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Surface Use in Meeting Room Collaboration

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ABSTRACT
Although we can now augment meeting rooms with large-format digital displays (e.g. digital whiteboards or tabletops), successful deployment of groupware tools for such environments has been limited. I believe this problem stems from a poor understanding of how teams make use of traditional meeting room *surfaces* (e.g. whiteboards, walls, tables) in collaboration; as a consequence, our large display groupware applications do not always reflect the general expectations users have of large displays, which replace traditional, non-digital meeting room surfaces. My research develops a framework for understanding how meeting room surfaces are used collaboratively, thereby providing insight into application design for digital display surfaces in meeting rooms.

Keywords
Large display groupware, meeting room collaboration

1. INTRODUCTION
For over two decades, researchers have investigated how large displays can augment our work practices, producing a wealth of novel interaction techniques and applications to support work [1]. These researchers have addressed input and usability issues, developed novel interaction techniques, and provided support for seamlessly moving information from one device to another. It is no longer difficult to build these displays or drive them computationally; instead, the question is now: how can large displays be used to support *real collaborative work* in meeting rooms? Furthermore, how can a large display *environment*, such as a meeting room with multiple displays, be used to augment collaborative activities? Many researchers are now asking the question: how should *multi-display ecologies*, or the way in which multiple displays interact with one another, behave?

My approach to the question of multi-display ecologies is to consider how teams use shared *surfaces* in meeting rooms to support their collaborative work. I use the term *surface* to denote the traditional flat surfaces found in meeting rooms (e.g. whiteboards, walls, flipcharts, bulletin boards, countertops, tables). Teams are accustomed to using such surfaces with existing work practices to support their collaborative work. As we build digital *displays* (e.g. SMARTBoard's) to replace these surfaces, we need to respect and support teams' existing *surface work practices*. Supporting these work practices facilitates positive transfer, thereby reducing the barrier to large display groupware usage [2]. For example, although teams sometimes overload the function of a given surface (e.g. by posting "bulletin board notices" on the whiteboard instead of the bulletin board), surfaces are typically used for particular activities: e.g. the projection screen is *typically* used to *present* information, not to *write* an action list. Similarly, one would not give a presentation using a bulletin board. What *roles* do these large surfaces play in meeting room collaboration?

Articulating and systematizing these roles allows us to understand the nature of *interactions* people have with the surfaces (e.g. manipulating information on the surface; viewing vs. monitoring the surfaces; the distance at which the interactions occur; who those interactions are for). By understanding these interactions, we can predict how introducing new interaction techniques or tools will influence collaboration. For example, "visibility of action" has been identified as a reason to use stylus or touch-based input for large displays [4]; however, if a particular large display is simply being used in a presentation role (where information is fairly static, and the main interaction is "viewing" and "gesturing"), then pen or stylus input is superfluous.

This work will contribute to the fields of HCI and CSCW in three major ways:

1. It will provide a descriptive framework of the roles surfaces play in traditional meeting room collaboration.
2. The framework will provide a means to analyze current large display groupware.
3. The framework will provide design guidance for new large display groupware technologies.

2. ETHNOGRAPHIC CASE STUDIES
To develop this framework, three case studies of six-person teams were performed to understand their collaborative use of meeting room surfaces. Each team was engaged in a competitive five-week term project, and assigned dedicated lab space (with work benches, chalkboards and PCs) and a meeting room (with whiteboards, tables, filing cabinets and PCs). In total, more than 60 hours of video was collected of the teams designing and building magnetically propelled trains.

Field notes and interview responses have guided video analysis on the recorded data, and this data is still being analyzed. However, the preliminary findings highlight three distinct roles that *upright surfaces* play in the collaborative work under study. These roles were used to codify teams' work practices around the upright displays in their environment. I intend to further refine this framework, and extend it to include the *horizontal surfaces* and *mobile surfaces* (e.g. paper and laptops) that the teams used.

2.1 Collaborative Roles of Upright Surfaces
The three roles *upright surfaces* appear to play in collaboration include a presentation role, an ideation role, and a reference role.

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	Content Dynamicism	Content Size/Density	Attentional Focus	"Interaction" Distance
Presentation Role	largely static	large	focus	viewed from distance
Ideation Role	largely dynamic	medium/dense	focus	within reach
Reference Role	static	medium-large	ambient	distant

Table 1. The *roles* that upright surfaces play in collaboration (along the left) can be described using the collaborative *dimensions of use* (along the top).

Although a given surface could play multiple roles, surfaces did not play more than two at any given time. Each role captures a set of team and individual behaviours, and reflects some aspect of teams' natural work practices with meeting room surfaces.

- ***Presentation Role***: Information is displayed for the purpose of dissemination to the group.
- ***IdeationRole***: Problems are "worked out" in a visible manner for the team members.
- ***Reference Role***: Key ideas are posted as external ambient memory, and may *become* the focus of discussion.

For example, when surfaces are used in the *Presentation role,* the content on the surface is typically static, large, the focus of a group's attention, and typically "interacted" with from a distance: team members generally only gesture at the display without being able to change its content. A wall or projection screen will often play this role when information is being disseminated to a group.

Underlying these roles is a space of "parameters" or "dimensions" that describe the surface properties and the team's interactions with the surfaces. I have tentatively identified four of these:

- ***Content Dynamicism***: Is this information something that is prepared in advance, or is it modified by an individual on the surface?
- ***Content Size/Density***: How large is the information on this surface? Is it deliberately large or small to facilitate higher density?
- ***Attentional Focus***: Are teams paying close attention to this information, or does it reside in the periphery?
- ***"Interaction" Distance***: What kind of distance is typical for "interaction" with this surface? Interaction includes viewing as well as modifying the information.

We can describe each role using these dimensions (Table 1). For example, surfaces playing the *Ideation role* are typically involved in collaborative idea generation or organization tasks; thus, the surface content is dynamic, typically medium-sized (visible from some distance), and teams are often within closer proximity of the surface. Thus, these *roles* are a set of positions in this space that reflect *typical upright surface work practices*. Designers of large display applications would therefore be wise to design toward these roles since users naturally use *upright surfaces* in these ways. Introducing applications that deviate drastically from these roles need to provide *significant* benefits or risk being perceived as being too taxing to use [2].

2.2 Applying the Framework

When the framework is more mature, it could be used in two ways: first, to analyze interaction techniques and large display groupware applications, and second, to guide and motivate new interaction techniques. A simple analysis might proceed as follows: consider a large display meeting room application whose content was dynamic and small, the main focus of attention for the group, yet was interacted with (i.e. manipulated) from a distance (i.e. not at the surface itself). Such an application does not fit any of the roles, suggesting that it would be "unnatural." Furthermore, individuals would have extraordinary difficulty monitoring changes to the document (since content is small) and because they cannot see who makes the changes (since interaction is at a distance). A more fully developed framework would aid us in identifying applications or design ideas that would likely fail.

The framework can also motivate design. My recent work on a prototype interaction technique called Pick-and-Point, extends Pick-and-Drop [3] by incorporating features of the presentation role (viewing and gesturing at large content from a distance). Pick-and-Point facilitates smooth multi-display information transfer (e.g. from TabletPC to large display), by allowing users to simply point at a display to redirect information. This pointing gesture places the "picked" object onto the pointed display, and maximizes it immediately, saving the user from painstaking window management. Its implementation uses the 6-DOF Polhemus Fastrak device, providing spatially-aware gestures and a smooth, socially acceptable means of floor control.

3. CURRENT & FUTURE WORK

I am continuing to develop this framework based on data from my original study, and refining it with further observations of both different kinds of teams and in different contexts altogether (e.g. studying students' use of communal study areas). As I move forward with this framework, extending it to *horizontal (tabletop) surfaces* as well, it will become possible to generatively map out the space of collaborative support on large displays. Understanding the scope of this space will help guide further prototyping efforts (e.g. Pick-and-Point). Using these prototypes, I can further test and refine the framework.

4. REFERENCES

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