Display-Based Activity in the Workplace

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Abstract: We have developed simple taxonomy of visual display-based activity in office spaces using field data. Three key user values that displays provide are identified and investigated in depth: 1) ready access to information, 2) social orientation, and 3) co-ordination and planning. This analysis also provides a deeper understanding of the mechanisms that people use to make displays useful to them and their activities in-the-large. Implications for the design of digitally enhanced and networked display technologies are derived from the findings and discussed.

Keywords User study, displays, ubiquitous computing, interaction design.

1 Introduction

Over the last few years, display technology has undergone a great deal of change, with displays that are cheaper, larger, smaller, higher definition, thinner and less power consuming (e.g. bi-polar displays). It is possible to build and develop touch screens allowing increased interactivity relatively cheaply, and to build in processing power with embedded computer technology. Through networking, displays can be accessed or controlled remotely, or used to control and update remote computers or other devices. This increasing affordability, interactivity, and connectivity, will offer a range of new social and individual behavioural affordances.

Several technologies have taken advantage of these developments in a range of novel application areas, including electronic whiteboards, for example, TiVoli/LiveBoard (Elrod *et al*., 1992), Moran *et al.'s*. work on 'collaborage' (1999) and remote collaboration and project planning (Moran *et al.*, 1998). They have also been used in supporting organisational awareness, such as Churchill *et al.*'s PlasmaPoster (2002) as well as in intelligent/dynamic information displays and signage (Cheverst *et al.*, 2002; O'Hara, Perry & Lewis, 2003). However, despite some small-scale studies of particular display types and practices (e.g. Bellotti & Rogers, 1997; Mynatt *et al.,* 1999; O'Hara *et al.*, 2003), further understanding of the display behaviours, motivations and values in support of everyday work, is important in highlighting opportunities and design considerations for the emerging generation of digital display technologies.

In order to better understand this design space, we conducted a study of current information displays in office environments, and used this to generate a taxonomy of some of the values that these had to their users.

This is a taxonomy of *use*, in that it is not a logical breakdown of all of the possible forms of display-based activity, but a classification of observed current patterns of use arising from the study. In doing so, we attempt to identify thematic display-use relationships, focusing in particular on the display activities of individuals within their personal work area. This paper reports on a study of current display behaviour, focussing in particular on the display activities of individuals within their personal work area. The aim of the study is therefore to gain an understanding of this behaviour: what and how that information is displayed, the underlying goals and motivations that influence display-related activities, the context of activities surrounding information display and the eventual use and interaction with this information. In addition, it explores the ways in which the characteristics of current display media support and hinder the achievement of these goals and activities.

Such an understanding of current practice can be used to derive opportunities and implications for technology and design. While such a study is based on *current* display practices, these opportunities and implications can go beyond simply providing digital replacements for current displayed media. Rather, by understanding users' motivations and goals, it is possible to identify opportunities for technology and design solutions that meet these needs in different ways.

2 The study

The intention of data collection was to identify the various forms of displays used, the reasons that people used displays, why they chose to use particular display formats for particular activities, and mechanisms that they used to create displays appropriate to their needs.

Fourteen participants took part in the study across a range of organisations (including different sizes, competencies and management structures) and professions

(including a variety of managers and directors, departmental administrators, designers, research students, software engineers, a systems administrator and editors). Participants were interviewed for 1-1.5 hours within their workspace, and were asked about each bit of displayed information or cluster of information in terms of the motivations, goals and the surrounding context of that information and its use and value to them. Photographs were also taken of the displayed items on participants' walls, and when allowed, from common areas in these organisations.

From the data collected, a taxonomy was developed of display activities loosely based around cognitive, social and organisation factors (note that this was not intended to provide a complete classification of tasks, but is used as an approach to segment the data into meaningful units [cf. Higgins & Safayeni, 1984; Brown *et al.* 2000]). The next three sections discuss the different ways in which displays were used through the taxonomy of different goals and functions associated with display behaviour within personal spaces. It highlights reasons for co-opting displays into workplace activities and how these factors were both limited by and made use of the display forms available.

3 Personal information access

One of the most important reported uses for displayed information was its value in quick retrieval and in incidental access with minimal cognitive effort. By making use of all surfaces (in contrast to the limited configurations of filing cabinets and drawers), information can be stored so that it is easy to locate and access. This allows people to link like information with like in spatial relationships on their walls and tabletops, and to place information in contextually appropriate locations associated with particular tasks.

3.1 Reminding

Retrospective reminding: This refers to the cuing of memories of past events, places, time periods, activities and people, etc. Such displays included photographs of family and friends, landscapes and artefacts, magazine clippings and posters. Some of the more important display artefacts would be positioned around key focus areas of work (e.g. the PC). What was interesting about this display behaviour was the deliberation over choice of material to display – with only a few meeting the display criteria. In this respect, there was a concern with aesthetics, whether it looked appropriate, or how it embodied the reminding event, place or activity.

Prospective reminding*:* This refers to information displayed to remind the person to do something at a future point in time or when triggered by a particular context. Sometimes these are reminders of something explicit to-do. Others are displayed to keep information 'in mind' that would otherwise become lost in a formal filling process (cf. Kidd, 1994). This was particularly the case for things that were peripheral to the interviewees' current thinking and work activities. For example, KM (a research assistant) displayed a document about a Greek studies symposium that was nothing to do with her work, but which she thought might be interesting to somehow follow up (i.e. this kind of event, although not necessarily this particular event) at an unspecified time.

The point of these displays is as an awareness indicator of things that can be maintained in a non-explicit way. In this sense, displays can be thought of as a form of informal filing system. Another example observed was the use of post-its to record and display URLs that might be interesting to follow up at some later point in time but which did not fit in with the participant's current web surfing session or activity. The display acted as a temporary holding pattern for this information that was otherwise difficult to categorise and file. The visual persistence of these displays was important, in that their content did not need to be explicitly sought out but could be viewed serendipitously during the course of other activities.

The display of these notes was deliberate, with reminders placed strategically and important or urgent reminders displayed where they would visually disrupt attention within the context of the rest of their information environment for example, on a PC monitor or next to cubicle exits. Media used for this type of reminding included Post-its, handouts and flyers. The lifecycle of much of this information was short to medium term, ranging from a day to a few months.

This kind of display could be divided into two distinct forms: direct and indirect relationships. For the former, the display explicitly represents what needs to be done; in the latter case, the display is not directly related, but acts as a memory cue. This latter form is an important feature because it relates to the way in which people typically appropriate artefacts for this purpose that were originally used for another purpose. For example, we observed a post-it that had been used to make a note of an address during a phone call, but which was then appropriated as a reminder display that they needed to send a follow-on letter; in another instance, a printout of a book review to read its summary was then appropriated as a display to remind the person to order it when it was published. Appropriating existing information artefacts thus provides a low-effort way of creating display reminders. This broader context of the display artefact needs to be considered when considering technologies, not simply the display of information itself.

Display for take away: Some displays in personal and group spaces displayed information for taking away and use elsewhere. For example, GB (an administrator) had pinned-up paper distribution lists on her cubicle

wall so that when she had a paper document to circulate around the department, she could take one from the wall and attach it to the document. Forms that were used regularly were displayed so that they were easy to find and take from the wall. For common spaces, it was common for printouts and contact cards to be left out on a reception area table for visitors to take away with them. These examples demonstrate how such displayed information is used within the context of a larger work process: it is this larger work process that impacts on media choice as well as the localised activity at the display. Related to this were examples of passers-by who noticed displayed printouts and asked for copies. Similarly, displayed documents and photographs would sometimes be removed to photocopy. In these circumstances, displayed information is more than just visible information; when thinking about new digital technologies we need to consider solutions that extend beyond the simple presentation of material to its distribution and later use.

3.2 Persistent informational availability

Quick reference: A common function of displayed information was for referencing frequently required or difficult to remember information – examples from the fieldwork involved pinning up frequently used proof reading marks and job reference numbers. In other offices, we commonly observed displayed lists of phone numbers and contact information, especially for immediate work groups and frequently contacted colleagues (fig. 1). Similarly, calendars and diaries of events were also displayed. The importance of having this information persistently visible and to hand is demonstrated in that much of this information could be found elsewhere, in paper or on-line phone directories. Multiple pages of information were also displayed to be simultaneously visible, again demonstrating the importance of *permanent* visibility. Such seemingly low time and effort returns associated with obtaining information for reference can have an important impact on display behaviour and encourage the printing of information for permanent display.
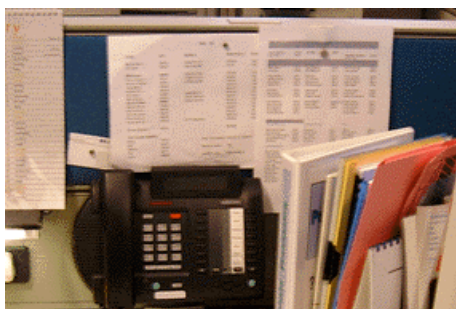

Figure 1. Information display for quick reference

The context of the referencing activity was also important here. For example, calendars were commonly

positioned near to the phone because they support collaborative planning over the phone. Likewise, some participants placed their own business card next to the phone to relay contact information back to people when requested over the phone. This latter is interesting because at face value it seems surprising that someone might need to access to their own contact details in this way. However, within the social context of a telephone interaction, it ensures that the information can be delivered professionally, without stumbling or error.

Another issue associated with this type of behaviour was that displayed reference material was not always used in its original location. For several referencing activities, displays were removed from vertical surfaces to be used elsewhere, such as on the desktop. When thinking of displays in these circumstances, it can be important to consider how flexible they may be in terms of movement around its immediate environment.

Such reference material was also updated periodically and a number of the participants had annotated their reference materials, such as phone lists, with additional or altered numbers. One participant (KM) used her telephone number list as an emerging organisation tool for other unrelated phone numbers with handwritten annotations. This was a low-effort way of updating information, allowing her to defer more formal updates of electronic versions of the reference material until a more suitable time.

Learning: Related to displaying information for quick reference is the notion of displaying things to learn. Indeed, one of the reasons suggested for displaying certain reference information in highly visible locations was to facilitate the learning of that information so that they would no longer need to refer to the information directly. As an example of this, one of the participants had pinned up her new fax number in an easy to see location to help her learn it as she referred to it.

4 Social orientation

One of the important roles played by office spaces is their use as extensions of the self in social interaction. Through our marking and use of space, we project information about ourselves, and what we are doing that makes them more than simply *spaces* for working in - they become socially meaningful *places* (cf. Harrison and Dourish, 1996). While we cannot always determine how others will interpret our spatial information configuration, we can deliberately manipulate what our spaces visibly contain to present a social image of ourselves for a variety of purposes.

4.1 Maintaining a social identity

Identity and image: Displayed information provides important information about identity of the owner of a particular space, such as their organisational status, roles and responsibilities, and the level of formality that

might be appropriate for personal interaction, as well as their personal interests, style and taste. The participants were very aware of what their displays expressed about themselves and what others might think, and this was an important factor in what they chose to display and, perhaps as importantly, did not display. Clearly, customisation of displays is an important design consideration, both in terms of content and in the organisation and format of the material displayed.

Image management was an important concern as to what was appropriate and inappropriate to display. Some displays did not have direct informational value but were purely decorative. This could be seen both at the individual level and at the organisational level (for example, corporate artwork displays and sculptures). Choice of media plays an important part in display adoption because of the 'image' that they portray. Thus the value of displayed information does not always lie in its direct functionality, rather, in the image that it presents to relevant others. This is clearly an important consideration in the design of display technologies, particularly in their aesthetics and in how this *visibly* expresses personal and organisational dynamics.

Social grooming: Another reason for displaying information was for social grooming and motivational purposes (cf. Dunbar, 1999). These were typically things that had been sent by other people with a particular sentiment associated with them. Examples of these included post-cards with supportive personal messages inside them or a particular meaning in the image – objects and information that made the person feel special or appreciated. In one example, a post-card of two Navaho Indians was sent to the owner and displayed because of the owner's interest in Indians but also because one looked like Princess Leah from Star Wars. This relates to an incident when a group of co-workers did Princess Leah impressions with Danish pastries in the canteen. Here, the fact that someone has thought about you is important, but this can have continued resonance beyond the initial receipt of the message. In this respect, the *persistence* of messages is important, and this is not well matched to electronic media, such as email, or printouts, which are normally uniform (A4) and are seen as impersonal. This use of artefacts raises the question of how sentiment and the effort to which the sender has gone to can be embodied in electronically displayed artefacts.

As well as the value of the display to it owner there were some interesting issues associated with *visibly* demonstrating appreciation for them. Indeed, it was sometimes considered rude not to display things that had been given to participants, even when the owner disliked them. This act of displaying has social value in binding relationships within a web of social and professional ties.

4.2 Maintaining a professional identity

Demonstrating achievements: There were several examples of individuals, groups, and organisations displaying things to demonstrate their achievements. Certificates, exhibits, excellence awards and patent awards were observed in this kind of display behaviour. These demonstrations are partly motivated by a need for kudos, but they also to help legitimise the activities of the owner to others - certain qualifications or excellence awards earn people the trust to do and say certain things.

Achievement displays also play a role in making work visible to others. An example of this came from the External Communications manager, who discussed the tension between the Graphics department, who created tangible work outputs, and the Plain English Group, who were perceived by the Graphics department as unproductive, because they didn't create anything tangible. It was therefore important for the Plain English Group to make their work visible to the graphics department and others in the organisation to show that they were doing something useful. They did this by displaying various "Plain English Awards" that they had achieved for their external communications and also by devoting a space on a whiteboard showing the number of these awards they had achieved so far that year (fig. 2).
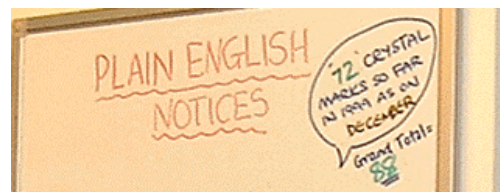

Figure 2. Demonstrations of achievements

5 Co-ordinating representations

Whilst we have discussed the social role that displays provide as a resource for visual communication, they also have a role in co-ordinating the actions of different people within an organisation. The key to understanding this is how displays make information about their creator's current activities available to others so they can align their own activities with them accordingly. This may occur informally, supporting general awareness, or at an organisational level with formal status.

5.1 Orientation for communication

Communication and awareness: Information is sometimes displayed within personal workspaces for communicating new information to others. This might be information displayed by the workspace owner when they are absent to provide status information to visitors who drop by. Whiteboards in particular were used to display this, for example, "working at home–contactable on 555 75654". This also extended

to providing status information about groups. In some of the administration areas, for example, in/out displays showed where people were, their holiday schedules or more general awareness information (see figure 3).

Figure 3. Display to communicate information on availability

Other examples of this included messages left by visitors to a person's workspace. Finding that the person was away, they left a post-it note saying "dropped by to discuss x–can you give me a call?" Both of these display types (i.e. shared display and personal access) require a high level of noticeability, but in different ways. The former needs to be visibly obvious to a visitor or in a place that would be obvious to look within a particular work context – hence the use of whiteboards for this. Most current displays of this type are large for this purpose. The latter only needs to be disruptive to the owner of the workspace, so is placed to be visible to the space's owner – the post-it left on the PC monitor or their chair are typical examples of this.

Conversational resources: Displays within personal spaces were important as a resource for initiating and scaffolding conversation. Visible information can be seen by visitors and invites comment, and this has value for social as well as professional interaction. For example, GB (an administrator) commented on the high value associated with people asking questions about her family photographs and humorous displays, while RM (a designer) commented on the importance of some of her displays in provoking collaborative discussions to generate new ideas. In order to act as a conversational resource, the media displayed require certain characteristics for people to mutually orient to them unobtrusively – and these need to be understood by the designers of displays intended for this role. Examples of these characteristics include whether the available space around the display allows people to effectively orient their discussion to the material exhibited and whether the display can be seen easily, without requiring explicit access permission by the space's owner. The role of displays in this context shares several of these implications with the use of paper documents in meetings, photographs in discussions and the problems associated with using laptops in face-to-face collaborative situations. In essence, this is because of the problems associated with the reciprocity of

(visual) perspectives: "I need to be able to see enough of what you can see so that we can have a common and mutually negotiable point of reference".

As alluded, the use of displays as conversational resources was particularly important for the administrators. A particular feature of administrative work is that people often come and ask for information. When visited, having information visually to hand allows them to continue their conversation without being distracted by a move to a filing cabinet or having to log in and download material off their PC. This supports social interaction, whilst allowing information to be distributed quickly and 'professionally'.

5.2 Orientation to work processes

Current and past work processes: several participants in the study displayed information associated with current and past work, including printouts, presentation slides, design sketches, research results, and whiteboard diagrams. Some of this behaviour was explicitly to make their work visible to others (displaying, for example, research findings and statistics). While partially related to the demonstration of achievements, it is somewhat different to this. This display activity is not just about making work visible for the purposes of showing that the owner has or does something, but is also about making others aware of the *content* of their work.

Some of the material displayed in the study related to information currently being worked on, such as ongoing whiteboard jottings of thinking-in-progress. As a by-product of this, information is made incidentally available to others (contrast this with the explicit display of information to inform others). Both explicit and implicit display of such information promotes awareness among others in the workplace as to what the owners of those spaces are involved in (and consequently how they can co-ordinate their own activities with them), yet they potentially have very different implications for technologies to support this behaviour.

Planning and information overview: A number of examples were seen in the field study of displays within personal workspaces and group spaces that were used specifically for providing an overview of certain information or activities. Project timelines and schedules were typical instances of this, as were 'to-do' lists. For example, we observed large wall calendars with key dates and scheduling lines marked on them. These displays were often relatively large, since their purpose was to show a lot of information at once and for users to be able to identify relationships between different parts of the information displayed.

The need for direct interaction with the information displayed can be an important part of the planning process, for example, making changes on a try-it-and-see basis. When used like this, the display is both a tool

for the thinking and planning process as well as a representation of the final embodiment of the plan. By making these planning displays visible to passers-by and visitors they become low effort co-ordination tools that allow other people to be aware of ongoing and planned activities and to pace their own work with that of the person or group maintaining the display.

6 Mechanisms of action

The taxonomy demonstrates the variety of uses to which displays are put. However, to achieve these, users have to apply a variety of mechanical strategies to select and organise the presentational media for display. In the section below, we highlight and explore these emerging issues in relation to display behaviour.

Location, meaning and function: The location of displayed information and its intended meaning and function are inextricably linked. For example, the sign "don't forget to take you swipe card" only has real value when placed near an exit door. Whilst this may seem obvious, it is important to consider how location may limit the value of information placed on displays once they have been situated somewhere. Location also impacts on the function of displayed information. For example, a notice board displayed in a kitchen or coffee area has different affordances to an identical notice board with the same content but displayed in a corridor. The former may support casual reading while waiting, whilst the latter may not because people will be on their way some other destination.

Location is also important in terms of who has access to and control over what is displayed: it can help define whom information is for and whether they have control over what is displayed. Compare the use of notice boards in shared workspaces with pin boards in personal spaces. Control is managed without having to explicitly define access and write-to permissions, as might be required in a non-physically owned or monitored virtual space. In physical spaces, control can be easily mediated through social protocols supported by location rather than explicitly enforced rules (see O'Hara *et al.*, 2003). To briefly elaborate, consider how we are aware of what is acceptable behaviour around displays in different areas; for e.g., it is not generally acceptable to display information in someone else's workspace (with the exception of messages such as post-it notes). While technology may allow users to remotely send something, such as a photograph to a display, social constraints on action may need to be overcome before this feels comfortable – is the display in this situation a personal or a group resource?

People also define sub-spaces spaces within their work area and this impacts on the kinds of artefacts displayed in that space. As an example, GB described different areas of her workspace in terms of the kind of work that would take place in those areas: the phone area, PC area, quiet work area, interactive area and a shared space. The things displayed in these areas reflected the particular needs of activity associated with that area. Other people partitioned their space in terms of semantic boundaries delimited by the things displayed in these areas. This raises the question of how display appliances might exploit these issues of 'making' a place (c.f. Harrison and Dourish, 1996), or places within a space.

Gardening activity and display space evolution: It was evident from the interviews that many things that had been on display for a long time were no longer useful to the owner. Several participants became self-conscious about the materials displayed on their walls and even commented that that would now throw them out. What was interesting about this is that it was only the interview that prompted them to do this and that otherwise they would not have bothered. Thus for many of the participants, there was no continuous 'gardening' of displayed information. The effort involved meant that this was only done intermittently, for example, when prompted by limited space or an office move. As such, the management of display space is best thought of as evolutionary: display artefacts compete for visual space as new material is added. More important and regularly used information will remain dominant on the surface of the display, while other information naturally gets covered as it diminishes in importance, relevance or frequency of use – the survival of the fittest (see fig 4).

Figure 4. Competition for display space

This aspect of display behaviour has implications for the digital display of information in terms of how information competes for space within the limited real estate of a digital display and the effort involved in managing the display space available. Designs that require limited amounts of gardening effort and utilise simple evolutionary style maintenance may offer greater value than those requiring high maintenance.

Bricolage: Many of the artefacts displayed could be characterised by the notion of *bricolage* – 'making do' with artefacts that, although not explicitly designed for a particular purpose, can be appropriated with little additional effort. A common example of this was seen in several offices where people had accidentally printed

out too many copies of a document, and used them in displays (in a variety of ways) rather than throw them away. We have also seen examples of this in prospective reminding, where post-it notes made during phone calls were used as reminders for follow up activities. This whole notion of bricolage is important because it suggests something about the level of effort people want to go to (low) for displaying certain types of information.

An aspect of bricolage can also be explained through the observation that work activities cannot be seen as discrete events: it is important to consider work as an ongoing process, where certain activities are prompted by others and need to be followed up with future actions. In many cases, the physical outputs of an activity can be used without additional generative effort in follow-on activities (e.g. the post-it note mentioned above) – even if those artefacts are not optimised for that follow-on activity. Effort, then is an important factor in the choice of materials used in displays (similarly, this is seen in gardening activity). Simon's notion of satisficing (1981) is of relevance here – the cognitive and temporal costs of customisation in optimising and shaping the displays are not worth the effort involved. This will have an impact in the design of displays in terms of the effort that the design forces its users to make in managing content and how to collate information for the display.

Gravity Wells: Another feature of display behaviour in workspaces was the way in which certain locations in the office space created 'gravity wells', or attractors, for the display of certain information. Most notable in this respect were the PC and telephone. These particularly important gravity wells for personal and reference information because they was such crucial focal points in the work that the participants were involved in (i.e. knowledge work). Post-it notes, ad hoc reminders and reference materials would often be placed around these areas, both by the owner of the workspace and visiting colleagues, since they were likely points of attention.

As previously noted, the exit points of a workspace were also useful gravity wells for information as reminders to do things when on the way to somewhere. For example, LJ (an administrator) used a bookstand next to her cube's exit to collect and display information that she would need to distribute later. This reminded her as she was leaving that this was an appropriate time to hand them out. Similar examples were seen in other office spaces for items to be taken home from the office. Displaying them by an exit space allowed reminding of this in the relevant context of leaving to go home.

Juxtaposition of Displays: The meaning or importance of displayed information can often be in their juxtaposition, rather than as individual display artefacts

in themselves. In a humorous example, one of the participants had a printout of characters from the Simpson's and a 'baby and father' photograph where the humour was derived from the similarity of the two display objects. We observed many examples of this in the collaging and collection of groups of documents and images that were displayed together. The importance of these displays is in their status as a collective grouping. This is not to say that the items had no intrinsic value in themselves, but that there was additional value in placing items together, so for example, project schedules and photographs of progress have value in themselves, but add context to interpreting each other.

7 Implications for design

The taxonomy of display use and the data presented on mechanisms of action provide important insights into current display use, and the values that the technologies currently available have for their users. However, one of the most important things to recognise is that when designing display technologies, we do not need to create electronic duplicates of current display systems. It is more important to understand users' motivations and needs that require them to display information in the way that they do. Thus, we do not need to duplicate display forms, but we should be sensitive to the reasons for particular display-based activities. This has two important high-level implications – that 1) new technologies do not need to physically *do* exactly the same things as existing ones to fulfil the same functions to their users, and 2) the use of future display technologies that have advanced functionality not seen in this study may be appropriated in additional ways to support remembering, in social orientation and in co-ordination and planning.

In designing display technologies, we will need to both support display-based activities, but as importantly, be careful not disrupt other activities that current displays support. It is perhaps not surprising that the data demonstrates individual, social and organisational roles for displays in co-ordination, and it is crucial to recognise that a display can have multiple roles within the workplace: the three factors discussed in the taxonomy are complex and in some cases are interrelated. To design displays that are suitable for a single functionality, or role, but which hinder other related activities is likely to fail to be adopted because of the increased effort costs associated with their use.

In the points below, we discuss design factors relevant to the likelihood of digital display adoption:
1) Current working practices involve contiguous display spaces in which all displayed information can be moved, 'written to' and 'read from' almost because it is in a uniform analogue (paper) format. Proprietary display standards are likely to fail in this context.
2) Lightweight methods of information placement on

displays are required for both within-display movement and the (more complex) inter-display movement. Similarly, information management on the display needs to be as simple and quick to maintain as photo-copying and pinning or sticking paper. Similarly, heavy-handed control over read/write privileges can add to the complexity of an interface. The data suggests we could make more use of the space-based social protocols currently applied in display management.

3) Location is important in interpreting and using displayed information. This can be supported through user-defined display placement; this may take the form of small, moveable displays that can be placed in context-appropriate locations, or large display environments with areas on them that can be appropriated for particular activities.

4) The value of much display use is in supporting time and event triggered reminding at the physical location that it is likely to be of benefit in. Indeed, information and documents are not always used in the location that they are found in. Thought needs to be given to how 'take-away' activity can be supported. However, this need not involve physical document removal, and could be linked to a technology supporting location-based reminding or document retrieval.

5) The format of displayed information is clearly important, and displayed information needs to make use of this. Uniform information or document formats within a display need to be clearly distinguishable from one another to aid rapid retrieval.

6) Spatial location and spatial layout guide attention both within the work area and in individual display artefacts to support incidental memory. This raises issues about the potential dangers in introducing dynamic display surfaces. Supporting this through 'evolutionary' mechanisms is vital in providing natural and lightweight display device interactions.

8 Conclusions

A simple analogical re-representation from a physical display to a digital form is likely to be inappropriate, interfering with current work practices and, more broadly, the flow of work. There is value in creating digitally displayed representations of information, but it is not necessary to attempt to replicate these directly. It is important that the designers understand the *role* that displays play in their users' activities so that decisions can be made about how to support activity.

The findings demonstrate the key goals and motivations underlying information display in personal work space and in larger shared workspaces. Categorising the findings in this way has highlighted some of the typical characteristics of the display media and user interaction with the information. These characteristics have been related to the goals and motivations to pro-

vide useful lessons about how user goals are satisfied through current display techniques. In addition, further issues associated with display behaviour have been raised that are important to consider when thinking about technological solutions within the space of dedicated display appliances. It is hoped that such an understanding can play a role in inspiring display design concepts and providing a framework within which to assess these concepts in a more critical manner.

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