

# Sharing Multimedia Content with Interactive Public Displays: A Case Study

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## Abstract

Plasma Posters are large screen, digital, interactive posterboards situated in public spaces, designed to facilitate informal content sharing within teams, groups, organizations and communities. While interest in interactive community poster boards has grown recently, few successful examples have been reported. In this paper we describe an ongoing installation of Plasma Posters within our organization, and report qualitative and quantitative data from 20 months of use showing the Posters have become an integral part of information sharing, complementing email and Web-based sharing. Success factors include our design process, the reliability and flexibility of the technology and the social setting of our organization. We briefly describe three external installations of the Plasma Poster Network in public places. We then reflect on content posting as “information staging” and the ways in which the public space itself becomes part of the “interface” to content.

**Categories and Subject Descriptors:** H.5.2 User Interfaces

**General Terms:** Design.

**Keywords:** Interactive public displays; information encountering; community; social capital; evaluation; adoption.

## INTRODUCTION

Large-screen, digital displays are becoming increasingly prevalent in public spaces. Such displays promote “everyday information encountering” [6]; people bump into digital information as they go about their daily business, just as they would paper fliers and signage. Bumping into information in this way requires less intention or focus on the part of readers than online information seeking or

“surfing” with personal computers or public kiosks.

Currently, most public displays are minimally interactive, and are designed for one-to-many, broadcast content distribution rather than aimed at promoting the sharing of community content. However, it is clear that there are significant opportunities around the corner for distribution of interactive multi-media digital content designed for social networking and community content sharing, as well as for entertainment and commerce.

Within organizations, public displays have been used to facilitate task-centered, synchronous, collaborative work in groups (e.g. [16,19]), as personal and group memory aids (e.g. [7]), and to offer awareness of colleagues’ activities (e.g. [10, 14]). More in line with our research interests, there have been experiments in the use of public displays for information sharing within groups and communities (e.g. [1, 13, 17, 21]). Most of these examples have suffered from limited adoption ([15], but see 21 for a system that was in use for some time), and where evaluations have taken place, use data have been from short trials. Thus, reported use patterns have tended to reflect novelty effects, reflecting people’s inquisitiveness rather than demonstration of an enduring technology.

In this paper, we describe our work in this area on the design and ongoing deployment of a network of interactive community boards, the Plasma Posters. We present data from 20 months of continued use – we summarize the initial 6 month deployment (see also [3,4]) and present an additional 14 months of use. Our data demonstrate that posting to the Plasma Posters has become an integral part of information sharing practice within our organization; the Plasma Posters offer a new, appealing genre of information distribution. Further, their physical presence and the nature of the content posted on them is a tangible manifestation or expression of the lab’s identity. It is also evident that, for authors, information sharing has become more explicitly “information staging”, an act of placing information on a public stage. The difference centres around assumptions about how reading takes place; email and Webpages are assumed to be read alone in private settings, with more focus or goal orientation than reading from the Plasma Posters.

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Before presenting quantitative and qualitative usage and evaluation data, we describe the current Plasma Poster interfaces and the underlying information parsing, hosting and distribution infrastructure.

## THE PLASMA POSTERS

The Plasma Posters are plasma displays with interactive overlays, oriented in portrait format, that enable direct touch interaction, designed for placement in public spaces to facilitate multimedia information sharing. The Plasma Posters are designed, not to replace but to complement, existing content sharing tools such as email, Usenet groups [8], online community spaces (e.g. see [9]). That said, desktop and PDA interfaces make content available also viewable from personal/private displays [e.g. 2]. Underlying the Plasma Posters is the Plasma Poster Network, a client-server system providing content parsing, management, hosting, and distribution. We do not describe the infrastructure in this paper, for details see [2,3,4,18]).

### Motivations for the design and introduction of the Plasma Posters

Our design of the Plasma Posters was inspired by the observation that informal interaction provides a foundation for social capital within organizations [5]. Within our own organization, we had observed that little sharing of informal content occurred across social groups, although such sharing was valued within groups. This trend was increasing in tandem with increases in email spam; people reported a general heightened sensitivity to sending or receiving “trivial” emails which previously had been part of informal, cross-group interchange [3]. Our design goal was to provide an easy, socially acceptable way to share multimedia content, and thus to promote polite, non-intrusive, “walk-by” information encountering. We hoped to promote informal information sharing, and to foster awareness of others’ interests and of others’ favored information sources.

System design proceeded iteratively, addressing technical and social issues in the creation, introduction and maintenance of the technology. Factors included consideration of existing information sharing practices and encouraging use; design of specific interface features (e.g. designing for reading from public displays in public spaces, designing to attract attention and encourage interaction and use; design for easy administration); and physical placement of the Plasma Posters. Design decisions on these factors were derived iteratively with recourse to fieldwork [3,4] and related work.

In order to underscore that the Plasma Posters are a *community* resource, we encouraged people to “sign up” to be a member of the Plasma Poster Community at FXPAL. Signing up meant supplying a photo, with the option of creating a personal profile and creating a “screen name”, and resulted in having a personal web-based repository of

current and past postings and being authenticated to post content to the Plasma Posters.

### Plasma Poster Locations

The Plasma Posters are all located in our single-floor lab. One is placed in a corridor, one in a foyer and one in our shared kitchen and eating area (Figure 8). All locations were selected after observing people’s movement through our office space, and based on two criteria: that the Plasma Posters would not obstruct people’s movement, and that all locations were well traveled.

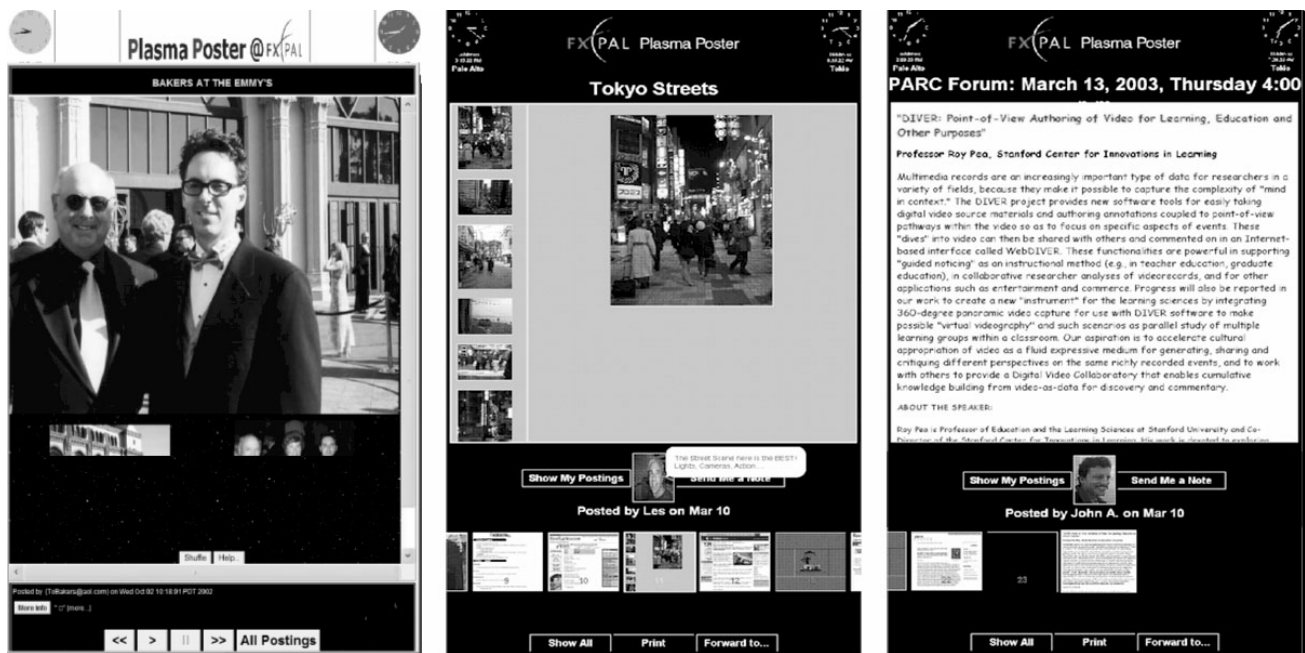
### Content sources and types

Most content that is posted to the Plasma Posters is generated by people within our lab, although some is automatically sampled from our intranet (e.g. announcing new technical reports, calendars of meetings). In the former case, there are two means of posting content: via a Web interface and using email. In keeping with previous observations [13], we discovered that providing an email interface for sending content to the posters resulted in a significant increase in postings. Posted content can be images and movies (sent in email as attachments), formatted text and URLs. Authors can send comments with their postings as text in the body of the email, and in the case of URLs, can select lines of text to be highlighted when displayed. Such comments and highlights can be used to give context for the posted content.

### Plasma Poster Interfaces

Large screen displays in public spaces afford different forms of engagement with content, and forms of reading differ depending on one’s physical proximity to the display [11]. The Plasma Poster interface has been designed to support several forms of engagement with content:

- *peripheral noticing* Interfaces are appealing from a distance so that the Plasma Poster adds to the ambience of the environment even for those who do not regularly, actively interact with them. Content changes regularly, cycling through automatically. Content is rendered large enough for people to get the gist of content that is posted from a distance.
- *active reading* Interfaces support interaction with content. Content can be *paused*, *scrolled* and *printed*. Live Web links can be followed.
- *navigating and browsing through posted content* Content can be browsed one item at a time and overviews are provided, searchable by date and author.
- *social connections* Given our intent is to encourage informal *social information flow* and to provide conversational “ice breakers”, our interface design(s) also emphasize the social dimension of posted information. People’s names and faces are displayed alongside posted information. *Messaging* is available: Items can be



**Figure 1.** A view of an earlier interface, and our current poster design. The leftmost image shows a posting of pictures from an event, along with the older style control buttons for content navigation. The rightmost images shows our current design in which overview and content displays are all gathered into a single view.

*forwarded* to others, or to oneself for reading later at a personal computer. Content authors can be emailed from the public display interface.

Figure 1 shows our interfaces; on the left side is our initial deployment interface and the central and right images show the current interface, released in March 2003. On the current interface, the author's title for the content posting is shown near the top of the display; it reads "Tokyo Streets" in the center image, and that on the right reads "PARC Forum: March 13, 2003, Thursday 4.00".

The main 'content region' in the centre of the interface displays content the author has posted; the middle image in Figure 1 shows several digital photographs and short movies sent from a colleague visiting Tokyo (in effect, digital postcards), the right screenshot shows formatted text. Every 30 seconds the content region updates; the next item in the presentation sequences (i.e. all items in the database that are currently marked for public display) is shown. Once all items in the sequence have been displayed, the cycle begins once again.

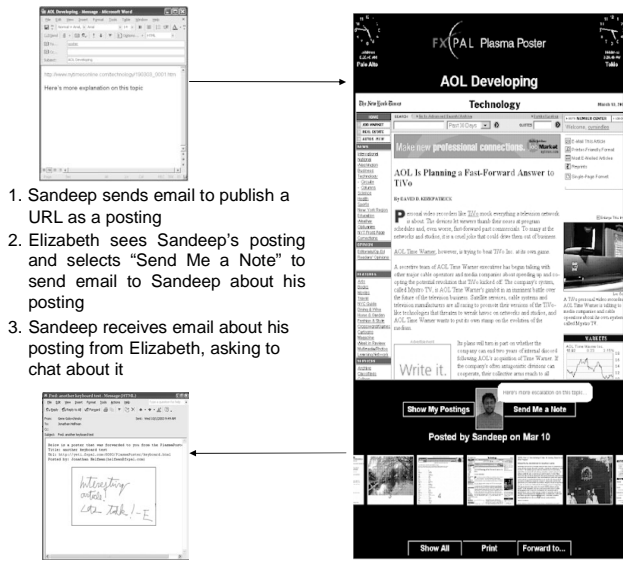
Touching anywhere on the Plasma Poster (e.g. when scrolling) reinitiates the 30 second timer, effectively pausing the content while it is being read. After observing that people were experiencing difficulties selecting scroll bars, we removed them, and made the entire content region "live" for scrolling. Readers can touch anywhere in this content region, and a flick of the finger upwards or downwards scrolls the page.

Below the content region is information related to the author: their photograph, their comments about the posting (shown in the speech bubble in the image on the left in Figure 1; the right image has no comment). On the left of the author's photograph is a button ("Show My Postings") to display other items this person has posted, and on the right of the author's photograph a "Send Me A Note" button allows reader to email the author. Selecting this button opens a dialog box where readers can scribble a note. This scribble, saved as a bitmap, along with a URL to the posted content, are sent back to the author (see Figure 2). Immediately below the author's photograph is the author's name and the date of posting.

Below the author's name are the overview thumbnails, an element that was introduced in March 2003. These show items that have recently been on view (to the left of centre), the current item (in the centre) and the items that are about to come on view (to the right of centre). In the middle image in Figure 1, the next item to be shown is a news item; on the right there are no more items in the sequence to be shown, this was the last item posted to the Plasma Poster Network, and the display cycle is about to begin again. Readers can select any thumbnail to be displayed by pressing it. The band of thumbnails is also scrollable; a reader can press, for example, on the centre thumbnail and flick their finger to the left or right, and the thumbnail 'carousel' will scroll to reveal other items in the presentation sequence.

Finally, along the bottom of the new interface there are three buttons: “Show All” button to show a list of items in the presentation sequence, “Print” to print the currently displayed posting, and “Forward To” to email comments and postings to oneself or to others. Forwarding is illustrated in Figure 2.

Postings are by default removed from the presentation sequence after 2 weeks, but posting duration can be set manually. All postings and relevant meta-data (e.g. date of posting, duration posted and comments) are retained in the Plasma Poster Network database and are accessible from personal and administrator content management Web pages. Thus old postings can be reviewed and reposted.



**Figure 2: Elizabeth sends a message to Sandeep about his posting by pressing the “Send Me a Note” button to the right of Sandeep’s picture**

### ADOPTION AND USE OF THE PLASMA POSTERS

Our metrics for success of the Plasma Poster Network centre around continued use, and the perception of value within the organization and within the user group. Having established at 6 months that people were using the Plasma Posters, we were interested in whether usage of the Plasma Posters has changed over time, and if so, how.

Quantitative data regarding posting and interactions at the Plasma Posters have been gathered. Observational studies have been conducted to see how people use the Plasma Posters. Periodically, content analyses of cork boards and office doors have been conducted to observe whether the Plasma Posters have had any impact on paper-based postings in public spaces. Qualitative evaluations conducted about people’s experiences with the Plasma Posters. Five interview-based evaluations (with 7, 10, 8, 6 and 8 interviewees respectively) and two email surveys (23 and 15 respondents) have been carried out. An email address for sending comments and reporting bugs was set up and has

received 49 messages, with an average of 2.4 per month. Finally, ongoing conversations with members of our user group, and with the company CEO have yielded insights, reflections and suggestions.

In analyzing our results, we consider the following questions: 1. *Are the Plasma Posters a success in terms of continuing to be used?* To address this we looked at posting and reading data; 2. *What kinds of content are shared?* To address this question, we carried out a detailed content analysis on content poster to the Plasma Posters; 3. *What impact have the Plasma Posters had on other forms of content sharing – have the Plasma Poster replaced email or Web pages as a means of content sharing?* For this question, we have begun to gather quantitative and qualitative data on use of group distribution email lists and physical poster boards over the period of deployment. We present preliminary data from these latter investigations in this paper, as analyses are ongoing; 4. *How does encountering/reading content on the Plasma Posters differ from information encountering in other situations (e.g. at the desktop)?* To address this question we present data from interviews, surveys and observational studies; 5. *Are the Plasma Posters perceived to be a valuable content sharing tool? Would people miss them if they were no longer available?* To address these questions we analyzed interview and survey results with community members and management.

Before presenting data to address these questions, we offer a brief description of FXPAL to provide some context for understanding use.

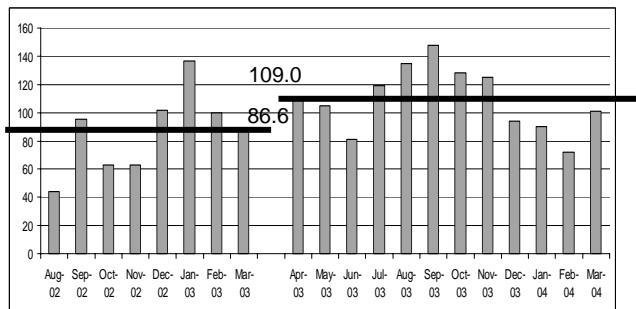
### FXPAL as a technology test site

FXPAL is a software research company, based in Palo Alto, California. Based on one floor, currently 49 people regularly work at FXPAL: 15 contractors, 1 regular visiting consultant, 5 administrative staff, 2 residents from Japan, 3 management, 23 researchers and 3 technical staff. Over the course of the last year, there have a few staff changes, with 6 active Plasma Poster community members leaving, but 4 new members signing up when they started work. During the Summer months, ~7 interns also work in the lab. All members of staff have their own offices or cubicles, and with the exception of the consultant all work in the office; telecommuting is not sanctioned by the organization.

### Plasma Poster use: posting patterns over time

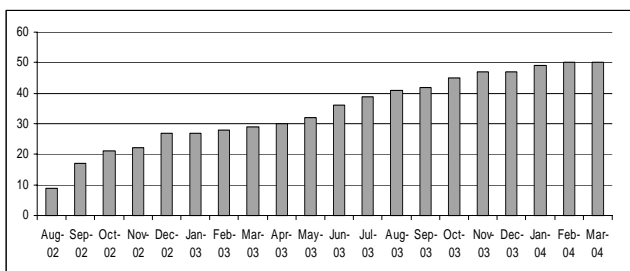
Over the past 20 months, 2000 postings have been sent to the Plasma Poster Network; 1957 postings were sent on days of the working week, and 43 over weekends. There are no significant differences between week days for posting activity. On average 100 items have been posted per month (range 44-148; sd 27.3; median 100.5; mode 63). All postings have been sent through email; none from the Web page. Figure 3 shows posting activity over the last 20 months; peaks in January and September of 2003 are

evident. Three active community members left in late 2003, most likely accounting for the drop in postings then and in early 2004, but numbers are increasing once again as new people sign up to be members of the posting community.



**Figure 3: Histogram of total number of postings by month between August 02 and March 04, delimited by our final major interface revision on 31 March 2003.**

Only 247 postings have had accompanying comments (appearing in the speech bubbles), representing about 12% of postings. These have appeared steadily over the year, have come from predominantly from 6 people who have generated 71.7% of them. Although inline highlighting of content has been requested frequently, only 8 people use this feature. They have annotated 50 (out of a total of 1257) postings since the introduction of this feature on 17<sup>th</sup> April 2003.



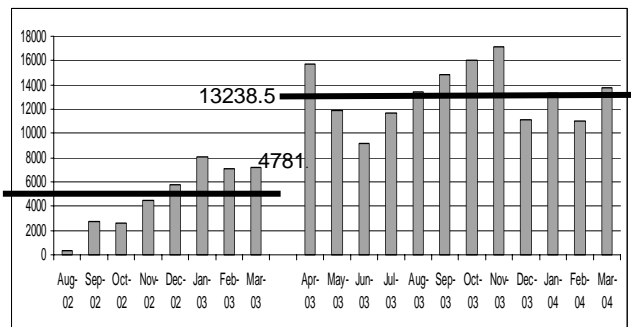
**Figure 4: Cumulative histogram of Plasma Poster content authors showing steady increase from initial deployment in July 2002 until March 2004.**

Active community members have increased steadily over time. Figure 4 shows a cumulative histogram of authors over the last year. However, level of posting activity is skewed, with a few people accounting for the bulk of material posted; 9 people were responsible for 75.2% of the posted materials. Of these, the top 7 are researchers, 1 is in management and 1 is a member of technical support staff. Overall, 74.1% of postings were from 21 researchers; 8.8% from 6 technical support staff; 7.6% from 7 contractors; 6.0% from 3 members of management staff; 1.9% from 3 administrative staff; 0.9% from 7 residents; and 0.8% from 3 student interns. Proportionally, administrative are the least active groups (2 of 5 of administrative staff have not posted). Of the Summer interns, only interns affiliated with the project have posted.

Six people have posted content when traveling. Interview comments suggest these are very popular; authors and viewers feel a social presence within the community is maintained by these postings.

### Plasma Poster use: interaction and reading practices

Since August 2002, we have recorded over 197,112 user interaction events from the three Plasma Posters. Interactions have been increasing steadily over time, and a peak in interest occurred in April just after the release of our new interface on March 31<sup>st</sup> 2003 (Figure 5).



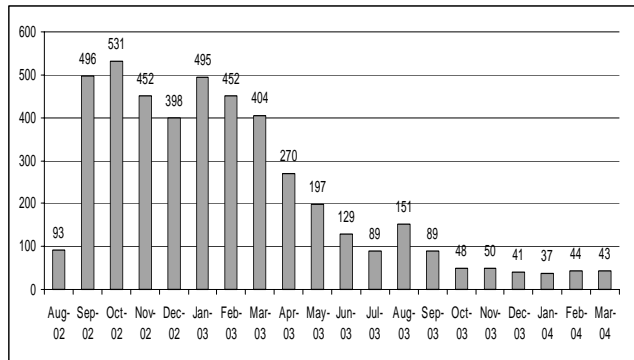
**Figure 5: Interactions at the Plasma Posters over 14 months, delimited by the introduction of our final major interface revision installed on 31 March 2003.**

Poster interaction data continue to reflect the working rhythms of the lab; weekday interactions account for 99% of the data logged, but some interactions do occur at weekends. People interact with content early in the morning and at lunch, tea and coffee breaks. There is a trend for increased activity as the week goes on, but there are still no significant differences between days of the working week.

Interaction events were categorized according to the analytic categories outlined above. *Active reading* accounts for 69% of all activity (scrolling content and following links; pausing content and printing); *navigation and browsing* of posted content for 29% (show all postings; show previous posting; show next posting) and *social messaging* for 2% of activity (replying to content authors; forwarding content to others). These data are in accord with data from 6 months of use, where we noted 62.4% for active reading, 36.3% for navigating and browsing of database items and 1.3% for messaging. One clear difference from earlier investigations that we noted was due to the introduction of the thumbnail overviews; there was a steady decline in the use of the ‘Show All’ button and overview maps, in favour of browsing all postings using the scrolling thumbnails (Figure 6). Although the messaging features are infrequently used, they are highly valued, people report liking that the capability is available.

*Peripheral noticing* is not represented in our touch-screen data logs, as no touch interaction occurs when people are not (inter)actively reading, messaging or browsing.

Observational studies in the last 6 months suggest all Plasma Posters are glanced at regularly people when are passing. In the case of the foyer poster this has proven hazardous on occasions as the foyer lies at a corridor T-junction. An email we received read: “On several occasions, I have nearly collided with people while navigating the corners near the balcony [foyer] plasma poster. Usually one or more of us is looking at PP content”.



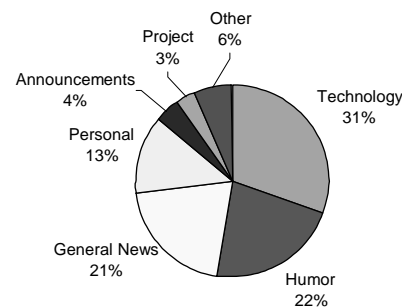
**Figure 6: Decline in use of ‘Show All’ button after introduction of scrollable thumbnails in March 2003**

Location continues to make a big difference to interaction. Analyses revealed 77.8% of all interaction events took place in the kitchen, 13.0% were at the hallway poster, and 9.2% were at the foyer poster. This is consistent with earlier results; at 6 months of use 67.9% of all activity occurred at the kitchen Plasma Poster, 19.8% at the hallway poster and 12.3% at the foyer poster. Location continues to make a big difference to interaction. Analyses revealed 77.8% of all interaction events took place in the kitchen, 13.0% were at the hallway poster, and 9.2% were at the foyer poster. This is consistent with earlier results; at 6 months of use 67.9% of all activity occurred at the kitchen Plasma Poster, 19.8% at the hallway poster and 12.3% at the foyer poster. Although the kitchen Plasma Poster continues to be the most positively perceived and the most interacted with, people report seeing things on the other posters and then going to the kitchen to read the content in more detail and when waiting for coffee to brew or food to be ready. This we believe is the real power of the *network of screens*, and people have become sophisticated consumers of the three posters for different purposes. The foyer and corridor posters seem to act as *primes*, as alerting or awareness displays while the kitchen poster is the reading and interacting.

#### Content analysis: What is posted?

Overall, 77.6% of the postings have been URLs, 7.4% have been formatted text, 0.2% have been a combination of images and movies, 0.5% have been movies, and 14.6% have been images. We carried out a content analysis of posted content over the deployment. Analyses by month indicate the distribution of item types has not changed, just

the volume. Analytic categories and results are shown in Figure 7: technology and business news items (e.g. new products, legal cases related to technology, financial reports); humorous items (e.g. cartoons, jokes); general news and interest items (e.g., hurricane updates, views of Mars, local areas news); personal items (e.g. vacation photos, personal hobbies); conference and talk announcements (internal and external); and project related information (directly related such as news items in the press about FXPAL projects or indirectly related items such as granting of related patents). We also noted postings related to internal social events, invitations to parties and sports activities, interactive games and surveys, and miscellaneous items posted in response to conversations – these are grouped in the “other” category.



**Figure 7: Content posted to the Plasma Posters.**

Technology, business and general news and humorous items represent the majority of items posted to the Plasma Posters. In many cases news items are posted ironically as a comment on events, so the news and humor categories are not entirely separable. News items unsurprisingly reflect what is going on in the world, e.g. hurricanes, ongoing hostilities in Iraq, sports events. Surprisingly little project related information is posted; interview results indicate that this kind of information is more likely to be exchanged in email and via project Web pages. ‘Conversational’ posting threads are readily apparent in the postings, as are media genres: most news items and humor are URLs, personal postings tend to be images and movies.

We have only been asked three times to remove content that was considered sensitive or inappropriate; twice removal was related to issues of proprietary information disclosure and once because an image was thought to be a little too risqué as visitors were present. The low incidence of ‘problem postings’ indicates conventions regarding ‘appropriate’ content have arisen. These norms are interestingly nuanced: a “Car For Sale” posting was deemed by three people independently to be an inappropriate use of the Plasma Posters.

#### Impact on other means of content sharing

People report that the Plasma Posters have had no impact on their posting to physical poster boards or email

distribution lists. To verify these assertions, we carried out analyses of cork board and email postings before and after the introduction of the Plasma Posters. Content analyses of all 7 public cork boards were carried out in July 2001, January 2002, July 2002, and in January, September, November and December 2003. No new postings have appeared on 2 of the boards, and patterns of change on other boards have remained unchanged since the introduction of the Plasma Posters. Of the 3 corridor boards that have changed, a research magazine is added once a month to one by a researcher, conference announcement posters are placed/removed on another, and a yearly calendar is placed on the other by an admin assistant. Of two kitchen boards, one has changed; a cartoon from the newspaper is posted on average once a month by a researcher and an administrative assistant posts greeting cards from present and past employees and information regarding catered lunches. Finally HR personnel post legal/HR materials, when appropriate, to a designated board in the mailroom. Characteristics of the posted materials are: 1. there is no urgency for content to be read, something that is shared with the Plasma Posters; 2. their native form is paper (i.e. too high effort to be posted to the Plasma Poster Network, they would need to be scanned first); and 3. persistent visibility is legally required, or is preferred, and thus both email and the Plasma Posters are inappropriate.

There are 61 group email distribution lists, only one of which is organization-wide and therefore equivalent to the Plasma Posters. Per month, there are fewer items posted to this email list than to the Plasma Posters (average postings is 58.9, sd 12.43). Analyses indicate no significant change before and after the installation of the Plasma Posters (an average of 59 per month for the three months prior to the installation, and an average of 59 per month since the installation). Content sent to this list differs from that sent to the Plasma Posters; 95% of items are text-only announcements for talks, visitors and catered events within the lab. We are still reviewing these data, and have begun analysis of other, more restricted, email distribution lists.

A questionnaire filled out by the 15 of the most active Plasma Poster users addressed selection criteria for the different methods of sharing. Materials sent through email tend to be time sensitive and obviously work related, while items sent to the Plasma Posters are non-urgent, and are characterized as “possibly of interest to someone” and “useful spam”. One person said “Spam has made everybody sensitive about email, so I hate sending people things by email unless I know them well or at least I’m pretty certain of how they’ll respond. You don’t get that with the Plasma Posters. They’re not someone’s personal Inbox. They’re just out there for everyone, and people can look or not.” People frequently reported selecting items to post that they thought would look good and be eye catching as well as interesting, hence the popularity of photographs.

### **Observations of Plasma Poster use**

Observations revealed that the physical and social setting has a strong effect on how and when people “interface” or interact with content. As noted, observational studies confirm quantitative data that the kitchen poster is used more than the corridor or foyer posters for interactive reading of content. Glances at the kitchen Plasma Poster regularly lead to touch screen interactions, whereas they less frequently do for the foyer and corridor Posters.

In terms of the social setting, people watch others reading and interacting with content - sometimes surreptitiously (see also [12]). Witnessing others reading items on the kitchen Plasma Poster frequently led to conversations and to collaborative content exploration. We observed people being aware that they are being watched while reading content, and then modifying their behavior (turning around, starting a conversation, lingering longer on a posting). People often use these impromptu social situations to point to other items that have been posted and to call out items they themselves have posted by scrolling through the thumbnails. We observed people approach the Poster and navigate to the material the previous reader was viewing – a form of content recommendation. In interview, people reported not browsing content while the break room was busy, opting to return at a later time when things were “quieter”, evidence for the way in which the social setting impacted people’s choices about content interaction.

### **Perceptions of the Plasma Posters**

Interview data consistently reflect people’s engagement with the Plasma Poster and a desire for them to remain in our public spaces. Although anecdotal, comments offered in interviews and surveys offer support for the quantitative data presented above. For example, one person stated they “couldn’t imagine what it would be like in the lab without them. The place would look empty, sterile”. Another said they looked forward to seeing what had been posted, and had made it part of their daily “coffee routine” in the morning to see what had been posted on the previous day. People report they see things on the Plasma Posters that they would otherwise not come across, and that it is good to see not just what others are interested in, but also to find out “where people look to find things”. One person remarked on seeing a posting “Very interesting. But I would never have thought to go to that site. How do people find these things?” These comments reflect the ways in which the Posters function to provide neutral, low effort, low intrusion, polite, social recommendations.

Consistently in our interview studies, people reported having conversations with others about postings and liked the possibility of forwarding posted items for reading later and for sharing with others. Reported conversational topics include work-related topics (conferences, product releases), discussions about news items and discussion of photographs. One person said he had few follow-up

conversations to postings, but liked to post anyway, stating “Some of it is to show people what you’re interested in – if they don’t understand, so what.” Author photographs are a major factor in people’s positive responses to the Plasma Posters, drawing people to read but also giving content a personal feel. Comments offered by company management confirm the Plasma Posters are seen as a positive addition to the milieu of the lab.

Reasons for non-posting have been consistent throughout the deployment. 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”; “I know most people in the lab and a lot of what I think of posting wouldn’t be interesting to them so I am pretty selective”). That said, on occasion initial tentative postings have led to more posting; one regular poster said although they had been unsure about posting at first, once they had started doing so, “it was addictive”.

Finally, an indication of people’s perceptions of the Plasma Posters is the speed and number of complaints received during occasional system or network crashes.

## SUMMARY AND DISCUSSION

The Plasma Posters are a success by our criteria related to continued use. Unlike most similar deployments, usage increased over the first few months of deployment and has reached a stable state. We have almost reached saturation with the number of people who have posted to the Plasma Poster Network. That said, posting is stratified; certain groups clearly feel more “ownership” or comfort with posting to the Plasma Poster than others. Researchers and contractors are most comfortable, whilst members of our technical and administration staff tend to be more reticent to generate content. Although most people have posted only a few times, members of all groups are enthusiastic “lurkers” and “voyeurs”, reading and browsing content, and interested in seeing what others read at the boards. Reading activities vary by location; the relative usage of three posters, has remained stable.

While the amount of content posted at any time has increased, types of content and reading activities at the posters have been stable. Emerging conventions regarding posted content can be observed – the Plasma Posters are considered appropriate for advertising personal interests and informing others but not for sales and advertising of commercial commodities. While this is clearly a social ‘norm’ emerging, design factors have also contributed to the posting of certain forms of content more than others. Announcements are infrequently posted, particularly for internal events. We believe this because items are not persistently on view, but rather cycle, and therefore appear at indeterminate times – with more items currently available for display, the likelihood of an item being seen decreases,

and the potential for reaching a broad audience declines. As has been noted elsewhere, persistence of display is crucial if an item is to serve successfully as a reminder for action [20]. Hence predominantly non-urgent, ‘of interest’ content is posted rather than urgent or time sensitive announcements that authors want to ensure are seen. Somewhat to our surprise the Plasma Posters have had no tangible impact on use of other content sharing means; thus they represent a new genre of communication, sitting alongside and complementing email and the Web.

Finally it is clear from interviews and observations that the Plasma Posters are viewed as contributing positively to the working milieu and culture of our organization.

## Factors for Success, Lessons Learnt

We would like to speculate on the success factors of Plasma Posters as community poster boards in our organization, and also point to some lessons we have learnt.

*Participatory design, ownership:* We iteratively designed the technology with participation of our user group, thus encouraging a sense of ‘ownership’ of the technology.

*Low effort to use, fit with existing practices:* This sense of ownership was enhanced by designing applications to promote control over content through ease of content authoring, publishing and modification (e.g. deletion). Other related technologies have suffered from lack of adoption when users did not see a clear fit with their everyday activities, where content sharing was less a part of the *shared* culture, and/or where authoring was more heavyweight (e.g. [1,13]).

*Means not ends:* The Plasma Poster Network and the Plasma Posters are an *enabling* technology. With the exception of the high-level goal, ‘for information sharing’, no particular vision of appropriate use was built into the network or the display interfaces. In contrast to many community-ware systems, we had no preconceptions about the kinds of content to be shown on the Plasma Posters. Content types and styles have been determined bottom-up, by our user group, and have emerged over time, again reinforcing a sense of ownership of the technology.

*Maintain infrequently used functionality:* At a general design level, we have had to revise some of our assumptions about what constitutes a successful interaction element or interface feature. Rather than evaluating interface features as better because they receive more use, we have found that features that are seldom used are in fact very highly rated in interview, and lead to the technology as being more highly valued overall (e.g. forwarding content). Our evaluation of the relative success or failure of any feature, therefore, is moderated by how *appreciated* it is and not simply by how much it is used.

*Continuity of service:* Continuity of service has been a major contributor to the success of the Plasma Posters. Complaints during service disruption are indicators of the



popularity of the system, but also point to the need for the system to be reliable, or “dependable” for the Posters to be viewed as a viable method of information sharing.

*Simplicity of form and function, clear identity:* As well as being reliably available, the Plasma Posters have a simple, easy-to-understand function that is rendered clearly in our interface. We have resisted calls for added functionality that would make the posters easy to appropriate for other tasks (e.g. brainstorming), choosing instead to keep the intended goal of social information sharing primary. The Plasma Posters therefore have a strong sense of identity.

*Social (Inter)Faces:* The increase in use after the introduction of author’s pictures and the thumbnail overview underscores the role of the Posters as proxies for authors and the power of ‘social’ content – associating people with content makes content much more attractive and interesting. This in turn fits in nicely with our goal of encouraging social networking by creating triggers for conversation around content.

*Neutral digital spaces:* The Plasma Posters are a ‘neutral’, non intrusive publishing space, much like ‘blogs’. With increasing email overload, and heightened awareness and intolerance of spam, the Plasma Poster Network represents a safe way to share mundane, non-urgent, general interest or whimsical material that could potentially be an intrusion sent to someone’s personal digital workspace.

*Communities of curiosity:* our community is made up of people who are informavores, inherently curious, and for whom information browsing, exploring and sharing constitute a large part of their identity.

*Organization:* FXPAL as an organization is tolerant to new technologies, to informal practices, and is invested in information dissemination and sharing. People are able to share and enjoy items of a whimsical nature that are not directly related to work activities.

*Synergistic displays* Having a network of displays mean that they act in synergy and make the presence of the Plasma Poster Network highly visible, the posters have an imposing, but not demanding, presence. Spaces are differentially suited for reading, glancing, navigating and messaging. Seeing items several times, even peripherally, primes later active reading.

## FUTURE WORK

Future work will focus on improving our current internal deployment, and on designing for our external deployments. Specific activities include further design of personal and online community Web pages; offering provision for directed content posting to specific Plasma Posters; and collecting ratings and mining logged activity data for automatic reposting of popular content and as feedback for content authors.

We have recently deployed the Plasma Poster Network with three different interfaces in other locations (Figure 8). The first is a slightly modified Plasma Poster, deployed in a government building in Mitaka City, a suburb of Tokyo. In the case of this deployment, one government employee posts all content to the Plasma Poster. Content consists primarily of text, Web pages and images. Anecdotally, we have heard that visitors to the building are interested in, and interact with the installation but to date we have no further data to report. Our second installation is an interface designed explicitly for sharing content between FXPAL and a sister research lab in Nakai, near Tokyo. This interface, named YeTi, has been designed for corporate information sharing, and as such has a more formal appearance than the Plasma Posters. We explicitly designed content channels (for People/Projects, Events, and News) and areas within the display for our content and for content posted from Japan. Again, this interface was launched in December 2003. Use data are being collected. Our final installation is a public display installed at a local café/art gallery in San Francisco, called the eyeCanvas. The interface was co-designed with the café/gallery owners, with a simple set of interactive applications as our initial deployment. The initial installation took place in September 2003. This deployment illustrates design issues that arise when we move from relatively closed and cohesive social spaces such as small organizations, into public settings that are inhabited by multiple intersecting and overlapping groups. (Re)design considerations include how to accommodate more content, security and authentication, and the robustness of the hardware.

## FINAL COMMENTS

As a final note, our experiences with designing for these varied public settings has reinforced the observation that



Plasma Posters at FXPAL

YeTi

Mitaka City

eyeCanvas

**Figure 8: Different interfaces have been deployed in many settings using a common infrastructure**

broad social setting analysis is essential in designing and evaluating system use in the case of these public technologies. The role of the *social setting as interface* is readily apparent - the entire social and physical setting is the interface to the consumption of the content, not simply the interface-as-display. Reading is a social act, a social display in itself, and that has consequences for what information is consumed and how it is consumed. The decision to read, navigate, create, annotate and message is driven as much by who is watching as about the usability of interface elements. Interface learning and technology appropriation is promoted through observation and emulation as well as exploration. People can be seen reading, reacting, and interacting with content, and acts of observation, of voyeurism, are themselves potentially visible to others. The social setting drives the extent to which the technology is perceived as functional or playful or both, and that in turn affects what is posted. Authors are aware of this, and of the resultant genre difference between the Plasma Posters and email: content posting more closely resembles "information staging" than "forwarding".

## REFERENCES

1. Agostini, A., De Michelis, G., Divitini, M., Grasso, M.A. and Snowdon, D. Design and Deployment of Community Systems: Reflections on the Campiello Experience. *Interacting with Computers*, Vol 14, No. 6, pp 691-714, 2002.
2. Carter, C., Churchill, E.F., Denoue, L., Helfman, J., Murphy, P and Nelson, L. Digital Graffiti Digital Graffiti: Public Annotation of Multimedia Content. *Proc. CHI 2004*, ACM Press, 2004
3. Churchill, E.F., Nelson, L. and Denoue, L. Multimedia Fliers: Information Sharing With Digital Community Bulletin Boards. *Proceedings of Communities and Technologies*, Kluwer Academic Publishers, 2003.
4. Churchill, E.F., Nelson, L. Denoue, L. and Girgensohn, A. The Plasma Poster Network: Posting Multimedia Content in Public Places. *Proc. IFIP Interact 2003*.
5. Cohen, D. and Prusak, L. *In Good Company. How social capital makes organizations work*, Boston, MA: Harvard Business School Press, 2001.
6. Erdelez, S. Information encountering: A conceptual framework for accidental information discovery. In P. Vakkari, R. Savolainen & B. Dervin. (Eds.), *Information Seeking in Context. Proc of Research in Information Needs, Seeking, and Use in Different Contexts*. Los Angeles, CA: Taylor Graham, 1997.
7. Fass, A.M., Folizzi, J. and Pausch, R. Messydesk and MessyBoard: Two designs inspired by the goal of improving human memory. *Proc. DIS2002*, ACM Press, 2002.
8. Fiore, A., Teirman, S.L. and Smith, M. Observed Behavior and Perceived Value of Authors in Usenet Newsgroups: Bridging the Gap. *Proc CHI*, ACM Press, 2002.
9. Girgensohn, A. and Lee, A. Making Web Sites be Places for Social Interaction. In *Proc. CSCW 2002*, New York: ACM Press, 2002
10. Greenberg, S. and Rounding, M. The Notification Collage: Posting Information to Public and Personal Displays. *Proc. CHI 2001*, 515-521, ACM Press, 2001.
11. O'Hara, K., Perry, M., Churchill, E.F. and Russell, D. *Public and Situated Displays*, Kluwer Academic Publishers, December 2003.
12. Hindmarsh, J., Heath, C., von Lehm, D. & Cleverly, J. Creating Assemblies: Aboard the Ghost Ship. *Proc. CSCW 2002*, New York: ACM Press, 2002.
13. Houde, S., Bellamy, R., Leahy, L. In Search of Design Principles for Tools and Practices to Support Communication within a Learning Community, *SIGCHI Bulletin*, 30(2), April 1998.
14. Huang, E., Mynatt, E., Semi-Public Displays for Small, Co-Located Groups. *Proc. CHI2003*, ACM Press, 2003.
15. Huang, E. M., Sue, A., Russell, D. M. On the adoption of groupware for large displays: Factors for design and deployment. In *Companion Proceedings of the International Conference on Ubiquitous Computing Seattle, Washington, 2003*
16. Klemmer, S.R., M.W. Newman, R. Farrell, M. Bilezikjian, J.A. Landay, *The Designers' Outpost: A Tangible Interface for Collaborative Web Site Design. Proc. UIST2001*, 2001.
17. McCarthy, J., Costa, T.J., Huang, E.M. and Tullio, J. Defragmenting the organization: Disseminating Community Knowledge Through Peripheral Displays. *ECSCW 2001 Workshop on Community Knowledge*.
18. Nelson, L., Churchill, E.F., Denoue, L., Helfman, J. and Murphy, P. *Goody Interfaces: An Approach for Rapidly Repurposing Digital Content. Proc. CHI 2004*, ACM, 2004
19. Pedersen, E., McCall, K., Moran, T. and Halasz, F. *Tivoli: An Electronic Whiteboard for Informal Workgroup Meetings. Proc. InterCHI'93*, ACM Press, 1993.
20. Perry, M and O'Hara, K. Display-Based Activity in the Workplace. *Proceedings of Interact '03*, Zurich, Switzerland, 2003.
21. Snowdon, D.N. and Grasso, A., Diffusing Information in Organizational Settings: Learning from Experience. *Proc. CHI 2002*, ACM Press, 2002