also present during summer months. Researchers work in separate project groups; there are 7 such groups, with little overlap in membership. The lab is located on the first floor of a two-storey building. All full-time researchers have their own offices. Contractors/consultants have offices or booths, and interns have either booths or desk space within a large, shared room.

Our study was in three parts. First, we mapped the lab space using floor layout charts. Then we observed/photographed activities in public areas, noting people's movement through the building. Following, this we engaged 17 people in a photograph and text diary study with subsequent interviews about their online and offline information sharing practices within the organization. Two administrative staff, 2 summer interns, 2 contractors/consultants, 3 support staff and 8 researchers took part in the study. Interviews were semi-structured and lasted between 30 and 90 minutes.

Observations

In accord with other studies, our observations confirmed that people are not always at their desks, but are often locally mobile, moving physically around the building (Bellotti and Bly, 1996). People engage in "water cooler", informal conversations (Whittaker *et al.,* 1994). Given our interest in content sharing in public spaces, we analyzed the use of *corkboards and paper postings*. There are 7 corkboards in the building; most are in corridors, one is located in the kitchen area and another in the mailroom area. As with the external community boards, each poster board has a different "personality"; one is dedicated to the display of items that are legally required to be on view (located in the mailroom), one is dedicated to newspaper clippings of interest (e.g. from the Nikkei Weekly), one is dedicated to conference and journal announcements, and the others are more informal, displaying jokes, ticket reductions for local events, and lunch menus.

Our analyses demonstrated that people's interest *is* piqued by others' postings in the physical environment. Most of our interviewees thought they were a valuable resource and that the environment would be "sterile" without them. Boards that changed frequently were deemed to be most interesting and eye-catching, and that

posted content was considered to reflect the "identity" and "milieu" of the lab. Events, such as presentations and visitors, and items posted on corkboards occasionally spark *in situ* conversations. People said they were sometimes pleasantly surprised to discover mutual interests with other colleagues when such conversations took place. The most read corkboards were those in areas where people were waiting or engaged in low concentration tasks such as waiting for printouts or coffee to brew, although hallway corkboards were also glanced at and sometimes referred to as people moved about the building. The 3 that are posted to and read most frequently are the conference announcement board, the newspaper clipping board and the kitchen-based, informal board. Four perceived problems with corkboards were expressed: (1) the presence of out-of-date materials – it is sometimes hard to tell what was still relevant; (2) interesting content sometimes "disappears" before it has been read; (3) it is hard to tell who posted material, so follow-up conversations are difficult to initiate; and (4) information on corkboards is not easy to copy and/or easily access digitally for later follow-up (e.g. URLs). This comment clearly reflected the fact that most information sharing occurs via computer. Therefore, to provide context for the use of poster boards as an information sharing resource we also interviewed people about other methods for information sharing.

As suspected, online sharing is strongly preferred, being seen as low overhead, given most people are working at their computers most of the time ("it doesn't take much effort to forward a link"). However, such online sharing tends to occur between members of *established* project and social groups. Little social mingling occurs through electronic media, and few opportunities arise for serendipitously discovering shared interests. *Email* is by far the most frequently used means of communication, although some people complained about email overload (see also Whittaker and Sidner, 1996). Email is used for coordination, to share formal and informal information, send announcements, and share ideas and interests. Most emails are sent to small sub-groups and targeted individuals. When interviewees were asked about sending company-wide emails on things that may be of general interest, a reticence was apparent. Email is perceived to be socially risky and a potential intrusion into people's personal digital space, so people err on the side of caution. As one person phrased it, "I don't want to fill other people's email boxes up with things that may be of peripheral interest to them. People get irritated". *Intranet web pages* are used for general administrative purposes and within projects for recording activities and research results. People seldom browse the intranet to learn about projects and colleagues' interests (one new person to the organization reported doing so). Use of the intranet tends to be for directed information access. *Presentations, seminars and reading groups* are used to share ideas about research areas and research results. On occasion, supporting materials are disseminated. Presentations tend to be company-wide, while participants in seminars and reading groups tend to be members of established teams. *Chats* in the hallways are a means of hearing about formal and informal information. These take place where people are waiting (e.g. the kitchen

area, by printers), passing time (e.g. by the magazine racks) or doing low concentration tasks in public areas (e.g. photocopying, checking mailboxes) (Whittaker *et al*., 1994).

Summary

Study 2 revealed that communication and content sharing with colleagues outside project and social groups is seen as valuable within our organization, but does not occur as frequently as is desired. People are routinely at their desks and accessible via online communication tools, but are also mobile within the building. Although all areas of the building are passed through, there are clearly identifiable gathering places, and places people spend time "idling" or waiting. People commonly share digital content within established groups. People seldom post physical fliers because of the "overhead" of producing them and/or placing them, and because digital communication tools are literally "at their fingertips". We concluded that digital poster boards could represent a new genre of informal, "lightweight" communication medium within FXPAL, leveraging the existing bias for electronic communications, and providing a less intrusive, more public method (not direct to others' email InBoxes), for sharing content. We predicted content posted on such bulletin boards would not have been previously shared lab-wide, and would provide new opportunities for conversation between lab members.

Issues for Design

Study 1 illuminated a number of dimensions along which public poster boards and practices surrounding their use tend to vary. These dimensions were used to elaborate a design space for creating and placing digital bulletin boards. Study 2 suggested digital bulletin boards could have a place within our organization. Specific observations from this study were also used to refine, elaborate and instantiate design possibilities raised in study 1. The following design guidelines were generated and characterized according to the areas identified in study 1: board location; social and material characteristics of boards; social, material and textual properties of content; and actions on content.

Location options are somewhat limited given digital bulletin boards are more fragile than physical bulletin boards. Whilst acknowledging that constraint, place digital community bulletin boards in relatively high traffic areas and in spaces where people may be passing by, waiting, "idling" or socializing. Be aware of interactions between location, content type and people's actions on content (e.g. directed information seeking versus noticing-in-passing as part of "everyday life information seeking" (Savolainen, 1995)). Consider ease of (physical) access to boards for reading (make sure people can reach interactive content), and for posting (i.e. make posting low effort by using tools for content sharing that are already familiar, such as email and the Web; see also comments by Houde *et al*., 1998).

Boards must be interactive to maintain the feeling of direct interaction with content. Design interfaces to emphasize content and for viewing in public places; move away from the desktop metaphor of personal computers. Board size (as with physical poster boards) restricts what can be shown at one time; design interfaces that cycle through information. Allow people to easily see content that is currently stored in the system but that may not always be visible; that is provide an easy way to get overviews of what has been posted.

Content must be attractive, and take into account screen resolution. Design inviting interfaces where content changes regularly, and make content easily readable from a distance. Digital content may include animation and interactivity; investigate what is likely to be posted and design to support as many file types as possible for the context of placement. Consider providing for author personalization in content appearance (e.g. personal "skins" around content or fonts), and/or possibilities for imposing board owner "branding"; consider trade-offs between these two models for the specific context of placement. Develop easily recognizable genres for different forms of content.

Practices around content must be taken into account. Provide a means for digital fliers to be commented on. Provide a means whereby postings of interest can be easily "taken away" and shared; i.e. printed or forwarded (to others or to oneself). Since digital content can easily be stored, provide a community repository or memory of postings that may be browsed after public showing of the content has expired. Unlike paper flier content, digital information can be accessed from distant locations and may require reformatting for other devices. Associate content clearly with people who have authored/sent that content to encourage communication between people; this has the added benefit of introducing social accountability which may prove a deterrent to posting "inappropriate" content. Provide means for content to be grouped and associated. Explicitly consider moderation policies; that is, consider restrictions on who can post, and how posting permission will be administered, and whether content will be monitored. Support easy administration and garbage collection of posted content, both for system developers, and for community members.

In the next section we describe our initial prototype, the Plasma Poster Network, where a number of these design guidelines are instantiated.

The Plasma Poster Network

Plasma Posters are plasma displays with interactive overlays that enable direct touch interaction. We placed three Plasma Posters in our lab, one in the kitchen area, one in a foyer and one in a hallway (see Figure 2). Inspired by the aspect ratio and layout of paper posters (Timmers, 1998), Plasma Posters are oriented in portrait format, distinguishing them from other plasma displays. Underlying the Plasma Posters is the Plasma Poster Network, a content storage and distribution infrastructure that posts content to all registered Plasma Posters. We first describe the interfaces that have been

iteratively designed over the last year to suit the needs of our local community members, then offer a brief overview of the underlying infrastructure.

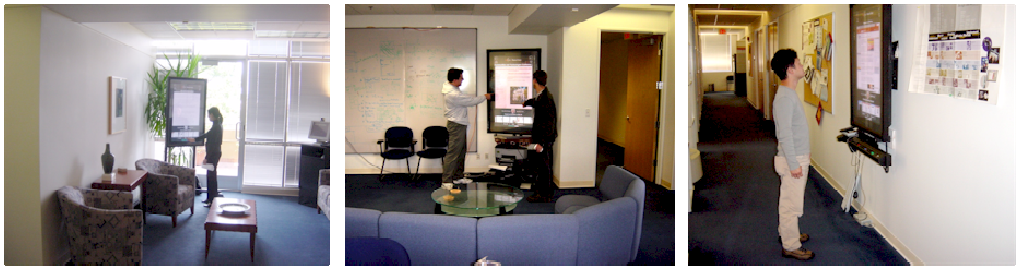

Figure 2: Plasma Posters are located in a corridor (left), a foyer (middle) and the kitchen (right)

Content, Interfaces and Reading Practices

Posting Content: The Plasma Poster Network stands in contrast to the deployment of advertising bulletin boards and digital poster boards, where non-interactive content is centrally authored and/or moderated, broadcast and displayed for an audience of consumers in public spaces. Rather, content that is displayed on the Plasma Posters is generated from two sources: content that is explicitly posted by individuals, and content that is automatically retrieved from selected intranet Web pages (e.g. announcements of new technical reports, announcements of upcoming meetings). To support the former case, we have implemented applications that allow authenticated community members to email items as attachments (text, URLs, images, digital movie clips) or post items from a Web. In using familiar tools like email and the Web, our intention has been to dovetail with existing content sharing tools and practices.

Displaying Content: Figure 3 shows the current "PosterShow" interface. The image on the left is a posting from a traveling colleague who has emailed images and some accompanying text as commentary. Any number of pictures can be posted; once displayed they can be zoomed, reduced and dragged. The image in the middle is posted text that has been formatted by the author. The image on the right is of a URL. Content can be scrolled and all links are live. Postings are by default removed after 2 weeks, but posting duration can be manually set. All postings and relevant meta-data (e.g. date of posting, duration posted and comments) are kept in the user's personal profile, accessible from a Web page, so old postings can be reviewed and reposted.

Reading content: Interactive, multi-media content on large displays in (relatively) public spaces is a different form of reader engagement with text than reading personal content from paper (O'Hara, 1996; Adler *et al.,* 1998) or from a personal reading appliance screen (Schilit *et al.,* 1998). However, analytic categories discussed in these contexts map fairly well to interaction with content on physical public poster boards (e.g. goal or task driven: skimming and active reading; undirected: browsing).

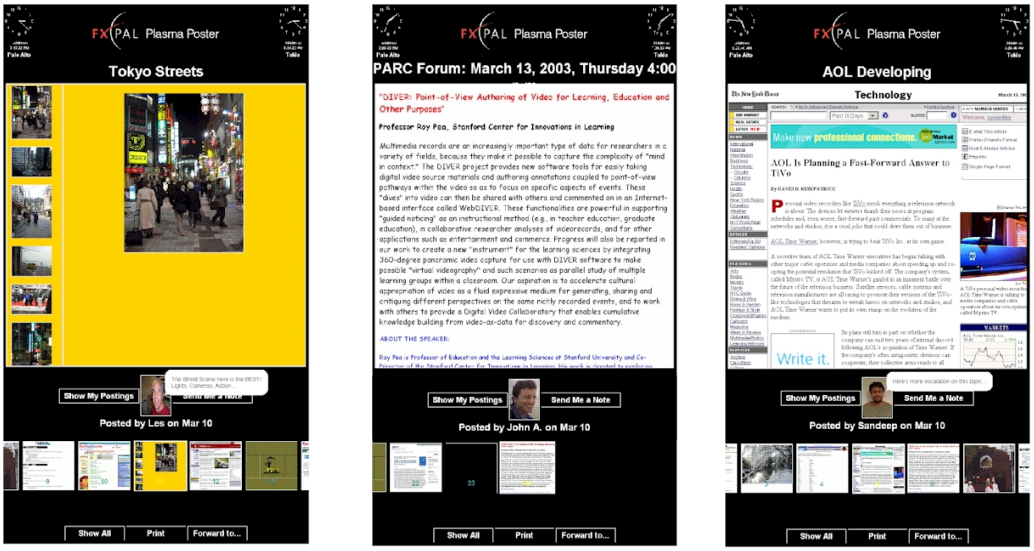

Figure 3: Examples from the "PosterShow" Interface: posted images, text and a URL. Author comments appear in speech bubbles by their photographs. Other content appears as thumbnails below the currently displayed 'main' posting. Bottom buttons are for overviews, printing and messaging.

Therefore, we have designed for the following forms of engagement with content:

(i) *peripheral noticing.* Public displays are a form of peripheral technology – until something catches one's eye when attention becomes focused and cognitive engagement with the text ensues. In the design of the Plasma Posters, effort has been expended in designing content to be visually attractive and to invite observation and interaction; display colors are selected to stand out in the local lighting conditions, animation and movement in the interface are supported, and large fonts give the gist of content from a distance. We take advantage of the dynamic properties of digital media; postings are cycled through automatically one at a time and displayed for 60 seconds. Given our focus on social networking and information sharing, all postings are augmented with contact information of the person who posted the content, the date/time of posting, and any additional audio or text commentary.

(ii) *(inter)active reading.* On traditional poster boards people manipulate posted pages on physical poster boards to be able to read content (lifting, moving aside), and take postings away to read later. On the Plasma Posters, content that is displayed can be *paused*, *scrolled* and *printed*. As noted, all interactions are touch-screen; interfaces have been designed to remove the need for virtual or physical keyboards. Touching the display (e.g. when scrolling) or selecting the pause button reinitiates the 60 second timer. Given digital content is hypertextual, we support the following of live Web links.

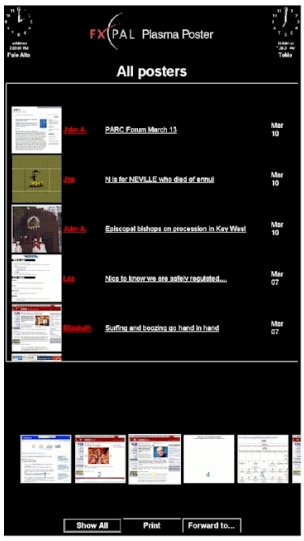

Figure 4: Scrollable content overviews by person, by posting date and by content help readers at the Plasma Posters browse posted content

(iii) *active browsing and searching* People remove physical postings to see what lies beneath. When they have noticed something previously, they sometimes come back to explicitly look for it. On the Plasma Posters, buttons are available for manually moving *forward* and *backward* through upcoming and previously displayed content. Browsing and navigating all items in the current list of postings is possible using with the *overviews* (Figure 4).

(iv) *messaging.* People remove physical postings to give to others, tear off tags and note down phone numbers, URLs and email addresses from physical postings for later follow-up. By selecting the 'forward' button and member photos from the member directory, items displayed on the Plasma Posters can be *forwarded* to one's own registered email address and/or to other people who may be interested. Comments may be emailed to authors[2]. As noted, content can be printed.

Implementation: Parsing, Storing and Distributing Content

The Plasma Poster Network is a client-server system that has been designed to make it easy for content creators to distribute information to their community. Server components provide the collection and hosting infrastructure. Client components provide a variety of content displays and interaction mechanisms.

The Plasma Poster server consists of the following components: a number of Java servlets that run in a standard Web server (e.g., Tomcat from the Apache Software Foundation); a relational database (e.g., MySQL from MySQL AB); a *ContentServer* Java application program controls access to the database using the Java standard interfaces (JDBC from Sun Microsystems). Servlets provide access to the Plasma Poster capabilities. *Overview* servlets provide representations of posted information organized for easy location and browsing of community content. Plasma Poster Web pages format the overview information into a variety of representations, including a tabular list, and tiled or overlapping image maps. *PosterMail* and *Posting* servlets allow posting of information to the Plasma Poster Network through email and through Web interfaces.

[2] At present, no authentication procedure is required at the board; members of the local community are trusted to identify themselves manually by selecting their own photo from the community member listings. However, implementing a badge-in mechanism or pin entry would be trivial.

A set of client components have been incorporated into the system, including: standalone applications; Web-based programs implemented as Java applets, and dynamic Web pages. The *PosterShow* Visual Basic application provides a cyclic view of posted content suitable for display and navigation on a Plasma Poster client platform (e.g., large plasma display or personal computer). *Annotation and mailer* clients allow free form responses made at a client platform to be distributed back into the user community (e.g., as a reply to the posting user or forwarding to others). Finally, Administration and Access Control Web pages allow us to easily maintain the content and metadata required by the system (for more details see Churchill, *et al.*, 2003).

The system facilitates the flow of information across the diverse sets of hardware and software upon which users conduct their online activities (i.e., linking email, Web interfaces, Web-based services, our own infrastructure services, and public and private device content representation services). The need to work within people's preferred working environments has lead us to adapt the behaviors of these other resources. One example of this approach for *repurposing* is the PosterMail servlet. Incoming email messages that users spend minimal time formatting (e.g., drag, drop, send) are parsed. Different content types (e.g., texts, movies, URLs, and collections of photographs) are detected and the content is appropriately arranged for presentation on the Plasma Posters (e.g., single frame, linked frames, or collages of content, with titles and commentary attached).

Use and Impact of the Plasma Posters

The Plasma Poster Network has been stable and used within our workplace for 6 months. Community activities have been logged, and qualitative evaluations carried out to document people's experiences, responses, and reasons for posting/non-posting. The qualitative evaluations were three interview-based evaluations (with 7, 10 and 8 interviewees respectively) and an email survey (with 23 respondents of which 13 had never or only once posted content to the Plasma Poster Network). These evaluations have provided us with ongoing user feedback regarding interface design and system features. In addition, the evaluation data are pertinent to our broader research questions regarding the potential in fostering social interactions for large screen, digital, community bulletin boards. For the purposes of the data analysis, we posed the following sets of questions:

1. **Relating to technology use**: Will people *post items* to share with others in physical spaces? Will people *read digital content* in public spaces? Do people *engage with content* on the Plasma Posters, and if so, are there *patterns of interaction by location and time*? What are *patterns of posting*?
2. **Relating to technology reception and impact**: Are the Plasma Posters perceived to be a *valuable addition* to existing methods of content sharing? That is, is content projected into the local physical environment seen as a

valuable addition to existing environmental and desktop methods of content sharing (e.g. corkboards, email and Web pages)? What are the most *popular forms of content*? What are *reasons for posting and non-posting*? Does content in the physical environment *cue conversations* between colleagues?

Posted content

Since the deployment of the current system 28 weeks ago, 501 postings have been sent to the Plasma Poster Network, with an average of 17.9 posted per week (range 1-43; sd 8.7; median 16; mode 14). This posting activity was generated by 28 people, again with an average of 17.9 postings per person (range 1-155; sd 32.7; median 4; mode 2). Nine people are responsible for the bulk of the posted materials (88.6%). All postings have occurred through email; nothing has been posted from the Web interface. During the first week of this deployment 14 items were posted. The greatest number of postings in a week was 10 weeks after deployment (43; mid October), and the fewest 2 weeks after deployment (1; mid August. Note that some adjustments were being made to the newly deployed system at that time). Most postings are during the working week (Monday-Friday; mean=98, sd=21), rather than the weekend (mean=5.5; sd=3.5). There are no significant differences between the days of the working week.

Three people have posted content when traveling (3 short reports, 4 conference announcements and 6 sets of photographs (see Figure 4), and one current events news article). Interview comments suggest these are very popular; authors and viewers feel a presence within the community is maintained by these postings. Posted content tends to be low urgency. Few items explicitly invite transactions or interactions (e.g. items for sale, requests for carpools, queries regarding related work are still are sent via email to targeted individuals). Content has varied from work-related to hobbies, and from general interest to company specific, including announcements of product releases and upcoming events, visitors, lunch menus and images from company events; 74% of the postings have been text or URLs, 25% have been images and 1% have been short movie clips. URLs largely consist of announcements for local and external events (e.g. conferences, movies, plays, sports), news items (unsurprisingly, often concerned with technology innovations), unusual examples of technology related products or designs, jokes and political commentary, interactive surveys, items of cultural or personal significance to the posting community member, book reviews and poetry. Not all content starts in digital format; several postings have been scans of paper materials. Although people can extend how long something is shown on the posters, almost all items posted are posted default setting and expire after 2 weeks. Re-posting has only occurred on a handful of occasions.

Interview and survey data revealed that content sent to the Plasma Posters would “probably not be emailed” to the lab-wide email alias, as people felt they wouldn’t want to “fill up others’ mailboxes” with things that may be of peripheral interest. These comments suggest to us the Plasma Posters do indeed provide a complementary

mechanism for content sharing within our lab. InBox cluttering from bulk email has been a common complaint in the organization even with work specific (e.g., technology innovation) or company sanctioned (e.g., product and organizational information) contents. This is not a complaint with the Plasma Posters. The most common reason for not posting was that people felt they didn't think others would be interested in their content ("I'm not sure what to post, my sense of humor is pretty different"; "my topics would be too boring"). People said they tended to share content with smaller groups; lab-wide visibility was not too risky ("with most things I would want to share with only a select group"; "I haven't come up with anything that would be of interest lab-wide yet").

Interacting with Content

We logged 22,201 user interaction events from the three Plasma Posters over 149 consecutive days (including weekends)[3]. People interacted with content that was on display on the Plasma Posters, but did not forward content or reply to content authors, although in interview people were intrigued by the potential of these features. Using the analytic categories outlined above, *(inter)active reading* accounts for 62.4% of all activity (scrolling content and following links; pausing content and printing); *navigation and browsing* for 35.4% (show all postings; resuming content cycling by pressing "Play"; show previous posting; show next posting) and *messaging* for only 1.3% of activity (replying to content authors; forwarding content to oneself or to others). Finally, 0.9% of activity was people looking for more information about content authors/posters.

Interacting with Content by Location and Time

Location makes a big difference to interaction. 67.9% of all activity occurred at the kitchen Plasma Poster, 19.8% at the hallway poster and 12.3% at the foyer poster. Table 1 shows the mean number of interactions per day broken down by the different Plasma Posters, and by reading, navigating and messaging activities. We are currently analyzing our interaction data by content type to establish whether different forms of content and different locations systematically invite particular forms of interaction.

Activity data reflect the working rhythms of the lab. Although the data in the tables include weekends, weekday interactions account for 99% of the data logged (weekday interaction events per day mean=205.9; sd=169.7; weekend mean=10.8; sd=8.2). Interview and survey data suggested people read content early in the morning and at coffee breaks. Our activity logs verified this; activity peaks are at 10am, 3pm and 4pm, and activity tails off around 6pm (not surprisingly, as most people leave the building between 5pm and 6pm). There is a trend for increased activity as the week goes on, but there are no significant differences between days. Most of the activity

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[3] Unforeseeable technical problems (e.g. loss of internet connectivity, power outages) meant that on occasion not all of the three Plasma Posters were available.

peaks were generated by interactions at the kitchen Plasma Poster. Again, this was in accord with our interview and survey findings. Few people reported reading content on the foyer poster or the hallway Plasma Poster. When asked why not, people said the foyer poster was "out of the way", and the hallway poster was "too close to people's offices", where "it feels odd to stand outside someone's office door and read stuff".

Kitchen	Active Reading	95.9	61.2%
	Navigating	58.9	37.5%
	Messaging	2.0	1.3%
	Totals	156.8	
Hallway	Active Reading	34.3	75.1%
	Navigating	10.7	23.5%
	Messaging	0.6	1.4%
	Totals	45.7	
Foyer	Active Reading	18.7	66.0%
	Navigating	9.1	31.9%
	Messaging	0.6	2.1%
	Totals	28.4	
All	Active Reading	149.0	64.5%
	Navigating	78.7	34.1%
	Messaging	3.3	1.4%
	Totals	230.9	

Table 1: mean and percentage interactions per day

The category that is not reflected in our activity logs is *peripheral noticing*, as no touch interaction occurs when people are not (inter)actively reading, messaging or browsing. Observational studies are currently being carried out to measure the extent of peripheral noticing and distant reading (e.g., analyzing basic motion near a poster along with the interaction events), by content and poster location. Initial results show the kitchen area is the most traveled and populated of the three areas. It is also where people tend to "hang out". Current affairs articles, technology news items, images and movies draw most attention. Popularity of content is also related to sender; content posted by regular posters of "quirky content" and by absent colleagues is very popular. While people glance at all the Plasma Posters, only glances at the kitchen Plasma Poster regularly lead to touch screen interactions.

Perceived impact

Reactions to the Plasma Posters have been largely positive. All survey respondents said they had read items posted to the Plasma Poster, and 19 of the 23 said they had conversed with people about posted content. Many said conversations occurred when they were with others in front of the Plasma Posters, but 13 said they also conversed with others later about content they had seen on the displays. One respondent said "I often talk about stuff I see on the Plasma Posters, more usually with friends outside of work in fact". Two people said they had posted content to the Plasma Poster Network as part of an ongoing discussion. Although we cannot measure whether the Plasma Posters have increased informal interactions in the lab, we took reportage of these "conversational threads" as support for our assertion that the Plasma Posters spark conversations.

People commented that they liked finding out about others' interests. As one person phrased it, "I like seeing other people's interests and foibles, plus there is often quite a lot of interesting and relevant information in there". Another said, "I like coming across things I would not see otherwise". People also liked getting postings

from absent and remote colleagues ("it is nice to find out what they are thinking about or doing"; "it is great to see their face on the display").

Survey respondents were asked to comment on whether they saw value in having the Plasma Posters and if they would miss them were they to be taken away. All but three of our 23 survey respondents saw value in having the Plasma Posters, and were in favor of retaining them. Comments included: "I would especially miss the pictures posted by people who are away and I like seeing pictures of things people have attended, like conferences"; "I would miss having topics to talk about when it goes quiet at lunchtimes"; "I would miss interacting with people on topics posted on the poster"; and finally, "I would miss tidbits and insights into people's personalities and what interests them". By contrast, one person (a non-poster) said they would not miss the Plasma Posters because they felt the posters actually *detracted* from spontaneous conversational topics arising over coffee breaks and lunch because conversational topics naturally drifted to what was being shown on the Plasma Posters.

The Plasma Posters were not valued equally. While 20 of our survey respondents stated they would miss the kitchen Plasma Poster, only 4 said they would miss the hallway Plasma Poster. Three people said they would miss the foyer Plasma Poster, and 3 others said they thought it is good for visitors. It has taken time for the technology to be accepted, and for people to want to use it. One regular poster said although they had been unsure what to post at first, once they had started doing so "it was addictive".

Discussion

The Plasma Poster Network is actively used, and has had an impact on the social communication patterns within our organization. Members of our community post a wide variety of multi-media content, and are active readers who follow links and scroll through postings. Even infrequently used features (e.g. forwarding content, printing, messaging and replying to content authors) are highly valued.

To complement the design guidelines and the usage data presented above, we would like to spell out some of the *ergonomic* (physical, behavioral and cognitive ergonomic factors), *technical* (both the prototype requirements and the supporting technical infrastructure of the deployment location) and *social factors* (knowledge, expertise, relationship dynamics, broader organizational/civic/cultural context) that have arisen within this deployment.

In terms of the ergonomic issues explored for the current deployment, we have made efforts to ensure the Plasma Posters are *effective* interactive, public displays for their current placement. We have addressed issues of screen height, lighting and glare, font and button size, and color saturation on the display. Sensitivity to visual pollution has been essential; certain animations and dynamic screen changes have proven disturbing to some viewers. Sound pollution has also been addressed; initially all Plasma Posters had speakers, but these have been inactivated at the request of our

users. Interface design has proceeded with consideration of how to effectively signal functionality and invite interaction, without implying features that are not supported. Given we have a highly technical community, it has been a challenge to restrict interaction to our design intent without incurring frustration; on occasions members of our user community have wanted to appropriate the plasma displays as collaborative, digital workspaces, or as large screen interfaces to personal computers. On the other hand, as is always the case in design, there are tradeoffs; just as these behaviors derive from their comfort with technologies, their expertise has also meant they are tolerant of prototype failures, vocal with feedback and helpful with debugging.

While the above considerations pertain to the design of interfaces, or the "public face" or "skin" of the technology, it is also clear that the physical and technical infrastructure of our working environment has been crucial to the success of the technology. Without the ability to easily access power sockets, utilize existing mail servers, take benefit from our high-speed intranet and so on, the deployment would not have been possible.

Deploying within our organizational setting has meant maintaining a sense of corporate professionalism that may not be so important in other settings. However, the restricted physical setting combined with the relative social informality of our workplace has been beneficial. For example, we have a minimal content moderation policy, relying on social accountability and a shared sense of content appropriateness[4]. Other locales will undoubtedly require more active content moderation. Having said that, our workplace has permeable boundaries, socially speaking; on several occasions (3), we have been asked to remove company sensitive material to avoid exposure to visitors. Judging content appropriateness becomes more problematic as we make it easy for people to post content into places they have never visited; even with the best of intentions, it is easy for people to *inadvertently* post socially inappropriate material.

Summary and Future Work

In this paper we have described the design and deployment of three digital, community bulletin boards, the Plasma Posters, within our lab. The Plasma Posters have become an everyday part of our environment, and are seen as a valuable addition to the physical environment and a complement to other content sharing methods. The Plasma Posters have increased social interaction between members of the lab. Content that in the past has been shared within small groups has been posted to the Plasma Posters resulting in the discovery of overlapping interests across groups. Interview data indicate some posted content may not have been previously shared *at all*, implying we have created a new genre of communication within our lab (see Yates and Orlikowski, 1992). These observations lend support to our belief that such technologies have a role to play in forging new ties and reinforcing existing ones

[4] Interestingly, however, when inappropriate content was posted and displayed on one occasion, it was perceived to be a *technology* problem and not a *social* problem.

(Granovetter, 1983). In this regard, their success stands in contrast to the infrequently used, non-digital, community poster boards, and seems to derive specifically from their networked, dynamic, interactive nature, and is, of course, related to the good fit with existing content sharing (and general work) practices.

The design of the Plasma Poster Network has involved careful consideration of *ergonomic factors*, *technical factors*, and *social factors*. As we prepare for deployment of this technology in an external site, we are using checklists derived from our design guidelines and observations.

In conclusion, we are encouraged by our initial explorations within this area with the design, development and deployment of the Plasma Poster Network. We believe such community technologies represent a new genre of community communication. They combine practices of online digital content sharing within social networks with public display technologies that, to date, have been more associated with broadcast, corporate content. Explorations within this design area are revealing ways in which the digitally enhanced, physical environment can be used as a canvas for asynchronous communication, blurring the boundaries between online community participation and offline interactions. There are many fascinating socio-technical design challenges to be faced.

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